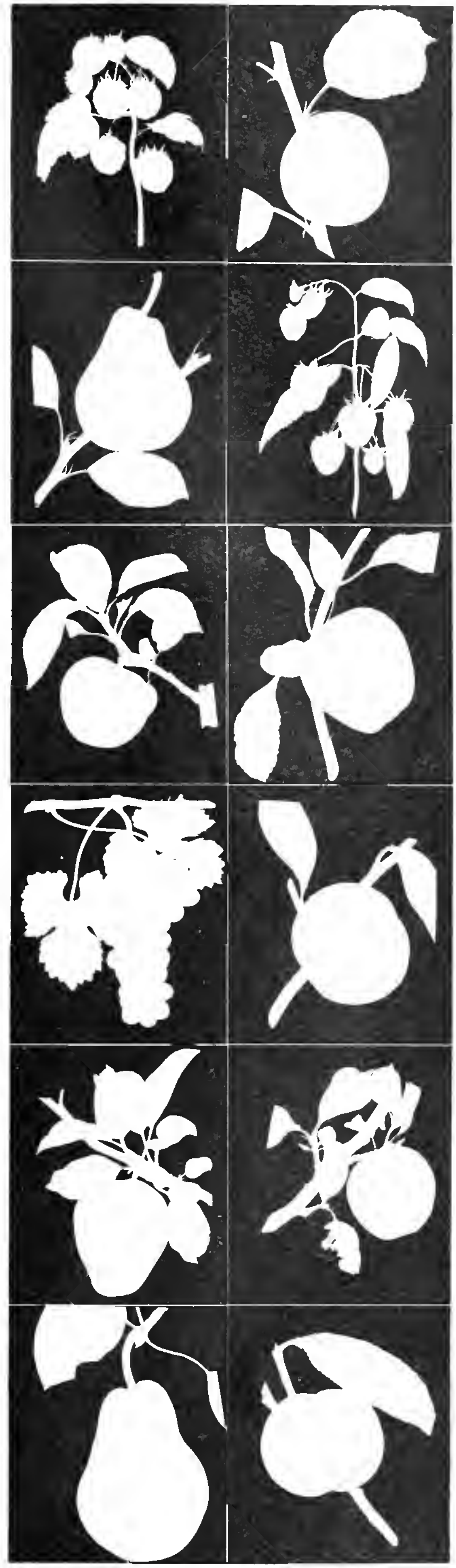
FRUIT NOTES



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DEPARTMENT OF PLANT AND SOIL SCIENCES

COOPERATIVE EXTENSION SERVICE, UNIVERSITY OF MASSACHUSETTS, UNITED STATES DEPARTMENT OF AGRICULTURE AND COUNTY EXTENSION SERVICES COOPERATING.

EDITORS
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The cost of publishing FRUIT NOTES has become a significant portion of the Smith-Lever allocation for my extension program. If we continue to send it free-of-charge very little money will be left for travel, attendance at meetings, and supplies. Thus, starting with the Spring Issue, FRUIT NOTES will be on a subscription basis at $3.00 per year for 4 issues. Hereafter, the subscription year will commence with the Winter Issue. A notice for renewing your subscription will appear in the fall issue of the previous year.

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VARIETIES OF GRAPES FOR MASSACHUSETTS

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The following is a list of varieties that are currently recommended for planting in Massachusetts. Many new seeded and seedless varieties have been introduced in recent years. Some of these may be equal to or better than the one listed. Those growers interested in grapes for wine should obtain a copy of the Catalog of New and Noteworthy Fruits from the New York State Fruit Testing Cooperative Association, Inc., Geneva, NY 14456. This catalog offers a description of the French-hybrid and other varieties suitable for wine production.

Variety	Recommended for	Harvest Season
Schuyler	T	late-August
Himrod	H	late August—early September
Van Buren	C & H	late August—early September
Ontario	H	late August—early September
Seneca	H	late August—early September
Suffolk Red	T	late August—early September
Fredonia	C & H	early September
Buffalo	H	early September
Delaware	C & H	mid-September
Lakemont	T	mid-September
Worden	C & H	mid-September
Blue Boy (Cook)	C & H	mid-September
Niagara	C & H	late-September
Concord	C & H	late-September
Steuben	T	late-September

T = Trial H = Home garden C = Commercial

All varieties are not necessarily equally adapted to all sections of the state. Late ripening varieties are recommended only for those areas with a sufficiently long growing season to permit satisfactory ripening of the fruit.

Variety Notes

Schuyler — A very early, high-quality, black grape. The clusters are medium to large and moderately compact. The berries are medium in size, tender, and juicy. The vine is vigorous, productive, and medium in hardiness. Schuyler require severe pruning to prevent overbearing.

Himrod — An early-ripening, seedless grape resulting from a cross between Ontario and Thompson Seedless. Its clusters are large and rather loose. The berries are medium, oval, sweet, yellow, vinous, and good. The vine is not completely winter-hardy under our conditions and should be restricted to the more favored sites.

Van Buren — An attractive, black grape of good to excellent quality. The vine is vigorous and productive. It is particularly susceptible to downy mildew.

Ontario — An early-ripening, white grape of high quality. The clusters are medium in size and tend to be loose. The berries tend to shatter considerably within a few days after harvest. The vines are medium in vigor and productivity, and are hardy.

Seneca — An early-ripening, white grape with a thin, tender, adherent skin. The berries are medium in size, oval, and have excellent flavor. The clusters are medium in size and compactness. Seneca is susceptible to winter injury.

Suffolk Red — A bright-red, seedless grape. The clusters are medium in size and tend to be loose. The berries are medium in size, round, and have very good quality. The vine is medium in hardiness.

Fredonia — A good-quality, black grape especially recommended for the roadside stand trade. The clusters are compact and medium in size. The vine is vigorous, hardy, and productive. It should be pruned less severely than Concord.

Buffalo — A black grape with medium to large size, sweet, vinous flavor and good adherence. The clusters are large and tend to be loose. The vine is vigorous and productive, and the fruit holds very well in storage. Buffalo tends to overbear and to be susceptible to winter injury if not properly pruned.

Lakemont — A yellowish-green, seedless grape. Its clusters are medium to large and moderately compact. The berries are medium to small in size, oval, tender, juicy, and sweet. The vine has moderate vigor and hardiness. Tends to overbear.

Delaware — A high-quality, red grape with small clusters and berries. The vines are hardy and are moderate in vigor and production. Delaware would add to the attractiveness of displays on a roadside stand.

Worden — Similar to Concord, but ripens a week to ten days earlier. While slightly superior to Concord in quality and attractiveness, it has a tendency to crack when ripe and shatters badly within a few days after it is harvested. A desirable variety for local trade and the home vineyard.

Blue Boy — (Cook) This is an attractive, black grape with an abundance of bluish bloom. Adherence of the berries is good and the quality is excellent. Vines are productive and the fruit holds in storage unusually well. Recommended for commercial planting and is a desirable variety for the home vineyard.

Niagara — A white grape of high quality with large compact clusters. Would add to attractiveness of display on a roadside stand. Ripens with Concord.

Concord — The particular merits of Concord are its adaptability to a wide variety of soils, its productiveness, hardiness, vigor, and shipping quality. Concord requires a growing season of approximately 160 days for proper ripening of its crop.

Steuben — Those growers who can mature Concord might wish to try this variety. The grapes are bluish-black in color, medium in size, and have very good quality. The clusters are medium to large, compact, and attractive. The vines are usually hardy, vigorous, and productive.

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VARIETIES OF PEACHES FOR MASSACHUSETTS

James F. Anderson
Department of Plant and Soil Sciences

Variety	Recommended for[1]	Flesh color[2]	Approximate harvest date[3]
Harbinger	C	Y	–30
Candor	T	Y	–20
Garnet Beauty	C	Y	–13
Sweethaven	T	Y	–13
Brighton	T	Y	–13
Harbelle	C	Y	–8
Reliance	H	Y	–4
Raritan Rose	C	W	–2
Redhaven	C	Y	0
Harken	C	Y	+3
Harbrite	C	Y	+5
Velvet	C	Y	+7
Jayhaven	T	Y	+7
Glohaven	C	Y	+10
Eden	T	W	+11
Richhaven	C	Y	+12
Canadian Harmony	C	Y	+16
Cresthaven	C	Y	+21
Jerseyglo	T	Y	+26
Autumnglo	T	Y	+30

[1] C – Commercial H – Home garden T – Trial

All varieties are not necessarily equally adapted to all sections of the state.

[2] Y – Yellow flesh
W – White flesh

[3] Based on harvest date for Redhaven (approximately August 20, but can vary from location to location and season to season). Minus sign indicates number of days before; plus sign indicates number of days after Redhaven.

Variety Notes

Harbinger – An attractive, small to medium-sized clingstone peach. The flesh is yellow, firm, melting, and has very good flavor for this season. The tree is vigorous, productive, and equal to Redhaven in bud hardiness.

Candor* – The fruits are well-colored, and small to medium in size. The flesh is yellow, firm, and juicy and the stone is semi-cling. The buds are hardy and the tree vigorous and productive.

Garnet Beauty – A bud-sport of Redhaven. Resembles Redhaven in color and texture. It is a semi-clingstone. The tree is vigorous, productive, and hardy.

Sweethaven* – An early, yellow-fleshed, semi-clingstone peach. The fruits are medium in size, roundish, and well colored. The flesh is juicy, slightly fibrous, but soft. The tree is vigorous, productive, and similar to Redhaven in bud hardiness.

Brighton* — An attractive, high-quality, yellow-fleshed peach. The fruit is roundish, uniformly medium in size, and highly colored. The flesh is medium firm, juicy, with very good flavor. The pit is semi-cling. The tree is vigorous, productive, and medium-hardy.

Harbelle — The fruit is large, attractive, with deep-yellow ground color and a bright-red blush. Flesh is a rich yellow, medium in firmness, of good quality. The stone is semi-free. The tree is productive, and medium in vigor and bud hardiness.

Reliance — A medium-sized, roundish, yellow-fleshed freestone peach of fair to good flavor. Reliance is recommended as a very hardy variety for the home fruit planting.

Raritan Rose — The fruit is large, round, attractive. The flesh is white, firm and juicy. The tree is large, upright-spreading, and productive. Bud hardiness is above average.

Redhaven — The medium-sized fruit is highly colored, attractive, and has firm flesh and fair flavor. The tree is very productive and requires heavy thinning.

Harken — A large attractive, yellow-fleshed peach. The flesh is firm, juicy, of good quality and the stone is free. The tree is vigorous, productive, and equal to Redhaven in bud hardiness.

Harbrite — A large, attractive, yellow-fleshed peach. The flesh is medium-firm, juicy, and of good flavor. The stone is free. The tree is very productive, hardy and moderately vigorous.

Velvet — A medium-to-large, attractive, freestone peach. The flesh is yellow, firm, juicy, and has very good flavor. The tree is moderately bud hardy.

Jayhaven* — A medium-large, round, bright-colored freestone. The flesh is yellow and melting. The tree is more bud hardy than Glohaven.

Glohaven — A large, roundish, mostly red peach with very little fuzz. The flesh is yellow, very firm, and has very good flavor. The stone is free. The tree is medium in bud hardiness, but is vigorous and productive.

Eden* — The fruit is large, roundish, with 60 percent red on a creamy white ground color. The white flesh is thick, firm, juicy, smooth, and very good in flavor. The stone is free. The tree is vigorous, equal to Redhaven in bud hardiness, and very productive.

Richhaven — A large, attractive, highly-colored freestone of very good quality. The tree is large, vigorous, and productive. Bud hardiness is above average.

Canadian Harmony — A large, highly-colored, yellow-fleshed peach. The flesh is firm, juicy and of good flavor. The tree is vigorous, productive, and about equal to Redhaven in bud hardiness.

Cresthaven* — A large, oblate-shaped peach with a dark-red blush. The bright yellow flesh is firm, juicy and slightly fibrous. There is some red at the pit. The flavor is very good. The tree is vigorous, productive, and medium in hardiness.

Jerseyglo* — The fruits are large, attractive, and freestone. The flesh is yellow and firm. The trees are vigorous and productive, and about equal to Redhaven in bud hardiness.

Autumnglo* — A large, round, highly-colored freestone. The flesh is yellow, firm, and melting. The trees are vigorous, productive, and are equal to Redhaven in bud hardiness.

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PERFORMANCE OF DISEASE RESISTANT APPLES IN MASSACHUSETTS

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and William J. Manning[3]

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A number of apple cultivars, with immunity to apple scab, and varying degrees of resistance to rusts, powdery mildew and fireblight, are currently available from commercial nurseries. As these cultivars have potential use in apple disease management programs, designed to reduce fungicide usage, we established a block of disease resistant apple cultivars at the Horticultural Research Center in the spring of 1978 to determine their performance in Massachusetts. Fruit were harvested in 1982 for the first time.

Eight cultivars were planted. Prima, Priscilla, and Sir Prize were developed by the Purdue, Rutgers, and Illinois (PRI) Agricultural Experiment Station cooperative apple breeding program. MacFree and Nova Easy-gro were developed in Canada and Liberty and NY61345-2 by the New York Agricultural Experiment Station. Disease-susceptible Imperial McIntosh was used for comparisons. Trees were obtained from either the New York State Fruit Testing Cooperative or Stark Bros. Nurseries.

Cultivars used have been described by their developers as follows:

Prima: 2-1/2 to 3". 60-80% bright red, over yellow ground color. Rich flavor and crisp texture, with mild subacid flavor. Flesh, light cream color. Little tendency for fruit to drop before harvest. Fruit matures 1 month before Red Delicious, and will retain its flavor for up to 1 month at 34 F. Trees are spreading and vigorous. Immune to apple scab, susceptible to cedar apple rust, slightly susceptible to powdery mildew, and resistant to fire blight. Excellent dessert apple.

Priscilla: 2-1/2 to 3". 75-90% bright red, over yellow ground color. Crisp texture and pleasant aromatic flavor. Texture and flavor maintained for 2-3 months at 34 F. 2 weeks before Delicious (10 days after Prima). Little tendency for fruit drop before harvest. Trees are moderately spreading and vigorous: terminal growth frequently determinate, ending in a flower bud. Trees and fruit are immune to apple scab, and resistant to cedar apple rust, and fire blight. Fine dessert quality.

Sir Prize: 3 to 3-1/2". Yellow, russet free. Ripens with Golden Delicious (4 weeks after Prima). Juicy flesh, fine grained texture with thin skin that is easily bruised with rough handling. Waxy skin does not shrivel in storage. Very good keeping quality through the winter season. Trees are vigorous, triploid and produce an annual crop. Immune to apple scab, moderately resistant to cedar apple rust and powdery mildew, trees have shown little fire blight. Excellent for home planting or use with direct sales or pick-your-own.

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[3] Professor of Plant Pathology

Macfree: 2-3/4", 75% medium to dark lively red, slightly stripped, over greenish-yellow ground color. Juicy white flesh, sometimes tinged with green. Slightly course, tough texture, moderate acidity and firm; pleasant flavor. Ripens a few days before Red Delicious, Stores 3 months at 32 C. Vigorous spreading tree: fruit borne throughout. Resistant to apple scab.

Nova Easy-gro: 2-1/2", blushed or stripped medium red over pale greenish-yellow ground color. Creamy white flesh, firm, crisp, moderately juicy, subacid; pleasant. Matures with Cortland, keeps well. Trees are moderately vigorous, and spreading, with fruit borne throughout the tree. Fruit resistant to apple scab. (Multigenic resistance from Russian seedling).

Liberty: 2-3/4", deep bright red, stripped on greenish-yellow ground color. (McIntosh parentage easily recognizable.) Flesh pale yellow, nearly white; crisp, juicy, slightly coarse in texture. "Sprightly", subacid; browns rapidly upon exposure to air. Keeps well under refridgeration until January and stores very well as juice, cider and sauce. Trees are "precocious"; out-yielded McIntosh and Red Delicious on similar topworked trees. Vigorous growth, round topped and spreading: very productive with fruitbuds terminally and laterally on shoots of current year's growth and spurs. Immune to apple scab and cedar apple rust; resistant to powdery mildew and fire blight.

NY 61345-2: 2-7/8", 90% red blush. Crisp, juicy, slightly coarse; sprightly. Tree: vigorous and upright. 2 days before Red Delicious. Immune to apple scab, moderately resistant to cedar apple rust and powdery mildew.

Standard insecticide sprays were applied from 1978-1982, but no fungicides were used. Natural inoculum for apple scab and cedar-apple rust was abundant in all years.

In mid-September, 100 randomly-chosen leaves per tree were evaluated for per cent apple scab, cedar-apple rust, and frog-eye leaf spot (black rot). Fruit were evaluated at harvest for scab and other diseases. Results are summarized in Table 1.

All of the disease resistant cultivars were completely free from fruit and foliar scab. Imperial McIntosh, however, had 48.5% foliar and 28.3% fruit scab. While all the disease resistant cultivars had less foliar cedar-apple rust than Imperial McIntosh, Macfree and Sir Prize had more foliar infection than Nova Easy-gro, NY 61345-1, Priscilla, and Liberty. The original Prima trees died before 1982. Several younger Prima trees were completely free from scab, but had extensive cedar-apple rust on leaves. One Prima fruit also had a rust infection spot. All cultivars had frog-eye leaf spot, with Sir Prize having the highest incidence. Frog-eye leaf spot on Sir Prize, however, consists primarily of small purplish flecks, rather than more typical symptoms.

To determine fruit quality, Nova Easy-gro, Liberty, Macfree, NY 61345-2, and Imperial McIntosh fruit were harvested and stored at 34 F. in a conventional cold storage. After one month of storage, fruit were removed, sliced, and offered to 29 randomly-chosen students, secretaries, faculty and technicians.

Most tasters found little difference between Imperial McIntosh, Macfree, and Nova Easy-gro. While all had similar textures Nova Easy-gro, and Macfree were judged to have slightly less flavor than Imperial McIntosh. NY 61345-2 was generally agreed to be a tasty and slightly tart apple. While not as firm as Imperial McIntosh, NY 61345-2 was rated as the first choice of most tasters. Liberty compared well with Imperial McIntosh, but was not as sweet and did not store as well.

When tasters were shown nonlabelled fruit of all the cultivars, all comments were favorable. More than 80% of the tasters agreed that they would purchase the fruit if available in roadside stands or in supermarkets.

In 1983, we will be adding the following new cultivars to our planting:

Redfree: Redfree is a medium size (2-3/4") apple with 90% good red color and smooth, waxy, russet-free skin. Flesh is white, crisp and juicy. Retains quality for two months or more in storage. Fruit ripens 3 weeks before Prima and 7 weeks before Delicious. Immune to scab and cedar rust, moderately resistant to fire blight and mildew.

Jonafree: Closely resembles and matures with Jonathan. Fruits are 2-1/2 to 2-3/4", 75% medium red, with a smooth russet-free skin. Flesh is pale, crisp, and juicy. Immune to scab and resistant to fire blight and cedar-apple rust. Moderately susceptible to mildew. Fruit hangs well to maturity and do not develop Jonathan spot.

King Luscious: A very large, highly-colored apple with good keeping, eating and cooking qualities. The skin is a deep red with a beautiful bloom. The flesh is pure white, with excellent flavor. Season of ripening is with Rome Beauty and Stayman, although it may be picked sooner for cooking purposes. The tree is a young and annual bearer, blooming a week after Rome Beauty, to make it almost completely frost-proof. The tree is semi-dwarf in habit, sets it scaffold branches well, and needs little pruning. Both tree and fruit are resistant to apple scab. U.S. Plant Patent No. 1994.

Redfree and Jonafree are being obtained from Hilltop Nurseries. King Luscious will come from Bountiful Ridge Nurseries.

All of the trees in the Disease Resistance block will be labelled this spring by name. Please feel free to examine them when you visit the Horticultural Research Center. For additional information on disease resistant apple trees, contact Dr. William J. Manning in the Department of Plant Pathology.

This activity is supported by the Massachusetts Cooperative Extension Service.

Table 1. Performance of young disease resistant apple trees in Massachusetts in 1982.

No. trees	Cultivars	% foliar disease (100 leaves evaluated/tree) Scab	Rust	Frog-eye	No. fruit	% Scab
2	Macfree	0	18.5	22.5	35	0
4	Nova Easy-gro	0	0.5	15.5	16	0
4	NY 61345-2	0	0.5	23.3	16	0
2	Priscilla	0	4.0	15.0	3	0
2	Sir Prize	0	32.0	75.5	0	0
3	Liberty	0	1.3	11.3	35	0
2	Imp. McIntosh	48.5	44.0	20.0	19	26.3

DISEASE MANAGEMENT FOR APPLES IN MASSACHUSETTS: 1982 RESULTS AND SUMMARY OF THE FIVE-YEAR PROGRAM

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The five-year pilot program to develop and evaluate new and innovative apple disease management practices in Massachusetts terminated in 1982. Our results for 1982 and a summary of the entire program are presented here.

1982 Results

In 1982, 13 commercial apple orchards were involved in the program. Four followed traditional disease management practices and served as controls for comparisons. The other 9 were visited by scouts on a regular basis and applied fungicides to manage apple scab (and other diseases) on a "post-infection" basis only. Hygrothermographs were used to determine when infection periods had occurred and when fungicides should be applied. A more complete description of the disease management program can be found in Fruit Notes 46(1) pp. 3-4.

Like many growing seasons in Massachusetts, 1982 was unusual. New green apple leaves emerged at the same time that mature ascospores of the scab fungus were available. Two extensive infection periods occurred in late May with heavy inoculum released. Primary scab season ended on 4th June. A complete summary of wetting and infection periods for 1982 is given in Table 1.

Fungicide usage and fruit disease incidence for disease management orchards are given in Table 2. Results for control orchards are in Table 3. Disease management orchards averaged one less fungicide application. Reduction in dosage equivalents (2.6 fewer than controls), however, resulted in savings of $32 per acre for fungicides. Disease management orchards had a slight increase in per cent diseased fruit at harvest when compared to controls. Savings realized with reduced fungicide costs, however, more than offset the slight increase in costs due to a few more diseased fruit at harvest.

Paired t-tests were used to compare results from disease management and control orchards (Table 4). No significant differences ($P = 0.05$) were found between the number of fungicide applications, per cent diseased fruit at harvest, and dollar losses from disease. There was a significant difference between actual fungicide usage, or dosage equivalents, and fungicide costs per acre. Disease management growers used less fungicide without significant increases in fruit diseases at harvest.

Variation in the number of fungicide sprays (8-14) and dosage equivalents (5.67-11.88) in IPM orchards is closely related with both efficiency in timing of scab sprays, and the necessity for fungicide applications for diseases other than apple scab, especially the rusts, and powdery mildew. When post-infection scab sprays were too late to inhibit apple scab infections, or poor coverage was achieved by spraying during windy weather, additional fungicide appli-

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cations at high rates were necessary to "burn-out" or eradicate scab lesions. Where rust control was essential, protective sprays were necessary before all wetting periods (over 4 hours in length) as post-infection applications of fungicides are not possible for rust management.

Five-Year Summary

A cost/benefit analysis for the five-year program is presented in Table 4. In each year of the program, disease management growers made fewer fungicide applications, with fewer dosage equivalents, and reduced fungicide costs, compared to control growers. Per cent diseased fruit at harvest in disease management orchards was either comparable to or only slightly higher than in control orchards. Disease management benefits per acre were variable, but always positive for cooperating growers.

When we examined the results for a five-year period, three trends became evident to us. The first was that disease management benefits are most likely to occur at a higher dollar level in dry spring seasons, as in 1980, rather than in wet ones, as in 1982. With fewer wetting periods, greater efficiency can be achieved in timing post-infection sprays.

The second trend is that continued benefits from disease management decrease in magnitude with time. Fungicide sprays and dosage equivalents cannot be further reduced in number every year. Many control growers have also begun to adopt disease management practices, obtained from the numerous Extension education programs we have been involved in over the past five years. It is becoming increasingly difficult to find control orchards where only traditional methods are used.

Per cent disease incidence for the five-year period is summarized in Table 5. Apple scab incidence has been reduced. The trend for calyx end rots, however, is increasing slightly. Timing sprays only for scab management may have increased infection possibilities for end rot fungi before or after bloom. Using fungicides that are good for scab management may also mean that they are not as good for end rot management. Anytime a practice is changed, we can expect that new problems may develop. The use of one or more sprays of a protective fungicide, rather than a "post-infection" or "kick-back" material, from tight cluster to petal fall, should eliminate calyx end rot problems, especially during wet growing seasons.

Acknowledgements:

We have been able to obtain considerable information about apple disease management during the last five years. We could not have done this without the enthusiastic and generous support and cooperation of the participating Massachusetts fruit growers.

This program was supported by special funds from the USDA, by the Massachusetts Cooperative Extension Service, and the Massachusetts Fruit Growers Association.

Table 1. Wetting and infection periods for the apple scab fungus at the Horticultural Research Center in Belchertown, MA in 1982

Date	Apple growth stage	Wetting Periods: Hour began	Wetting Periods: Duration (hrs.)	Wetting Periods: Mean Temp. (°F)	Rain (mm)	% Mature apple scab ascospores	Potential primary scab infection severity
4/17/82	Green tip	20	8	50	17.2	5	None
4/21/82	Green tip	8	5	48	4.5	10	None
4/24/82	1" green	22	8	52	0.01	23	None
4/26/82	1" green	13	24	52	23.5	25	Heavy
4/27/82	Tight cluster	23	12	40	4.6	25	None
5/8/82	Early bloom	24	9	51	0.7	55	None
5/19/82	Petal fall	23	4	67	7.8	55	None
5/22/82	Petal fall	22	58	44	16.1	53	Heavy
5/29/82	Late petal fall	1	34	56	70.8	50	Heavy
5/30/82	1/4" fruit	24	14	58	0.5	30	Moderate
6/1/82	1/4" fruit	21	15	60	24.5	5	Moderate
*6/4/82	1/4" fruit	17	91	52	93.2	3	Heavy

*End of primary scab season.

Table 2. Cost/benefit analysis of fungicide usage and fruit quality in disease management orchards in 1982

Orchard	% Diseased fruits at harvest	$ Loss to disease per acre	Number of fungicide sprays	Dosage equivalents	Fungicide cost per acre
1	0.1 scab 0.1 end rot	7.70	11	8.26	$ 81.75
2	0.1 scab 0.1 black rot 1.1 end rot 1.1 quince rust	92.40	11	11.76	$122.72
3	0.1 scab 0.2 quince rust 1.8 end rot	80.85	11	10.2	$100.40
4	0.3 scab 0.1 quince rust 2.3 end rot 0.1 black rot	107.80	14	11.88	$113.46
5	0.2 scab	7.70	14	10.32	$121.28
6	0.1 scab 0.1 quince rust 0.1 bitter rot 2.8 end rot	119.35	10	8.80	$ 95.01
7	0.1 scab	19.25	11	8.48	$ 97.14
8	0.4 end rot	15.40	11	9.44	$122.31
9	0.1 end rot	3.85	8	5.67	$ 66.18
Avg.	0.11 scab 1.00 end rot 0.16 quince rust 0.04 other 1.31 TOTAL	50.48	11.20	9.42	$102.25

Table 3. Cost/benefit analysis of fungicide usage and fruit quality in control orchards in 1982

Orchard	% Diseased fruits at harvest	$ Loss to disease per acre	Number of fungicide sprays	Dosage equivalents	Fungicide cost per acre
1	0	0	12	13.64	$149.10
2	0.10 scab	3.85	12	11.64	$133.44
3	0.60 scab 0.30 end rot 0.10 black rot	77.00	12	9.81	$106.38
4	0	0	14	13.0	$148.29
Average	0.53	20.21	12.5	12.02	$134.30

Table 4. Cost/benefit analysis for fungicide usage and disease incidence in Massachusetts: 1978 through 1982

	Results by years of the program									
	1978		1979		1980		1981		1982	
Average inputs	M*	C	M	C	M	C	M	C	M	C
No. of fungicide applications	11.80	12.50	10.64	13.00	9.45	10.36	11.00	13.00	11.22	12.50
Dosage equivalents	12.04	12.18	9.77	11.11	8.11	8.80	9.63	12.04	9.42	12.02**
Fungicide cost/acre ($)	---+	---	74.06	88.68	85.26	94.58	106.72	140.00	102.25	134.30**
% diseased fruits at harvest	3.45	1.32	0.99	0.93	0.88	0.99	0.77	0.20	1.31	0.53
Loss to disease/acre	---+	---	46.28	43.48	50.31	56.30	35.28	9.79	50.47	20.21
Disease management benefits per acre ($)			11.82		15.31		7.79		1.79	

+ = Data not taken, first year of program

* M = Disease management orchard, C = control orchard

** Significantly different, compared to M results

Table 5. Per cent disease incidence at harvest in apples from disease management orchards in Massachusetts for a five-year period

Disease	1978	1979	1980	1981	1982
Apple scab	2.88	0.66	0.46	0.13	0.11
Calyx end rots	0	0.08	0.19	0.14	1.00
Rusts	0	0.06	0.07	0.03	0.17
Black rot	0.44	0.07	0.08	0.02	0.02
Bitter rot	0.02	0.05	0.02	0.04	0.01
Fly speck	0.06	0.06	0.04	0.04	0
Other*	0.05	0.01	0.05	0.37	0
Total	3.45	0.99	0.90	0.77	1.31

*Other includes sooty blotch, moldy core and white rot.

FACTORS AFFECTING NUTRIENT CONTENT OF THE FOLIAGE AND FRUITS OF APPLE TREES

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Ideas as to what constitutes a desirable fertilizer program have changed several times during the last 80 years. At one time it was thought that orchards needed only phosphorous (P) and potassium (K) containing fertilizers. Very little, if any, nitrogen (N) was recommended. The use of N, only, was the next concept for meeting the nutrient need of trees. By 1950 annual applications of N and occasional applications of K, magnesium (Mg) and boron (B) were being recommended in Massachusetts. With the exception of N, Mg was considered the element most likely to be deficient in our orchard soils. P was not considered a limiting factor in orchard soils and there was no evidence that apple trees suffered from lack of calcium (Ca).

In the mid-1950's, Weeks et al. in Massachusetts reported that McIntosh trees with a medium level of leaf N and a high level of leaf K produced fruit with more red color than those with high or medium N and low K, and growers were advised to use less N and more K. By this time the detrimental effects of high N on pre-harvest drop, flesh firmness and storage life of fruits was well recognized. Leaf analysis now was considered a more useful diagnostic tool than soil analysis for determining the nutritional needs of apple trees.

During the last 2 decades even greater attention has been given to the effects of nutrition on the quality of harvested fruits. Calcium deficiency was found associated with some physiological disorders of apples. These findings have continued to stimulate considerable research emphasis on the roles of both macro- and micro-elements in the postharvest quality of fruits. An area of particular interest in England and Massachusetts is determining the usefulness of fruit analysis for predicting storage life. Hence, it is obvious that the scope of apple nutrition has widened from theconcern about the tree to achieving optimum nutrition for both the tree and the fruit. Unfortunately, the needs of the tree and fruit may differ and a compromise is necessary in some instances. Here we review the factors affecting the nutrient content of the trees and fruit, and the relationship between nutrition and fruit quality.

Crop Size

The effects of crop size on vegetative growth, nutrient uptake, and leaf and fruit nutrition are shown in Table 1.

Table 1. The effects of cropping on growth, and leaf and fruit nutrition of apple trees.

Measure	Heavy cropping trees in comparison to non-bearing or light-cropping trees will have:
Vegetative growth	Less shoot and root growth.
Nutrient uptake	Less uptake of elements because of restriction of root growth.
Leaf N	Higher leaf N
Fruit N	No effect but if fruit N too high quality will be reduced.
Leaf K	Lower leaf K
Fruit K	Lower fruit K because of large demand of fruits for this element
Leaf Ca	High leaf Ca
Fruit Ca	Higher fruit Ca
Leaf Mg	Slightly higher leaf Mg
Fruit Mg	Little, if any, effect
Leaf P	Little, if any, effect
Fruit P	Little, if any, effect

Leaves from a large crop tree may contain 0.2 to 0.3% more N than when the same tree has a light crop. K in leaves may decline as much as 0.4% in a heavy crop year. Leaf Ca follows the same trend as N and exhibits about the same difference as N in leaf content between the light and heavy crop years. Leaf Mg is slightly higher in a heavy crop than in a light crop year. Crop size has little, if any, effect on leaf P.

Total K absorbed and the total dry matter produced is similar for fruiting and non-fruiting trees but in heavy-cropping trees is translocated into the fruits. Thus, the demand of a large crop for K is great and both the tree and fruit may be deficient in this element. Leaf injury because of K deficiency can cause pre-harvest drop and reduce fruit size. In contrast, light cropping trees are probably much higher in K than is needed because of "luxury" uptake.

A very small amount of Ca moves into the fruits in comparison to the amounts of Mg, N, P and K. Nevertheless the presence of adequate Ca in the soil does not assure sufficient uptake by the tree and translocation especially to the fruit; nor does adequate Ca in the tree ensure optimum Ca levels in the fruit because there is competition between leaves and fruits for this element and leaves are a stronger competitor. The high leaf/fruit ratio on light cropping trees tends to increase fruit size which dilutes the Ca content of the fruit. In contrast, heavy cropping reduces the excessive vegetative demand for Ca and makes this element more available to the fruit. Fruit size may be reduced by heavy cropping; smaller fruit have more Ca than larger fruit.

Fruits which constitute the greater part of the total dry matter in fruiting trees, have a much lower N concentration in their dry matter than is found in the new growth of non-fruiting or light-fruiting trees. Therefore, N deficiency is most likely to occur on non- or light-fruiting trees which have large demand for this element for root and top growth, than on a heavy-cropping tree. Mg tends to accumulate at a uniform rate in the fruit and any reduction in Ca accumulation is reflected by a higher ratio of Mg and/or K to Ca.

It is clear from above that the nutrient needs differ greatly for the non- or light-cropping tree in comparison to the heavy-cropping tree. Except for uptake of K, which is very mobile, the uptake and transport of nutrients is suppressed by heavy fruiting. Also with the exception of K the demands for the other nutrients is much less in heavily bearing trees in comparison to those with no crop or a light crop. What does this mean in regard to fertilization?

Young non-bearing trees require heavy fertilization with N to stimulate growth and only moderate amounts of K, and P is not considered a limiting factor in orchard soils. N levels should be reduced in bearing trees (1.80 - 2.00% leaf N is optimum for most varieties) and moderate levels of K, Mg, B and high levels of Ca should be maintained. Unfortunately, sufficiently high levels of Ca generally are possible only by spray applications of $CaCl_2$. And, as discussed later, soil management practices may have greater influence on tree nutrition than fertilization.

Interaction Among Elements

Ca deficiency can occur independently of its availability in the soil because excess K can affect uptake, and after uptake the distribution within the tree. Thus, the Ca/K ratio may be as important as the availability of the Ca. Researchers in South Africa believe that leaf Ca level of 1.60% and a K/Ca ratio of 0.65 are necessary to minimize the incidence of bitter pit under their conditions.

An excess of N increases the need for Ca. In young leaves of rapidly growing shoots most of the Ca may be tied up in the form of calcium oxalate and the supply of this element may thus be low for other functions.

Leaf Mg is apt to be suppressed by high leaf K but in fruits there is a positive correlation between K and Mg, showing that an increase in one element is accompanied by an increase in the other. At Ca levels below a certain threshold value, Mg may substitute for Ca. However, increasing Mg from a deficient to an adequate level can actually increase Ca uptake because breakdown of the feeder root system, essential for nutrient uptake, is the first effect of Mg deficiency.

Roots and Soil

The growth and function of the roots are closely linked to those of the shoot. The roots are dependent on the shoots for assimilation whereas roots produce hormones and remove from the soil elements essential for shoot activity. An important factor restricting root development is the aeration status of the soil. Roots of fruit trees will avoid regions of poor aeration. Thus, on soils with a high water table, the trees will be shallow rooted. Nutrient uptake may be sufficient on these soils, however, shallow-rooted trees will suffer from drought sooner than those with deep roots. A drought will lower the availability of nutrients to the roots, restrict root growth, and may decrease the absorptive capacity of the roots quite markedly.

Far more insidious conditions occur in soils subject to temporary water logging because of the presence of a hardpan near the soil surface. This occurs on a Wethersfield soil at the Horticultural Research Center where trees will become severely weakened or die for lack of soil oxygen because of temporary water saturation within 20 inches of the soil surface in the spring.

Not all horizons in the soil are equally able to supply nutrients to the tree. The concentrations of most elements are highest at the soil surface and decrease with depth, but the rate of decrease differs between elements. For example, there is a strong vertical difference in K status in soil, K being highest near the surface.

Under drought conditions the permeability of the roots to water uptake decreases very rapidly; reduction in water permeability reduces the uptake of all ions. In Massachusetts we are particularly concerned about K and B deficiency and reduced fruit size in drought years.

Soil Management

Soil-mulch systems. When apple trees are heavily mulched, it is necessary to adjust fertilizer programs, especially after the mulch commenced to decay. While the material applied as mulch varies considerably in chemical content, the average hay mulch contains approximately 1% N, 0.4% P, and 1.3% K. On this basis, 33 pounds of hay mulch is equivalent to 1 pound of ammonium nitrate in respect to the N added to the soil. The heavy application of mulch eventually adds large quantities of K and N to the soil. In addition to adding K to the soil, mulch makes more readily available the soil's reserve supply of K.

Mulching presents a dilemma in regards to nutrition. Hay mulch can suppress grass and weed growth, improve soil structure, conserve moisture, and is a source of N and K. Calcium mobility might be greater under mulched trees because this element is carried by water. High K is favorable for red color development and the need of this element is high in heavy-cropping trees. In contrast, high K can suppress Ca uptake and mulch might provide excessive N.

Cultivation. This system of soil management is generally practiced only in young plantings when land has been cleared from woods or when an old orchard site is renovated. After a year or 2, grasses and weeds are allowed to re-establish themselves between the rows or the land is re-seeded.

Cultivation under the trees can affect nutrient level because it destroys the roots in the surface soil which is particularly high in K and P. Grass and weed competition are reduced by cultivation, thus soil moisture is conserved and N is more available because grass competes with the trees for N.

Chemical Weed Control. Considerable attention has been given to the effect of herbicides on nutrition. A number of workers have reported that sub-lethal concentrations of simazine will increase leaf N of apple trees. In contrast, in our field studies, no differences in nutrient levels or in growth of apple trees could be attributed to simazine. However, in greenhouse studies, we found that low concentrations of soil-incorporated simazine did increase leaf N of McIntosh apple trees grown in 30 lb. cans. We believe the lack of a response under our field conditions is because most of the simazine is adsorbed by the organic matter in the upper 3 inches of the soil and not available to tree roots.

The effects of herbicide strips on root growth and nutrient uptake have recently received much attention in England and Europe. The studies at East Malling Research Station show that apple trees produce most of their roots in and obtain most of their mineral nutrients from the soil of the herbicide strip. Root growth under the grassed alley appeared deeper and more sparse.

Herbicides indirectly affect the nutrition of fruit trees because killing of vegetation under the trees reduces the competition between the grass and tree roots for minerals and water. Furthermore, herbicides will decrease soil pH and adversely affect earthworm populations and thereby soil structure.

Effects of Fertilization on Fruit Quality

Calcium: In 1936 bitter pit was found to be related to low Ca levels in apples. Thirty years later it could still be stated that "Inspite of the very low Ca status of many orchards soils.. there have been few reports of direct responses by bearing apple trees to Ca..." (Temperate to Tropical Fruit Nutrition, Norman F. Childers, Editor). Today, however, there is strong concern about Ca levels in apples and pears just about anywhere in the world that they are grown.

At first, this concern was directed at bitter pit and cork spot but today we know that many physiological disorders may be at least partly related to low Ca levels in the fruit. In warmer fruit growing areas, cork spot and bitter pit remain the most serious effects of low Ca, but in cooler areas various forms of internal breakdown are the most serious Ca-deficiency problem. In British Columbia, Canada, the 'Spartan' apple industry was almost destroyed by breakdown problems before methods of raising fruit Ca levels were successfully developed.

Nitrogen: Excessive amount of N in the tree and fruit can severely reduce fruit quality. The vigorous growth that it encourages reduces the Ca level of the fruit. Moreover, the high N fruit tend to be larger, greener, softer, more subject to preharvest drop, and to have more cork spot and bitter pit. These fruit also tend to develop greater amounts of scald, bitter pit, internal browning, and internal breakdown during and after storage.

Excessive N levels are probably very common but deficient levels rarely occur. In the Pacific Northwest it has been estimated that 50 to 75% of apple orchards and a smaller percentage of pear orchards, are excessively high in N. The effects of high N on apples are perhaps being masked at harvest by use of growth regulators, especially Alar, but growth regulators cannot mask their consequences after storage.

Potassium: K deficiency has only a mild effect on fruit quality, reducing acidity of the fruit and reducing red coloration. Excessive amounts of K in fruit are a greater danger to fruit quality, since they lead to increased scald, bitter pit, and internal breakdown after storage.

Magnesium: There is little evidence that either too little or too much Mg directly affects fruit quality. However, excess Mg interferes with Ca just as does excess K, so excessive amounts of Mg will produce Ca deficiency effects in fruit.

Phosphorus: P deficiency can reduce tree growth and yield, and in several parts of the world it has also been shown to cause increased amounts of breakdown of apples during storage. However, in North America there has been very little evidence for P deficiency in fruit. We have recently found that high levels of P in apples, especially in combination with low levels of Ca, greatly increased breakdown of apples during storage.

Boron: B deficiency has occurred over much of North America, causing both internal and external cork development in fruit. Excessive levels of B in fruit can cause earlier maturation and increased amounts of water core at harvest, and increased amounts of breakdown after storage. Thus, a moderate level of B is important for good fruit quality.

B also influences Ca movement in the tree. If it is deficient, less Ca is moved to the fruit and Ca deficiency can result. It is therefore important to maintain adequate B levels as a part of a program to avoid Ca deficiency.

POMOLOGICAL NOTES

For Those Who Care To Know. The first mimeographed copies of FRUIT NOTES was issued in March, 1936 with Bill Thies, Editor, at about the time of the spring flood. (The spring flood of 1936 is well remembered by some of us older folks.) With an exception of a few months when no issue was prepared, it has appeared at regular intervals from 1936 to the present time. William Lord became Editor in 1955 and William Bramlage, Co-editor, in 1966. We have a mailing list of approximately 1600 and it is mailed to 19 foreign countries.

INTEGRATED MANAGEMENT OF APPLE PESTS IN MASSACHUSETTS, 1982 RESULTS: INSECTS

W.M. Coli[1], R. Zahnleuter[2], D. Gordon[3], K. Leahy[3], J. Parella[3], D. Roberts[3] and R.J. Prokopy[4]

Summary of Results.

In 1982, 36 IPM blocks received 27% fewer insecticide and 17% fewer miticide but 20% more aphicide dosage equivalents than check blocks. Insect injury to fruit at harvest in IPM blocks averaged 4.2%, versus 3.5% in the checks. Growers completely implementing IPM specialist recommendations (100% cooperator blocks) realized a net benefit of $56.95 per acre from IPM.

Number of orchard blocks scouted.

In 1982, each week from April 12 to September 15, field staff visited 36 IPM blocks (about 400 acres) in 20 commercial orchards throughout the state. Growers received a written scouting report and were contacted in person or by telephone by the IPM specialist regarding the need for spraying, recommended materials, rates and timing.

Four commercial check blocks were monitored for presence of aphids and mites and their predators 2 or 3 times during the season. In addition, on-tree harvest surveys and comparisons of spray records were performed in 7 commercial check orchards.

Grower financial support.

All participating IPM growers were charged $20 per scouted acre for insect and mite scouting and advising. A minimum charge of $400 was instituted for growers who wished to be on the program but who signed up less than 20 acres. The charge for disease scouting, weather monitoring stations and grower advising was $200 per orchard in 1982.

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[1]Pest Management Specialist

[2]Senior Field Scout

[3]Field Scout

[4]Extension Entomologist

[5]Reduced spray programs on apples have been discussed in previous issues of Fruit Notes: 41(1), 41(2), 41(3), and 43(3), and our 1978, 44(6), 45(6) and 47(1).

Total grower contribution to the IPM program was $9,500 in 1982, up from $8,500 in 1981. This money was placed in an Extension Activity Account earmarked for Apple IPM program uses (scout salaries, etc.).

We would like to extend special thanks to Mr. David Chandler, Meadowbrook Orchards for his generous donation of a 1975 Buick station wagon for IPM use. The addition of this fine vehicle should enable us to extend the useful life of other IPM vehicles previously donated by the Massachusetts Fruit Growers Association.

The extent of grower financial support of the Apple IPM program has been commendable and will serve as a standard by which to gauge levels of support of new IPM projects serving other commodity groups in the state.

On behalf of all IPM program staff past and present, we wish to express our sincere appreciation for the support and cooperation our pilot program has received.

Sampling methods.
We have discussed our monitoring techniques in previous issues of Fruit Notes. One major addition to these techniques was continued field testing of a visual trap for Tentiform leafminer. As we reported in 1981, preliminary results are encouraging. These results will be discussed in a later issue of Fruit Notes.

Degree of cooperation with IPM specialist advising.
The extent of grower cooperation with specialist spray recommendations was excellent in 1982, averaging 83% cooperation (range 43 - 100%). While this is somewhat lower than last year when cooperation averaged 89%, in 1981 only 11% of IPM blocks (4 36 blocks) completely followed specialist advising, but in 1982, 42% of IPM blocks (15 out of 36) completely implemented specialist recommendations.

Such blocks had substantially lower harvest injury in spite of fewer insecticide spray applications when compared to all partial cooperator IPM blocks (Table 1).

Table 1. Percent insect injury and number of insecticide dosage equivalents (DE) in 100% vs. partial cooperator IPM blocks, 1982.

	All IPM Blocks			Previous Year IPM Blocks only		
	% Insect Injury	Insecticide DE	No. Blocks	% Insect Injury	Insecticide DE	No. Blocks
100% Cooperators	3.4	4.9	15	2.8	4.6	12
Partial Cooperators	4.7	6.2	21	5.6	6.4	12

New or unusual occurrences.

Some blocks again experienced a problem with gypsy moths (GM) blowing in during bloom. Very little fruit injury resulted from GM feeding this year, however, and control with petal fall sprays was excellent. Few growers experienced problems with large, late instar larvae migrating from adjacent defoliated oak stands in 1982.

Spotted tentiform and apple blotch leafminers (STLM/ABLM) were well below treatment levels in many IPM blocks where 1981 mine counts had been high. Although some IPM growers used Vydate* (oxamyl) at pink, others who elected to wait for results of mine counts were able to withhold leafminer treatments for the entire season without the harmful polulation increases that occurred in past years.

The reasons for this drop in leafminer pressure are unclear, and our present knowledge does not allow us to predict the potential for leafminer problems in 1983.

Both syrphid fly and cecidomyiid midge aphid predators were abundant in IPM blocks in 1982 (Table 3). In spite of this, honeydew accumulation was extensive enough to warrant aphicide sprays in 10 such blocks.

Fruit injury.

Fruit injury at harvest in Previous-year IPM, First-year IPM and check blocks averaged 4.3, 3.8 and 3.5%, respectively (Table 2). The somewhat higher injury level in Previous-year blocks was due largely to sooty mold fungus growing on aphid honeydew observed on 21% of sampled fruit in one IPM block.

This injury resulted from a late season (August) infestation of green aphids on watersprout regrowth in the top center of tree canopies. It is doubtful that such injury is of economic significance in this case, however, as the grower typically wipes and polishes fruit prior to display in the apple sales room at the farm and should be able to remove most of this injury.

Of insects causing non-removable injury, San Jose Scale (SJS) was most troublesome and difficult to control in many commercial block samples (Table 2). For the first time in recent memory average injury from SJS surpassed that of the tarnished plant bug, (TPB) normally the single most injurious apple pest in Massachusetts.

Lack of adequate SJS control can be attributed to several factors. These include: (a) reduced usage of semidormant oil sprays; (b) frequent and heavy rain showers when treatment was required for 1st generation SJS crawlers; (c) grower reliance on concentrate sprays (30-50 gals. per acre) on large trees in hot, dry weather when treating for 2nd generation crawlers; and (d) substantially reduced use of microencapsulated methylparathion (Penncap-M*) in

*Trade Name

response to pesticide board regulations governing its use.

In one block with a long history of SJS problems, Diazinon*provided excellent SJS control in combination with an aggressive oil program, pruning to enhance spray penetration, and frequent grower scouting. This program resulted in 0% SJS injury in 1982 compared to 9% such injury in the block in 1980.

European apple sawfly (EAS) injury was substantially higher in all blocks checked in 1982 than in previous years (Table 2). This finding, also observed by IPM personnel in Vermont, may have been due largely to higher EAS populations in several blocks (cumulative average of 43 EAS per trap in one case, 27 per trap in another, for example).

This apparently higher than normal EAS injury may also be related to our continued efforts to distinguish between TPB "dimples" and EAS "stings" which are similar in appearance. Inasmuch as most EAS injury in 1982 consisted of "stings" rather than well developed larval burrows, most EAS injury was not of economic significance.

Tarnished plant bug injury was somewhat lower in 1982 than in recent years. As we have noted previously and as researchers in New York State have recently confirmed, the majority of TPB injury consists of "dimples" in the fruit calyx which will not adversely affect fruit grade.

In 1982, based on use of white TPB traps, 21% of IPM blocks were able to withhold pre-bloom TPB sprays while sustaining 1.1% injury from this pest, compared to 0.83% injury in the sprayed checks.

Plum curculio (PC) injury was lower on average in all blocks in 1982, accounting for 0.43, 0.37 and 0.26% average injury in Previous-year IPM, First-year IPM and checks, respectively (Table 2).

Much of the observed PC injury occurred in late June with an unexpected burst of PC activity and most injury was confined to block peripheries. Several blocks achieved good PC control using border sprays subsequent to an initial block-wide PC treatment applied in response to first observation of this pest's activity in commercial blocks.

Combined injury from Gypsy moth, Apple maggot fly (AMF), Leafrollers (LR), Codling moth (CM), White apple leafhopper (WAL) and Green fruitworms (GFW) was low in 1982, accounting for a total of 0.04, 0.12, and 0.09% injury in Previous-year IPM, First-year IPM and check blocks, respectively.

Private scout/consultants (New England Fruit Consultants) report a possible case of resistance in Green Fruitworm to organophosphate insecticides. Such resistance in GFW has been noted in the Hudson Valley of New York and points out the need for continued monitoring of pests which are presently of minor significance in New England.

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*Trade name

Table 2. Average % insect injury on fruit at harvest in Previous-Year IPM, First-Year IPM and Check commercial orchards in Massachusetts, 1982.

Pests	1982 Injury (%)[z]		
	Previous-Year[y] IPM blocks (25 blocks)	First Year IPM blocks (11 blocks)	Check (7 blocks)
Tarnished Plant Bug	1.12	0.76	0.83
Plum Curculio	0.43	0.37	0.26
San Jose Scale	0.84	1.61	1.86
European Apple Sawfly	0.87	0.83	0.47
Gypsy Moth	0.01	0.06	0.0
Apple Maggot Fly	0.01	0.0	0.0
Leaf Roller	0.02	0.04	0.04
Codling Moth	0.0	0.0	0.0
White Apple Leafhopper	0.0	0.0	0.04
Green Fruitworm	0.01	0.02	0.01
Sooty Mold fungus	1.00	0.12	0.0
Total % injury	4.31	3.81	3.51

[z] Based on on-tree survey of 600-2,000 fruit per block at harvest (100 fruit per tree from each of 2 trees adjacent to each trapping station).

[y] Orchards which have been on an IPM program one or more years.

Mite populations.

Table 3 contains results of mite sampling performed in IPM and check commercial orchards in 1982. Relatively high numbers of mites per leaf in IPM orchards probably have more to do with sampling methods than with any differences in control efficacy among blocks.

In IPM blocks samples were taken on a weekly basis proximal to "hot spots" and were initiated when signs of bronzing or active mites were observed. Samples in Check orchards, on the other hand, were collected at random intervals, often after growers had treated for mites.

There is an apparent association between higher prey mite numbers and higher predatory mite numbers. However, from a pest management perspective, 1982 was not a good year for biological mite control in Massachusetts. In most IPM blocks the early part of the growing season (through early July) saw few mite problems. Heavy rainshowers apparently washed adult mites off the leaves and cool wet weather was not conducive to mite reproduction. Bronzing was mild at this time and trees were growing vigorously.

In July and August, however, hot dry conditions resulted in rapid mite buildup in many blocks. ERM numbers above treatment level continued in some cases into September. Red mite eggs were observed in

Table 3. Mean abundance of pest and predaceous arthropods at peak sample populations on foliage in Previous-Year IPM, First-Year IPM, and Check blocks, 1982.

Species[y]	Mean abundance/Sample unit[z]		
	Previous IPM Blocks	New IPM Blocks	Check Blocks
European red mite	47.1	51.8	1.1
Two spotted mite	1.4	3.0	0.4
A. fallacis	0.02	0.04	0.01
Green aphids	43.0	39.9	16.0
A. aphidimyza	8.4	21.0	5.7
Syrphid spp.	11.7	21.5	2.0
Leafminers[x] (1st gen.)	0.31	0.19	0.0
(2nd gen.)	0.39	0.36	0.0
(3rd gen.)	0.65	0.36	0.0

[z]Sample unit = Individual leaves for mites and leafminers, and foliar terminals for aphids and aphid predators.

[y]In 1982, mite sampling was performed near "hot spots" when initial leaf bronzing or numerous active mites were noticed. In check blocks, trees were sampled randomly.

[x]First generation mine counts in 21 previous and 9 new IPM blocks; 2nd generation mine counts in 20 previous and 11 new IPM blocks; 3rd generation mine counts in 23 previous and 12 new blocks.

the fruit calyx in significant numbers in 2 blocks. Amblyseius fallacis, our major predatory mite, was present in low numbers in 1982, a phenomenon reported by other Northeast and Canadian tree fruit entomologists. A. fallacis was first observed on August 4, after red mite and two spotted mite populations had reached treatment levels at several sites. A. fallacis was ultimately found in 21% of IPM blocks, but the highest recorded sample had only 0.3 predators per leaf. IPM blocks averaged 0.03 A. fallacis per leaf compared to 0.01 per leaf in the checks.

We are not able to explain why predator mite numbers were low in 1982 (down from an average of 0.2 per leaf in 1981). However, A. fallacis appeared too late and in too few numbers to affect red and two spotted mite numbers in monitored orchards.

Insecticide, aphicide and miticide use.

Previous-Year IPM blocks (average 6.3 insecticide sprays, range 4 to 10) and First-Year IPM blocks (average 7.0 insecticide sprays, range 4 to 10.4) received 28% and 20% fewer insecticide spray applications, respectively, than check blocks (average 8.8 sprays, range 4 to 12) (Table 4). Check blocks received no aphicide sprays. Previous-Year IPM blocks averaged 0.2 aphicide applications and First-Year IPM blocks averaged 0.4 such sprays. Miticide spray applications were 32% and 43% lower in Previous-Year and First-Year IPM blocks, respectively, than in checks, due in part to grower interest in preserving and encouraging predatory mites.

Dosage equivalents of pesticides that were used followed similar patterns. DE of insecticide used in Previous-Year or First-Year IPM blocks were 30% and 21% less than in the checks. DE of miticide used were 17% and 9% less than those of the checks. DE of aphicide used were 20% and 30% more than those of the checks, however.

Table 4. Numbers of pesticide treatments and dosage equivalents[z] of pesticide applied for insect and mite pest control in IPM and check blocks, 1982.

Treatment	Previous Year IPM blocks (24)	First Year IPM blocks (12)	Check blocks (7)
Oil	0.8	1.0	0.6
Insecticide	6.3	7.0	8.8
Miticide	1.3	1.1	1.9
Aphicide	0.2	0.4	0.0
<u>Dosage Equivalents</u>			
Oil	0.7	1.0	0.6
Insecticide	5.5	6.2	7.8
Miticide	1.0	1.1	1.2
Aphicide	0.2	0.3	0.0

[z]Dosage equivalent = Actual pesticide rate/100 gal. / Amount recommended in New England Pest Control Guide.

Cost benefit analysis.

Both Previous-and First-Year IPM blocks realized substantial savings in insecticide spray materials and spray application costs compared to check blocks (Table 5). However, cost inputs for oil, aphicide and miticide materials were higher in both types of IPM blocks compared to the checks. In addition, higher levels of fruit injury resulted in $34.65 and $11.55 more fruit lost due to insect injury compared to the checks in Previous-Year and First-Year IPM blocks, respectively. Cost savings from IPM practices averaged

$17.64/A in Previous-Year IPM blocks, and $3.25/A in First-Year IPM blocks.

It is interesting to note that in 1982, the most favorable cost/benefit ratio existed in 15 100% Cooperator IPM blocks. While the cost of oil, miticide and aphicide sprays was greater in such blocks compared to the checks, substantial per-acre savings in insecticide materials and application costs, combined with a slight reduction in the value of fruit lost due to insect injury, resulted in an average net benefit from IPM of $56.95 per acre.

This finding may illustrate the potential value to growers from complete rather than partial implementation of an IPM system. This is particularly true with regard to the use of reduced pesticide rates and the need for cooperation between pest manager and grower to insure optimal spray timing. This latter factor is of particular significance inasmuch as IPM spray decisions frequently are made when pest levels have reached an action threshold level. Substantial delays in spray application beyond this point may result in higher levels of injury than if growers had followed a traditional preventative program.

Pesticide use, insect injury and cost benefit analysis, 1978-1982.

Figure 1a details trends in dosage equivalents of insecticide used in IPM vs. check blocks since the inception of the Apple IPM pilot program. Check insecticide use remained near the level used prior to IPM program initiation while cooperating IPM blocks have experience an overall 26% reduction in insecticide DE used. Similar results are evident in Figure 1b, detailing miticide DE used from 1978-1982. In this case, IPM blocks have used an average of 54% fewer such materials than check blocks.

Fruit injury at harvest was lower in IPM blocks in 3 out of 5 years in spite of lower pesticide use, averaging 13% less fruit injury than checks.

Table 6 contains results of cost benefit comparisons performed from 1978-1982. Data from 1980 to 1982 are subsets of all IPM blocks which account for degree of cooperation with specialist recommendations, a parameter which may strongly influence program results.

Over the 5 year span of the pilot program, highly cooperative IPM growers realized an average net benefit of about $82.00 per acre, exclusive of scouting costs. Private scout consultants presently are offering IPM services to growers for $20-$30 per acre, indicating a potential savings to growers for continued IPM effort. Growers who plan to perform their own scouting will be able to save even this scout/consultant fee and should be able to realize a more favorable net benefit.

Table 5. Cost benefit comparison of insect and mite results in Previous Year IPM, First-Year IPM 100% Cooperator IPM and check commercial apple blocks in Massachusetts, 1982.

Parameter	Orchard Type: Previous Year IPM	Orchard Type: First Year IPM	Orchard Type: 100% Cooperator IPM[z]	Check	Difference vs. Check: Previous Year IPM	Difference vs. Check: First Year IPM	Difference vs. Check: 100% Cooperator IPM
Avg. #sprays/A							
Oil	0.8	1.0	0.7	0.6	+25%	+40%	+14%
Insecticide	6.3	7.0	6.2	8.8	-28%	-20%	-30%
Miticide	1.3	1.1	1.4	1.9	-32%	-12%	-26%
Aphicide	0.2	0.4	0.3	0	+20%	+40%	+30%
Avg. # dosage equivalents/A							
Oil	0.7	1.0	0.7	0.6	+14%	+40%	+14%
Insecticide	5.5	6.2	5.0	7.8	-29%	-21%	-36%
Miticide	1.0	1.1	1.2	1.2	-17%	- 8%	0
Aphicide	0.2	0.3	0.2	0	+20%	+30%	+20%
Avg. cost/A spray materials							
Oil	$ 19.20	$ 26.13	$ 18.95	$ 17.65	+$ 1.55	+$ 8.58	+$ 1.30
Insecticide	$ 80.29	$102.19	$ 75.77	$127.69	-$47.40	-$25.50	-$51.92
Miticide	$ 23.45	$ 25.41	$ 28.62	$ 22.25	+$ 1.20	+$ 3.16	+$ 6.37
Aphicide	$ 2.18	$ 6.23	$ 3.33	0	+$ 2.18	+$ 6.23	+$ 3.33
Avg. application cost/A[y]	$ 24.76	$ 27.31	$ 22.40	$ 34.58	-$ 9.82	$ 7.27	-$12.18
Avg. % insect injury[x]	4.3	3.8	3.4	3.5	+19%	+8%	-3%
Avg. value/A fruit loss due to insect injury	$165.55	$146.30	$130.90	$134.75	+$34.65	+$11.55	-$ 3.85
Avg. net benefit or loss from IPM[v]	+$17.64	+$3.25	+$56.95				

[z]15 blocks treated completely according to Entomology IPM Specialist advising. Includes data from 12 Previous-Year and 3 First-Year IPM blocks.

[y]Based on 15 minutes to spray one acre, $6.05/hr labor cost, $2.12/A per spray date, fuel and oil.

[x]Includes permanent and removable (e.g. sooty mold) injury.

[w]Based on avg. values as of Sep. 30: US Fancy fruit @ $9.00/bu, US #1 Fruit @ $6.00/bu, cull fruit @ $2.00/bu and avg. yields of 550 bu/A.

[v]Does not include cost of scouting, traps, travel or administration in IPM blocks.

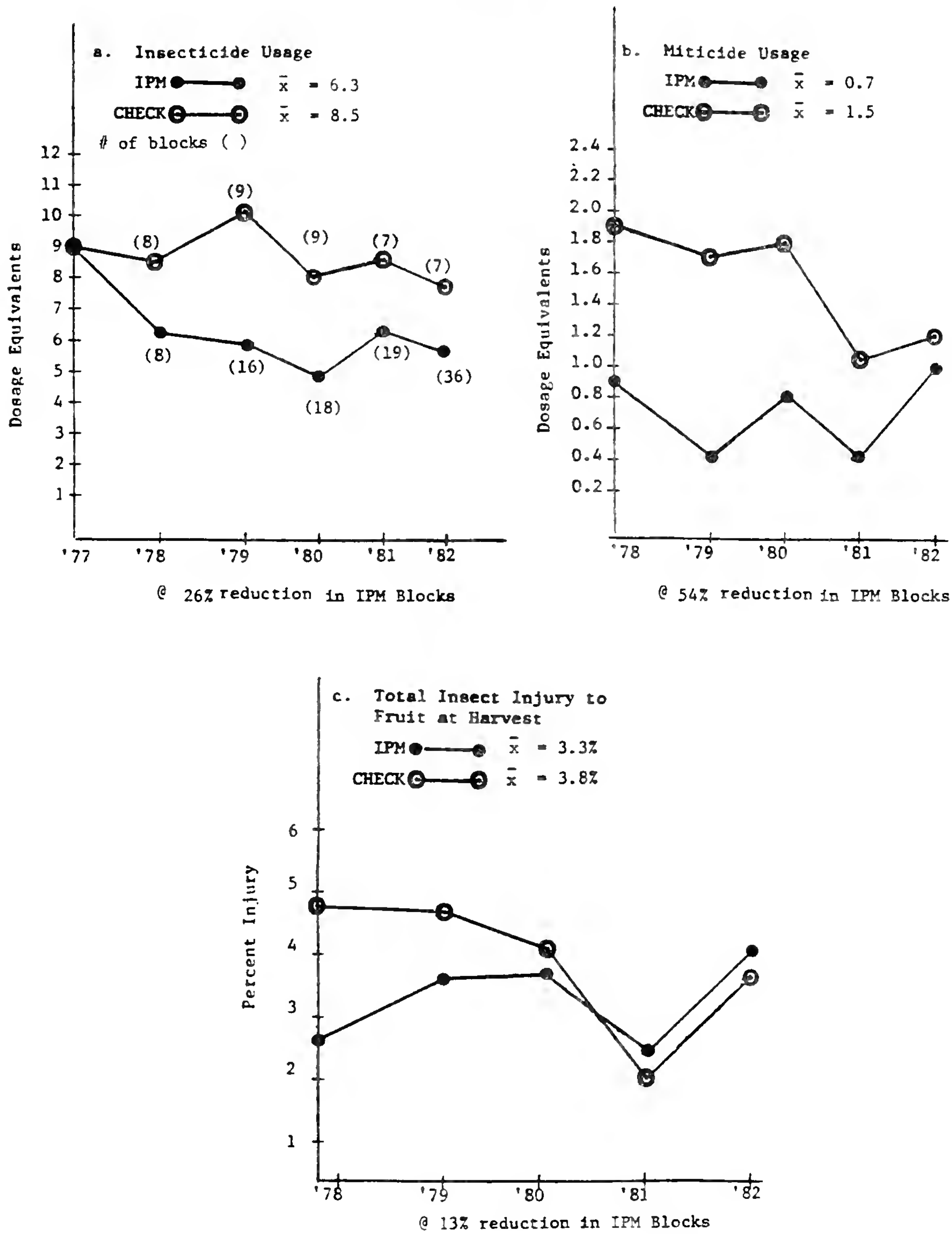
Table 6. Cost/benefit analysis of arthropod pest control practices in IPM vs Check blocks, 1978-1982.

	Difference IPM vs Check				
	1978	1979	1980[z]	1981[z]	1982[z]
Cost of materials					
Oil	- $5.81	+$ 0.23	-$ 2.84	-$ 2.62	+$ 1.30
Insecticide	-$12.51	-$51.64	-$42.50	-$37.01	-$51.92
Miticide	-$15.83	-$14.59	-$19.49	-$16.85	+$ 6.37
Aphicide	0.0	-$ 0.11	-$ 4.30	0.0	+$ 3.33
Cost of pesticide application	-$ 9.64	-$16.05	-$ 7.82	-$ 8.96	-$12.18
Value of fruit lost due to insect injury	-$53.37	-$40.46	-$16.42	+$25.26	-$ 3.85
Avg. net benefit from IPM	+$97.16	+$122.83	+$93.37	+40.18	+$56.95

Five year average net benefit from IPM +82.10

[z] 1980 data = Complete cooperator blocks.
1981 data = Previous-Year IPM blocks.
1982 data = Complete cooperator IPM blocks.

Figure 1. Trends in Pesticide Usage and Insect Injury to Fruit, 1977-1982.



Cooperative Extension Service
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Amherst, Massachusetts 01003

FRUIT NOTES

PREPARED BY
DEPARTMENT OF PLANT AND SOIL SCIENCES

COOPERATIVE EXTENSION SERVICE, UNIVERSITY OF MASSACHUSETTS, UNITED STATES DEPARTMENT OF AGRICULTURE AND COUNTY EXTENSION SERVICES COOPERATING.

EDITORS
W. J. LORD AND W. J. BRAMLAGE

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NUTRITIONAL PROBLEMS IN 1982
AND SUGGESTIONS FOR FERTILIZATION OF APPLE TREES IN 1983

William J. Lord
Department of Plant and Soil Sciences

Prospects for a heavy bloom in 1983 are not too likely following the large crop in 1982. However, there are ample flower buds for a good crop in 1983.

The analysis of leaf samples from commercial orchards showed that potassium (K) and magnesium (Mg) was deficient in many orchards in 1982 and boron (B) was generally low. Visual observations of Mg deficiency were quite prevalent on both apple and pear trees, which is unusual, and perhaps resulted from leaching of this element by the heavy rainfall in June (9.6 inches at the Horticultural Research Center). It is possible that leaching of K and Mg occurred both from the leaves and soil. Mineral analysis of McIntosh fruits from 24 orchards sampled shortly prior to harvest in 1982 showed that calcium (Ca) levels were low. Two blocks of trees in each orchard were sampled. Only 5 of the 24 orchards produced fruit in both blocks with Ca levels high enough to clearly predict that their fruit had a high potential for long-term storage of good quality fruit.

Information on the Leaf Analysis Reports indicated that some growers continue to apply a "complete fertilizer". Cost could be reduced by using fertilizer that contains no phosphorous (P) since there is no evidence that our apple trees need this element beyond what is present in the soil.

With the above observations in mind, we present the following suggestions as a guide for fertilization in 1983.

<u>Nitrogen</u> (N): Most orchards had a large crop in 1982, therefore, the trees may be low in available N for utilization this spring. We suggest higher rates than normal of N this year unless the trees were excessively vigorous in 1982 or were heavily pruned this past winter.

<u>Potassium</u> (K): Over 90% of the leaf samples were deficient, probably due to the demand for this element by the large crop, and/or leaching because of heavy rainfall.

The leaf scorch symptoms of K deficiency may be confused with the leaf margin burn from calcium chloride sprays. However, unlike leaf burn from calcium chloride sprays, the scorch of leaf margins due to K deficiency progresses from the older leaves to the younger leaves of current season shoots as the season advances. The scorch may turn gray in color and leaf fall may occur late in the growing season.

The K requirements of apple trees with a large crop are high because the fruit utilizes about 3 times as much K as N. Since the quantity of K stored by the tree is extremely small, it seems important to supply adequate K this spring on trees that had heavy fruit set in 1982.

The requirements of apple trees for K (expressed as K_2O), based on potential yields, are as follows: (a) less than 15 bu: 1.3 lbs./tree; (b) 15 to 25 bu: 1.3 to 2.7 lbs/tree; and (c) more than 25 bu: 2.7 to 4.3 lbs/tree. It is necessary, however, to maintain a balance among the essential nutrients for apple trees. For example, excessive levels of K can reduce both leaf and fruit Ca. Therefore, we strongly urge that you participate in our leaf analysis program to more accurately determine the K needs of your apple trees.

Calcium (Ca): Our suggestions for meeting the Ca needs of apple trees can be found in another article in this issue of FRUIT NOTES.

Boron (B): B can be supplied to apple trees either by foliar or soil applications. Use the most economical and convenient method. However, it is safest to apply all elements as a fertilizer except in emergency situations.

Soil applications of boron should be applied to orchards every 3 years. The rate of application per tree vary with tree age and size. In low density orchards, apply ¼ pound of borax (11.1% actual B) or its equivalent under young trees coming into bearing, ½ to 3/4 pound to medium age and size trees and 3/4 to 1 pound to large or mature trees. Be sure to note the percent actual B in the fertilizer being used to supply this element. B containing fertilizers vary from approximately 11 to 21% actual B.

In medium and high density orchards (115 trees/acre or higher), it might be best to apply B on an acre basis. We suggest the following rates per acre of borax (11.1% actual B) or its equivalent: (a) trees 4 to 7 years of age - 12 lbs; (b) trees 8 to 15 years of age - 12 to 24 lbs; and (c) trees 16 to 30 years of age - 24 to 48 lbs.

When the soil application of B is followed by a wet spring, it may be advisable to apply 2 foliar applications of B the following year.

Many growers now rely on annual foliar applications of B. The usual practice is to add Solubor to the first 2 cover sprays. Fertilizer grades of borax may contain grit and should not be used in a sprayer. Mature trees should receive 4 pounds of Solubor per acre each year. Consequently, the goal is to apply about 2 pounds per acre in each of the 2 applications. For young orchards, the addition of 1/2 pound of Solubor per 100 gallons (dilute basis) to the first 2 cover sprays meets the B requirements of these trees. Reports of New York State indicate that sprays can be concentrated up to 8X with satisfactory results.

Leaf samples from orchards treated with Solubor have indicated adequate leaf boron levels but the fruit was deficient in this element. Whether or not B applied as a fertilizer more adequately meets the B requirement of apples than foliar applied B is not known by us.

Magnesium (Mg): Deficiency symptoms of this element are characterized by necrotic (brown) areas between the veins. The older, basal leaves on shoots and spurs are usually affected first, and as the season progresses the injury symptoms appear on the younger leaves. The deficiency symptoms frequently become apparent in late July and early August. By late summer, the shoots on which leaves show Mg deficiency may be defoliated except for a few leaves near their terminals. Mg deficiency increases fruit drop at harvest.

Weather conditions may have been responsible for the frequent symptoms last year and the question is what to do if you suspect or know that you had trees low in Mg. If you have been applying a dolomitic limestone on a regular basis (dolomitic limestone contains magnesium), no corrective procedures should be necessary. However, take leaf samples again for analysis in 1983.

If you have not applied dolomitic limestone recently and you suspect low Mg levels in your trees, we suggest applying this kind of lime this spring.

Manganese (Mn): Apple leaves from trees showing Mn deficiency in 1978 had 12 to 15 ppm of this element which is much below the desired levels of 30 to 60 ppm. Mn deficiency symptoms are characterized by interveinal fading of chlorophyll with the veins remaining green. For those who are unfamiliar with the symptoms of Mn deficiency, we refer you to the photograph that appeared in the May/June 1978 Issue of FRUIT NOTES.

Mn deficiency should be corrected on trees showing considerable foliage damage. Although we have no definite proof, Mn deficiency appeared to be associated with excessive fruit drop on a few trees in orchard in 1977. Mn deficiency can be corrected by foliar applications of manganese sulfate or of a fungicide containing Mn. Apply manganese sulfate at about first cover at the rate of 3 lbs. per 100 gallons of water. If using a Mn-containing fungicide, 2 or 3 applications are necessary with timings about petal fall, first and second cover.

Zinc (Zn): Based on optimum levels of Zn established by Warren Stiles, Cornell University (See FRUIT NOTES 47(2):20-26, 1982) some of our orchards continue to be low in this element. W. Stiles believes that apple trees require approximately 2 lbs. of Zn per acre annually if applied as inorganic salts in dormant sprays or approximately 0.2 to 0.3 lbs. of actual Zn applied as foliar sprays of EDTA chelates (3 to 5 lbs/acre).

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EFFECTS OF TYPE OF NITROGENOUS FERTILIZER APPLIED UNDER STURDEESPUR DELICIOUS TREES ON EXCHANGEABLE ELEMENTS IN THE SOIL

William J. Lord, John Baker and Richard A. Damon, Jr.

In a previous issue of FRUIT NOTES (Vol. 45, No.4), we reported our findings on the effects of calcium nitrate ($Ca(NO_3)_2$, ammonium nitrate (NH_4NO_3) or potassium nitrate (KNO_3) applied annually from 1972 through 1979 on soil pH, the nutrient levels in leaves, on bitter pit, and fruit calcium (Ca) levels. To briefly review these findings, neither $Ca(NO_3)_2$ nor KNO_3 affected soil pH, whereas NH_4NO_3 increased soil acidity. Nitrogen (N) source had little influence on N, potassium (K), magnesium (Mg), or Ca content of leaves, no appreciable influence on fruit Ca and no effect on the incidence of bitter pit.

Here we present our findings on the effects of N sources applied annually since 1972 on exchangeable Ca, Mg and K in the soil (Table 1).

Table 1. Effects of N sources applied annually since 1972 on exchangeable Ca, Mg and K in the surface 6 inches of soil.

Treatment	Meq/100 g in soil of:		
	Ca	Mg	K
		1978	
Control[z]	6.40ab[y]	2.35a	0.26b
KNO_3	6.00b	2.06a	1.30a
NH_4NO_3	4.04c	1.02b	1.15a
$Ca(NO_3)_2$	7.44a	1.45b	0.98a
		1981	
Control[z]	7.34a	2.90a	0.15b
NH_4NO_3	5.36b	1.57b	0.73a
$Ca(NO_3)_2$	8.33a	1.50b	0.77a

[z] Untreated soil between trees.

[y] Numbers in a column for each year followed by a different letter are significantly different at odds of 19 to 1.

In 1978 soil treated with NH_4NO_3 for 7 consecutive years had less exchangeable Ca and Mg than untreated soil from between the trees. In contrast exchangeable Ca was similar in untreated soil and in soil fertilized with KNO_3 or $Ca(NO_3)_2$. Soil K was higher under the trees than between the trees but N source did not influence K, which had been applied equivalently under all trees.

The original experimental design was changed in 1980 with the elimination of the KNO_3 treatment but with the continuation of NH_4NO_3 or $Ca(NO_3)_2$ applications. Our data in 1981 after 10 consecutive annual applications of $Ca(NO_3)_2$ are in agreement with those obtained in 1978 (Table 1) in that its use has not substantially increased the amount of exchangeable Ca in the soil. Thus, our study continues to emphasize the difficulty of affecting soil, tree and fruit Ca when fertilizing with $Ca(NO_3)_2$ because the amount applied is small when it is based on the N needs of the trees.

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PRELIMINARY FINDINGS FROM THE MULTI-STATE COOPERATIVE APPLE INTERSTEM PLANTING[1,2]

William J. Lord
Department of Plant and Soil Sciences

The preliminary results from a cooperative interstem planting established in 10 states in 1976 are published in the Fruit Varieties Journal, 1982 (Vol. 36, No. 1) and authored by David Ferree of the Ohio Agricultural Research and Development Center, Wooster, Ohio. The purpose of this multi-state planting is to study the growth and yield potential of 2 scion cultivars with an M9 interstem for dwarfing on 3 vigorous rootstocks under a diversity of climatic conditions.

Trees for the plantings were propagated by double grafting a 6-inch stempiece of M9 on scions of Sturdeespur Delicious or Empire and on rootstocks of MM111, Ottawa II or Antonovka Seedlings. Ottawa II and Antonovka rootstocks were selected because they provide good anchorage and cold hardiness. MM111 served as the control. This rootstock has shown good soil adaptability but lacks precocity when used as the understock on 2-piece trees.

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1 States cooperating in this study were Illinois, Indiana, Iowa, Kansas, Kentucky, Massachusetts, Michigan, Missouri, Ohio and Wisconsin.

2 Editors Note. The trees for the Massachusetts planting were exceptionally poor, causing tree loss the year of planting, poor growth of surviving trees and lack of fruitfulness. Other interstem trees were planted on this site in 1979, and no tree loss has been experienced and growth is vigorous.

The data from the multi-state plantings, summarized by Ferree after the first 5-years of study showed that tree losses occurred at all sites except in Illinois and Iowa. The highest tree losses were experienced in Massachusetts and Wisconsin. The losses were attributed to poor tree quality. Trees on the Kentucky site experienced severe frost heaving in 1978. Regardless of rootstock, the growth on the trees was weak in 1979 and they were removed in 1980.

Tree size based on cross-sectional area was quite variable among the planting sites. In general, the trees in Illinois, Iowa, Kansas, Missouri and Ohio were larger than those in Massachusetts, Michigan, Wisconsin and Indiana. Those on the Indiana site were smallest.

Compilation of the data from the 9 sites indicated that the trees on MM111 were 15-20% smaller than those on Antonovka seedling or Ottawa II. The trunk circumference and branch spread of the Empire trees were larger than those of Sturdeespur on comparable rootstocks.

The trees were planted with the stempiece 2 inches above the soil line and the development of root suckers had been of concern on all sites. Trees on Ottawa II have tended to produce fewer root suckers than Antonovka or MM111, particularly in Kansas, Massachusetts and Ohio. Trees in Missouri and Ohio produced nearly twice as many suckers as in other states. Of particular interest in areas where fireblight is of major concern is the fact that several states observed fireblight strikes on Antonovka root suckers in 1981.

The trees produced their first crop in 1979 and the Empire trees showed the tendency to bear earlier than Sturdeespur Delicious. However, adequate data are yet not available to evaluate the yield efficiency of the various scion/rootstock combinations.

Ferree summarized the preliminary findings from the multistate interstem planting by stating "...it is clear that significant differences exist in root suckering potential of vigorous rootstocks used as root systems for interstem trees. An association also appears to exist between increased suckering and vigorous scion growth. We have also confirmed that producing interstem trees through double grafting should be avoided because of poor tree quality and general lack of vigor is considered as a major factor contributing to poor early tree performance in several of the test sites".

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Future of Tree Fruit IPM in Massachusetts

W.M. Coli[1], R.J. Prokopy[2] and W.J. Manning[3]

As we have stated previously, 1982 was the final year of the Apple IPM pilot program. We anticipate the future of tree fruit IPM in the state to be two fold:

1) Continued extension involvement - Federal funds for IPM will continue to come to the state on a formula basis at least through FY 1983. While no one can accurately predict the level of funding or the security of such funds given the cost-cutting emphasis of the present administration, IPM monies are a high priority item in USDA's budget and appear to be reasonably safe from the "budget axe."

   The 1983 growing season will see the implementation of IPM programs in cranberries, forage crops, and potatoes, thereby substantially reducing the amount of USDA money available for continuing an apple IPM program.

   Nonetheless, the Extension administration has accepted a proposal to continue a part-time IPM Specialist position at the University for the purpose of maintaining a scaled-down apple program effort. A major factor in this decision was the willingness of many large and small growers throughout the state to pledge their financial support of such an effort. As of this writing, $3,500 has been pledged by growers, for which we extend our thanks.

   Mr. William Coli will remain in his present capacity of Tree Fruit IPM Specialist, with additional responsibilities in the area of peach and pear pest management and as overall coordinator of the multi-crop Massachusetts IPM program. Mr. Coli will serve as a resource person for pest management related questions. In addition, he will continue to take principal responsibility for development of the twice-weekly insect and disease pest status messages based on his own scouting in commercial orchards at several locations as well as on reports from cooperating private scout/consultants, and regional fruit specialists. As in the past, apple scab spore maturity information will be provided by W.J. Manning, Dan Cooley and Chris Becker in the Department of Plant Pathology.

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[1]Extension Pest Management Specialist

[2]Extension Entomologist

[3]Extension Plant Pathologist

2) Private sector implementation - During the course of the apple pilot program, numerous growers have received IPM training or have assigned some member of their orchard staff to receive such training. In most cases, these individuals will be able, with some support from extension, to continue with an IPM approach on their own.

For other growers, there presently are 3 individuals offering private IPM scouting/consultant services in the region. These three, and a fourth person who recently announced similar plans, all received their initial IPM training with the Massachusetts apple IPM program and should provide growers with an excellent choice of available services.

The individuals we refer to and their addresses are:

Clarence Boston
242 Cayenne Street
West Springfield, MA

David Gordon
51 Pond View Drive
Amherst, MA 01002
(413) 523-5293

Glenn Morin/Dr. Robin Spitko
D.B.A. New England Fruit Consultants
P.O. Box J
Lake Pleasant, MA 01347
(413) 367-9578

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PUBLICATION AVAILABLE

The Northeast Regional Agricultural Engineering Service Publication - 4 entitled "Trickle Irrigation in the Eastern United States" may be obtained by writing to the Cooperative Plan-Service, Agricultural Engineering Building, University of Massachusetts, Amherst, MA 01003. There is a $1.50 charge for the publication. Make checks payable to: Cooperative Extension Activity Fund.

Dr. Donald Elfving, Research Scientist, Simcoe, Ontario referred to the above publication during his talk on trickle irrigation of apple trees at the New England Fruit Meetings in January, 1983. Elfving stated that NRAES-4 is a valuable guide for tree fruit and small fruit growers interested in trickle irrigation. Information is presented on advantages and potential problems; plant-soil-water relationships; system components, specific crop recommendations; system planning; designing laterals and submains; preventing line clogging, and water application calculations.

SAMPLING SOIL FOR NEMATODES

Dr. Richard Rohde
Department of Plant Pathology
University of Massachusetts

The best time to take soil samples for counts of nematode populations is mid-May through early-July and in mid-September through October. Nematodes are distributed in clusters through the field, thus it is important to collect soil from several areas. For each 5000 sq. ft. area take 10 or more sub-samples. Samples should be taken at soil depths of 2-10 inches and can be collected with a trowel, spade or soil sampling tube. On sites sampled prior to planting, obtain the soil samples where you think the tree rows will be located. When sampling an established orchard, obtain the soil for nematode counts from the root zone of the fruit trees. The sample should also include small roots of the fruit trees since lesion nematodes, the most common orchard nematode in our area, is in the roots during part of its life cycle.

Mix the soil in a bucket and then put 1 quart of the mixed soil in a plastic container. Samples can be stored in a refrigerator for several months but should not be exposed to high temperatures such as could occur in a plastic bag lying in direct sunlight or in a car trunk on a hot day. Also, dried-out soil is useless.

The soil samples for nematode counts should be sent to your Regional Fruit Specialist, or directly to Dr. Richard Rohde, Department of Plant Pathology, Fernald Hall, University of Massachusetts, Amherst 01003.

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PRUNING PLUM TREES

James F. Anderson
Department of Plant and Soil Sciences

There has been an increased interest in the production of plums in Massachusetts, especially on the part of growers operating farm markets. Since the apple is the major tree fruit in Massachusetts, most research and extension activity has been devoted to that crop and little attention has been given to the plum.

The discussion that follows is offered as a brief guide to the training and pruning of plum trees.

Training Young Trees

There is a marked difference in the growth habit of plum trees depending on type and variety. Some are decidedly upright while others are distinctly spreading in growth habit. Regardless of growth habit, most are probably best trained as a central or modified central leader tree.

The plum tree should have 5 or 6 scaffold branches spaced about 6 inches apart and spirally around the leader. On upright growing trees, it would be advisable to spread the branches to improve the trees structure. Excessively long branches should be shortened, preferably by cutting it back to an outward growing lateral. Heading-back cuts may be used when necessary to shorten and/or stiffen the scaffold branches.

Pruning Bearing Trees

Flower buds are formed laterally on current seasons growth and on the extension growth of spurs. The flower buds are simple, containing 1 to 3 flowers, but no leaves. The terminal bud of both shoots and spurs are leaf buds. European varieties fruit more heavily from spurs; Japanese types fruit heavily from both shoots and spurs. The shoot of a Japanese plum is similar to the peach in flower bud development.

Annual pruning helps to maintain a supply of new wood on which the flower buds can form. For the Japanese varieties, an annual shoot growth of 10 to 20 inches for young trees and 10 to 12 inches for older bearing trees is desired. European varieties should average 9 to 18 inches of annual shoot growth for young trees and 6 to 10 inches for older bearing trees. After a plum tree begins bearing, an annual thinning out of watersprouts and branches growing towards the center of the tree will constitute the major part of the pruning operation. The tree should be kept open to allow for good light penetration, air movement and spray coverage. Control of brown rot will be much easier if the tree is prevented from becoming too dense. Keeping the trees open will also maintain fruiting throughout the lower and inner portions of the tree. Some heading-back cuts may be necessary to shorten and/or stiffen the scaffold branches.

Removal of Black Knots

The plum is particularly susceptible to the fungus disease, black knot, which may be identified in the dormant season by black swellings or cankers on the branches. The principal control for this disease is to prune off and burn these knots. Remove small branches entirely. On larger branches, cut to an outward growing lateral. In any case, the cut should be made at least six inches below any evidence of the disease and all diseased wood should be removed from the orchard. This may necessitate more drastic pruning than would be recommended ordinarily.

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A VISUAL MONITORING TRAP FOR THE APPLE BLOTCH LEAFMINER[1]

Thomas Green[2], William Coli[3], Geoffrey Hubbell[4],
and Ronald Prokopy[5]
Department of Entomology

For the past 3 years, we have attempted to develop a visual monitoring trap for the apple blotch leafminer, Phyllonorycter crataegella. This insect, an organophosphate-resistant pest of apple foliage, is implicated in premature leaf and fruit drop and reduction in fruit set the following season. A pheromone trap is available for a related species, P. blancardella (spotted tentiform leafminer), but this pheromone is not effective in attracting P. crataegella, the predominant species in Massachusetts commercial orchards. We theorized that if a visual monitoring trap were available for P. crataegella, the need for a pre-bloom insecticide application against the overwintering generation adults might be determined from trap capture levels. Here, we present a brief summary of our research on the development and utility of a visual trap for P. crataegella.

Results

In 6 experiments, we determined the number of P. crataegella captured on sticky-coated (=Tangle-Trap[R]) traps painted with commercially available paints of various colors. The consistently highest captures in these experiments were on traps painted with Sherwin-Williams Tartar Red Dark[R] Enamel. Results of 2 of the experiments are presented in Table 1.

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1 We wish to express our appreciation to the following IPM field scouts for assistance with data collection: David Gordon, Kathleen Leahy, Joseph Parella, Douglas Roberts, and Roy Zahnleuter.

2 Extension Technician

3 Extension Pest Management Specialist

4 Research Assistant

5 Extension Entomologist

Table 1. Comparison of P. crataegella captures on 20 x 30 centimeter* (cm) horizontal (sticky-side-up) traps of various colors, positioned 1.5 meters** (m) above ground in the interior part of the tree canopy.

Experiment 1		Experiment 2	
Color of trap	Average number P. crataegella per trap	Color of trap	Average number P. crataegella per trap
Red	610	Red	1580
Green	548	Green	1267
Orange	500	Light Gray	1200
Gray	486	Black	1141
Foil	470	White	1126
White	467	Medium Gray	1113
Yellow	447	Dark Gray	976
Blue	411		
Clear	368		
Black	356		

* One centimeter = 2.54 inches

** One meter = 39.37 inches

The next step in the development and utilization of a visual trap was to evaluate the influence of the orientation of the trap on its effectiveness in capturing P. crataegella. The orientations tested were: (1) horizontal, sticky-side-up; (2) horizontal, sticky-side-down; (3) vertical; (4) 90 degree (tent-shaped), sticky-side-up; and (5) 90 degree (V-shaped), sticky-side down. Captures were higher on the horizontal, sticky-side-up traps than on those with the vertical or sticky-side-down orientations (Table 2).

Table 2. Comparison of P. crataegella captures on 20 x 30 cm red traps of various orientations, positioned 1.5 m above ground in the interior part of the tree canopy.

Orientation of trap	Average number P. crataegella per trap
Horizontal, sticky-side-up	131
90^{o} (tent-shaped), sticky-side-up	85
Vertical	12
90^{o} (V-shaped), sticky-side-down	10
Horizontal, sticky-side-down	5

We then compared P. crataegella captures on horizontal (sticky-side-up) red traps placed at various positions within the tree. This experiment was conducted in a block of semi-dwarf trees, ca. 5 m in height and 4.5 m in diameter. The in-tree positionings were: (1) 0.5 m above ground, halfway between the trunk and dripline; (2) 1.5 m above ground, halfway between the trunk and dripline; (3) 0.5 m below the tree top, halfway between the trunk and outermost foliage; (4) 1.5 m above ground, 0.5 m out from the tree trunk; and (5) 1.5 m above ground, 0.5 m in from the dripline. Traps placed 0.5 m from the trunk and 1.5 m above the ground (position 4) captured the most leafminers (Table 3).

Table 3. Comparison of P. crataegella captures on 20 x 30 cm horizontal red traps (sticky-side-up) at various positions within the tree.

Position of trap	Average number P. crataegella per trap
1.5 m height, 0.5 m out from trunk	161
1.5 m height, halfway between dripline and trunk	125
0.5 m height, halfway between dripline and trunk	96
1.5 m height, 0.5 m in from dripline	87
0.5 m from tree top, halfway between trunk and outermost foliage	11

In the spring of 1982, the red horizontal (sticky-side-up) traps were used in 21 IPM orchard blocks in Massachusetts. The traps were placed 1.5 m above the ground and ca. halfway between the tree trunk and dripline. Each week, as part of the regular field scouting routine, leafminer adults were counted and removed from the traps, and foliage was sampled to determine the average number of mines per leaf. Cumulative average trop captures were highly positively correlated with the number of mines per leaf in the 21 blocks sampled. Figure 1 represents a regression of mines per leaf on trap captures through 2 weeks after petal fall and illustrates a prediction of 0.13 mines per leaf (the first generation Economic Injury Level for stressed trees) at a cumulative average of 12 P. crataegella per trap.

Conclusions

Sticky-coated, 20 x 30 centimeter red traps, hung at chest height inside the canopy of apple trees, were effective for monitoring *P. crataegella* adults. We recommend that the traps be used at a rate of 1 per 0.8-1.2 hectares*, and that a pesticide treatment (oxamyl or fenvalerate) against the adults be applied before any white shows on the flower petals if cumulative pre-bloom captures (from silver-tip through late pink) reach or exceed 6 adults per trap. This tentative action threshold is conservative, allowing for both the reproductive potential of *P. crataegella* and for tree stress due to drought, calcium chloride burn, and/or mite injury. Additional work is planned for the 1983 season to further validate this threshold and to develop an additional action threshold for unstressed trees. This trap should be valuable in reducing the need to wait until first generation mines appear before a leafminer spray decision can be accurately made.

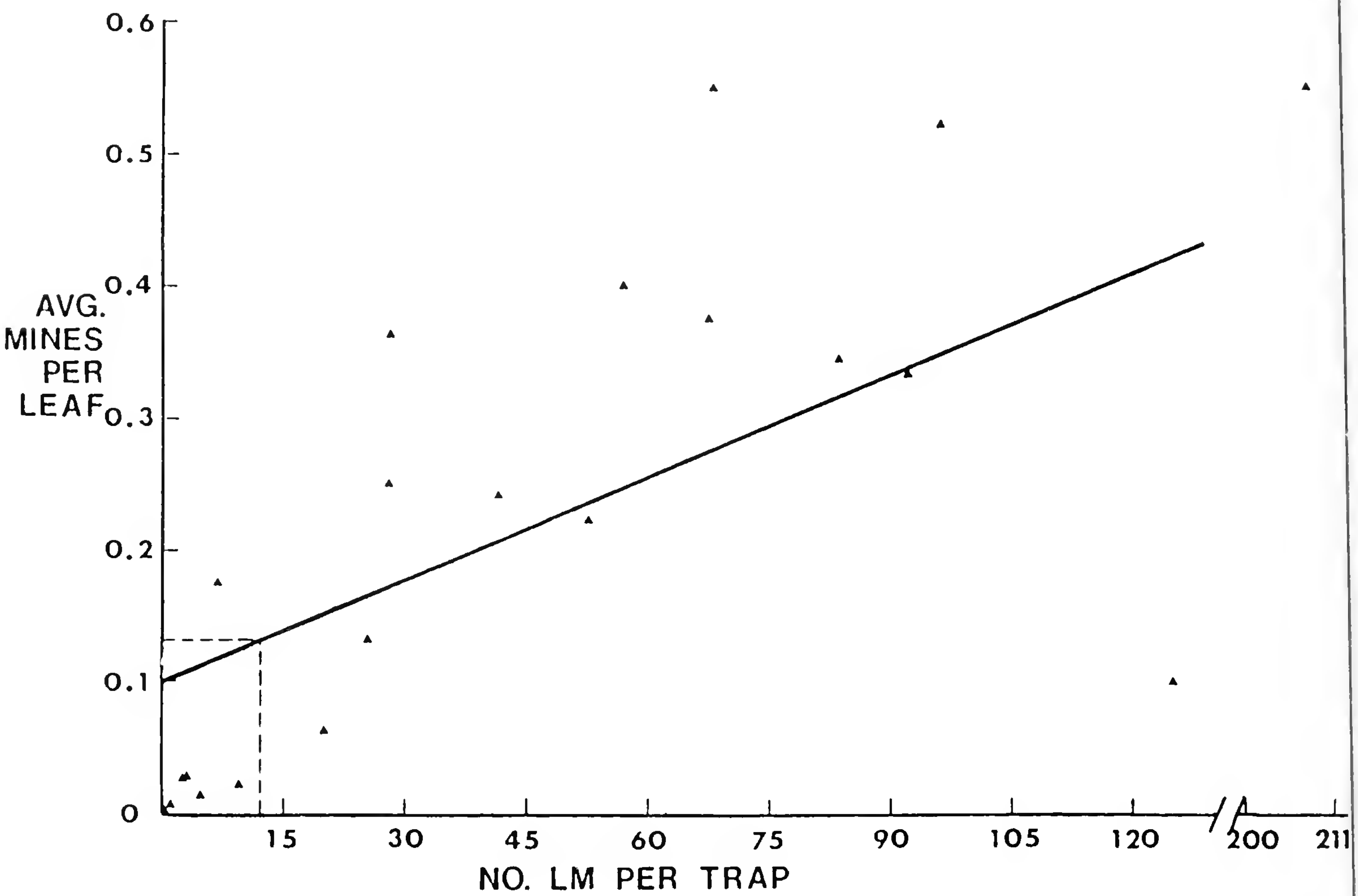

Figure 1. Regression of first generation mines per leaf on visual trap captures in 21 commercial orchard blocks.

*One hectare = 2.471 acres

ARE HIGH DENSITY STRAWBERRIES ON RIDGES FOR YOU?

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High density systems with up to 58,000 plants per acre planted three inches apart on ridges 8 to 12 inches high and 3 feet apart are presently receiving a great deal of attention. Yields of up to 45,000 quarts per acre are reported; and many growers are wondering if they should adopt this system. Here are a few things to consider in arriving at a decision.

Is your soil suited to the ridge system? A fairly level, well-drained site is a necessity. Breaking up the soil to a depth of 16 to 18 inches with a subsoiler, followed by deep plowing, 10 to 12 inches deep, is practiced by growers who use the system successfully. Specialized, expensive equipment is needed for leveling the soil and constructing the ridges.

Soil fumigation is recommended for any system of growing strawberries. It is essential to prevent losses from black root rot and other soil-borne diseases in order to obtain the high yields possible with this system. Overhead irrigation for frost protection and to maintain ample soil moisture is also recommended for all growers, but is more essential for the ridge system since the ridges dry out much faster than level beds. More frequent nitrogen fertilization is necessary with the ridge system because of the leaching of nitrogen resulting from irrigating more often. And greater attention to insect, disease and weed control, and winter protection must be given in order to obtain high yields. Maintaining the winter mulch is more difficult because of the sloping sides of the ridges.

Extremely high yields are possible with the high density ridge system of growing strawberries for large scale, top notch, specialist strawberry growers with the proper site and soil conditions. For the average grower operating on a small scale, growing a variety of crops on hilly, rocky, New England soils, such yields are not very likely. Most growers are probably better off with the more conventional systems of matted row or some sort of spaced runner system on 4 to 6 inch high raised beds.

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SUGGESTIONS FOR USE OF CALCIUM SPRAYS IN 1983

Mack Drake and William J. Bramlage
Department of Plant and Soil Sciences

Calcium chloride ($CaCl_2$) foliar sprays are recommended in Massachusetts for all apple growers to increase the flesh calcium (Ca) content. Higher flesh Ca can markedly reduce bitter pit, cork spot and fruit breakdown during storage.

Apply foliar sprays of $CaCl_2$, beginning 3 weeks after petal fall and repeat at 2 week intervals totaling 6 to 8 applications. Apply 6 pounds $CaCl_2$ per acre per spray until mid-July. After mid-July apply 8-10 pounds per acre per spray. Continue foliar $CaCl_2$ until fruit are ready for harvest. Use a technical grade of $CaCl_2$ such as Allied Chemical Dow Flake, 77-80% $CaCl_2$. Other brands may be equally suitable.

Experience in Massachusetts has shown that $CaCl_2$ can be combined with pesticide sprays. However, some growers have observed that the combination of Captan or Guthion (azinphos methyl) 50 WP and $CaCl_2$ may increase foliar burn. DO NOT MIX $CaCl_2$ AND SOLUBOR SPRAYS! ALWAYS DISSOLVE $CaCl_2$ IN A PAIL OF WATER and add this last, when the spray tank is nearly full, to insure that the $CaCl_2$ is completely dissolved before spraying begins.

Foliar $CaCl_2$ sprays may be applied as dilute (300 gallons/acre) or up to 10X concentration (30 gallons/acre). In our research, apple flesh Ca was increased more by concentrated than by dilute sprays.

$CaCl_2$ sprays can cause burn of leaf margins. Foliar injury has been more serious on McIntosh than on Delicious or Cortland. Apple leaves are less susceptible to $CaCl_2$ burn after mid-July. McIntosh growing on M7 may be more susceptible to foliar burn than those on standard rootstock. Weak or injured trees may be more susceptible to $CaCl_2$ burn than healthy trees. To reduce the chance of leaf burn, DO NOT REPEAT A FOLIAR $CaCl_2$ SPRAY UNLESS ONE-HALF TO ONE INCH OF RAIN HAS FALLEN SINCE THE LAST APPLICATION.

In 1982, 3 different materials were compared as suppliers of foliar Ca at the University of Massachusetts Horticultural Research Center. One was commercial $CaCl_2$; the second was a proprietary formulation of $CaCl_2$; and the third was a chelated Ca compound. Rate of application was 86 grams Ca per tree in a total of 8 applications. Fruit Ca was 115, 165, 155 and 158 parts per million respectively, for control, $CaCl_2$, Formulation 1 and Formulation 2; the amount of the breakdown was 33, 7, 7 and 11 percent. respectively, for fruit air stored at 32^oF for 5 months and then held at 74^oF for 7 days. These results agree with those of previous years, and show the positive effect of increased fruit Ca in reducing storage breakdown of Massachusetts-grown McIntosh apples. We do not recommend long term storage of McIntosh apples with less than 150 ppm flesh Ca.

Questions have been asked about possible accumulations of chloride (Cl) in the soil. Chloride salts are highly soluble. Research in the Netherlands showed that there was no annual build-up or accumulation of chloride where annual rainfall exceeded 30 inches per year. Rainfall in all areas of Massachusetts exceeds 30 inches per year.

Annual application of muriate of potash (potassium chloride) for corn silage, vegetable crops and alfalfa in Massachusetts usually exceeds 200 pounds per acre, supplying about 100 pounds of chloride per acre. Only 35 pounds of chloride are applied per acre when our recommendations for foliar $CaCl_2$ sprays are followed. Also, it is important to note that this 35 pounds of chloride is applied in 6 to 8 increments of 4 to 6 pounds per acre foliar application as compared to the 100 pounds of chloride in one application for corn, vegetables and alfalfa.

WARNING: The initial pH of commercial $CaCl_2$ in water is 10.3, since small amounts of free CaO form Ca(OH) in water. There is evidence that the high pH may reduce effectiveness of some pesticides. It is therefore recommended that 2 quarts of 5% vinegar be added per 100 pounds of $CaCl_2$ to neutralize the excess (OH) and bring the reaction of the spray solution to about pH 6.0.

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AN UPDATE ON CALYX-END ROT, AND REPORT OF AN APPLE LEAF SPOT CAUSED BY THE FUNGUS *SCLEROTINIA SCLEROTIORUM*

Christopher M. Becker[1], Daniel R. Cooley[2] and William J. Manning[3]
Department of Plant Pathology

Calyx-end rot of apple, caused by the fungus *Sclerotinia sclerotiorum*, has been observed in Massachusetts orchards in recent years. A report on fruit symptoms and losses in 1980 was published in FRUIT NOTES 46(1):1-3. During the 1982 growing season, calyx-end rot was again prevalent in many Massachusetts orchards. *S. sclerotiorum* was also found to cause a previously unreported leaf spot.

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1 Research Assistant
2 Extension Technician
3 Professor of Plant Pathology

ADDENDUM

After this issue of FRUIT NOTES had gone to press, it came to our attention that the recommendations for use of $CaCl_2$ appear to be in conflict with statements in the "Annual March Message to Massachusetts Fruit Growers (1983)", issued by Ronald Prokopy, William Coli and Thomas Green of the Department of Entomology. To avoid confusion from "mixed messages", the following additional comments are presented:

Beginning about 1975, in Massachusetts we recommended separating the applications of $CaCl_2$ and pesticides. However, for the past 5 years many Massachusetts growers have combined $CaCl_2$ with pesticide sprays without observed reduction in effectiveness of pesticides. Nevertheless, as we warn on page 17, addition of $CaCl_2$ can significantly raise the pH of the spray solution, which theoretically can reduce the effectiveness of the pesticides.

This past year, Dr. George Greene conducted experiments at Biglerville, PA which showed that while $CaCl_2$ raised the pH of water it caused no measurable increase in disease or insect damage to apples when combined with the pesticides he was using. It should be noted, however, that some other researchers have reported evidence of reduced effectiveness of pesticides at these high pH's.

In 1982 a number of Massachusetts growers added vinegar to lower the solution to about pH 6, as recommended on page 17, to their mixture of $CaCl_2$ and pesticides. There was no dissatisfaction with results.

Nevertheless, since some researchers and some states have issued warnings of possible ineffectiveness of vinegar as a remedy, the following additional steps can be taken if a grower feels that they are necessary.

1. Use $CaCl_2$ of a higher purity grade. Technical grade (77-80%) $CaCl_2$ will affect pH somewhat more than high purity grade materials. However, the higher purity grade is much more expensive and less available.

2. Apply $CaCl_2$ sprays separately from pesticides.

3. Use a commercial buffer rather than vinegar to lower the pH. Some concerns have been published that acetic acid, the chief component of vinegar, may not be stable over long periods in the spray mixture. However, it should also be noted that some commercial buffers may cause Ca to precipitate from solution, thereby reducing the value of the $CaCl_2$ sprays.

It should be recognized that we are not recommending the above steps. We are alerting growers to concerns that have been raised elsewhere, and to steps that can be taken if they feel that these concerns warrant extra precautions.

William J. Bramlage, William Coli and Mack Drake

In mid-June, 2-8% of the McIntosh fruit observed in 8 of 10 orchards visited by disease management scouts, were developing calyx-end rots (Fig. 1). Delicious, Cortland, and Macoun also had end rots, but at lower rates. Most infected fruits ripened prematurely, or dropped by mid-August. Despite the premature drop, disease management scouts recorded an average of 1.00% infected fruit in 10 orchards during a harvest survey (FRUIT NOTES 48(1):11).

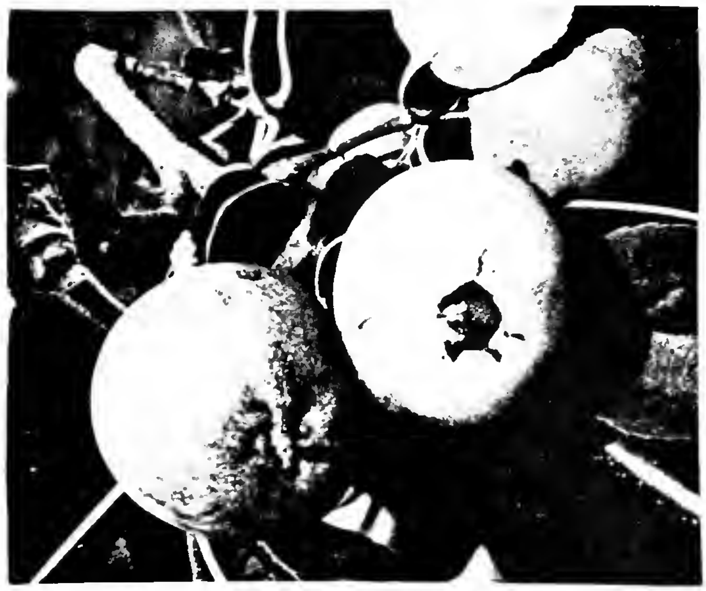

Fig. 1. Developing McIntosh fruit with calyx-end rot.

All orchards with calyx-end rotted fruit in mid-June developed a previously undescribed leaf spot. Spots were 1-3 cm in diameter, light brown, and visible on both sides of the leaf (Fig. 2). These lesions were not bound by veins. Some lesions were noticed next to non-pollinated, wilted blossoms, and several lesions had developed following contact with young end rotted-fruit. Numerous other spots contained an anther[1] in the center of the lesion. Infected leaves seldom had more than one spot per leaf, with lesions typically larger than frog-eye leaf spot (caused by Physalospora obtusa)or "captan spot". In contrast to typical frog-eye leaf spot, the Sclerotinia lesions were an even than without concentric darkened areas. Most infected leaves turned yellow

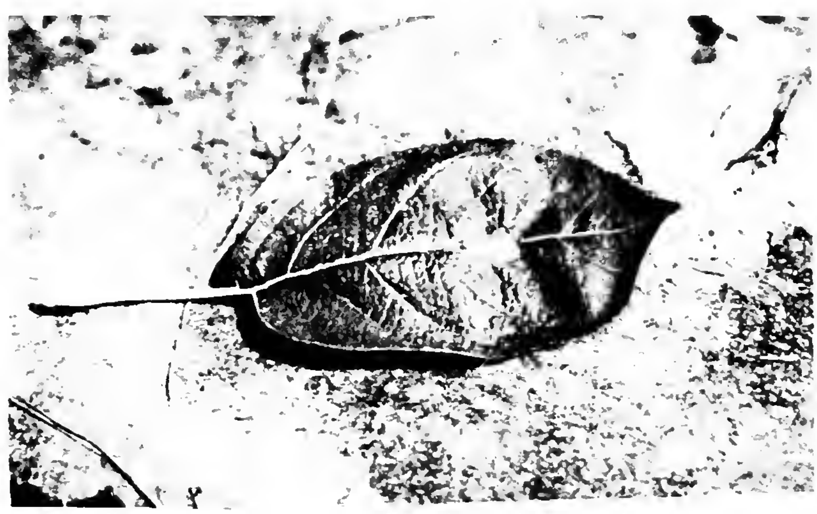

Fig. 2. McIntosh leaf with Sclerotinia leaf spot.

1 from an apple blossom

within several weeks and dropped by mid-July to mid-August.

Isolations from the center or edge of these foliar infections onto sterile petri plates of potato carrot agar consistently yielded the fungus Sclerotinia sclerotiorum. This was the first reported isolation of the fungus from apple foliage. Controlled laboratory studies were conducted to determine the conditions necessary for foliar infection by S. sclerotiorum. Results showed that not only would the fungus infect wounded leaves, but that unwounded leaves developed lesions providing that continuous moisture was present.

The life cycle of Sclerotinia sclerotiorum is well known on beans, lettuce and many other vegetable crops. However, to date no successful studies have been done on how the fungus infects apples. It is presently believed that spores, released during spring rains, infect blossoms. It is further thought that prolonged wet weather encourages the fungus to continue growth into developing fruit with an end rot resulting. It is likely that foliage infections occurred directly from spores, or following contact with young fruit infected with S. sclerotiorum. It may be possible that fungal spores are present on anthers or pollen grains, thus, explaining many of the foliar infections described above.

At this time, the fungus does not seem to present an economic threat to apple foliage. However, end rots have been increasing during the past 3 years (FRUIT NOTES 48(1):10-16). Current apple scab fungicide programs may not provide adequate control of calyx-end rots and no fungicides are currently registered for the disease. When prolonged infection periods exist between pink and first cover, applications of captan and benomyl may be helpful.

In attempts to gain more information about the disease on apples, the Department of Plant Pathology hopes to monitor development of Sclerotinia sclerotiorum under controlled conditions in the field next season.

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USE OF PROMALIN TO INCREASE BRANCHING OF YOUNG TREES

Duane W. Greene
Department of Plant and Soil Sciences

Abbott Laboratories has been granted final label registration for Promalin to improve branching on apple trees. There are several varieties and strains such as Macoun, Empire, Macspur and other spur-types that branch sparsely, which limits their productive capacity. Promalin* may increase lateral bud break and total shoot growth per tree and improve branch angles on non-bearing trees. Promalin may also reduce the potential return bloom for the season following application. Therefore, Promalin is primarily recommended for non-bearing trees to enhance early scaffold branch growth and development and to provide a better tree framework.

Application Methods and Rates Suggested on Label

Foliar sprays. Use one-half (0.50) to one (1) pint of Promalin per 5 gallons of spray solution to attain a concentration of 250 ppm of Promalin in the final spray solution. Wetting, spray coverage and subsequent absorption can be improved by the addition of a wetting agent such as Buffer-X, Tween 20, or Glyodin. The wetting agent should be added to the spray tank before Promalin. The final spray should not be alkaline. If you have reason to suspect that your water may be alkaline, then it may be advisable to add a buffer such as Sorba Spray, vinegar or a buffered surfactant such as Buffer-X.

Latex applications. Use one-third (0.33) pint of Promalin per one (1) pint of interior flat latex paint to attain a concentration of 7500 ppm. Mix thoroughly. A buffered wetting agent such as Buffer-X or Tween-20 should be added to the tank mix at a rate of 0.5 to 1.0% prior to the addition of the Promalin. This practice will improve the solubility of Promalin in the latex paint and will also improve wetting and absorption through the waxy layers on the bark surfaces.

Research in Massachusetts showed that sometimes too many branches are stimulated following a Promalin application. This is especially true when 500 ppm Promalin is used on very responsive varieties, such as Macspur and Empire, at a time when growth is rapid and environmental conditions favor foliar penetration. This situation can be overcome by: 1) using lower rates of Promalin; 2) using the high rate of Promalin, then returning about 3-4 weeks after application and removing the unwanted developing shoots.

Method of Application Suggested on Label

Foliar sprays. Uniformly apply the Promalin spray mixture with a pressurized hand sprayer, hand gun attachment to an airblast sprayer, or an airblast sprayer to thoroughly wet the bark and foliage surfaces. Do not apply to point of runoff. It is suggested that

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*Trade name

approximately five to ten (5-10) gallons of spray mixture will treat an acre of non-bearing (1-5 year old) trees on a 12 x 12 spacing (310 trees). Spray volume should be adjusted to tree size and density.

On small trees we have found a small (2-3 gal.) hand sprayer very useful. Branching is stimulated only on portions of the tree that are sprayed. The spray can be directed only to the areas of the tree where branching is desired.

Latex applications. Uniformly apply the Promalin-latex mixture with a brush or sponge to thoroughly cover the bark surface. Apply only to one-year-old dormant branches.

Under Massachusetts conditions we believe that foliar sprays should be the first choice of application. Foliar sprays are easier to apply and may be more effective. The exception to this might be during the first year the trees are in the ground.

Timing of Application

Foliar sprays. Application of Promalin should be made during the period when there are from one (1) to three (3) inches of new terminal shoot growth. This period generally coincides with a timing of one (1) to two (2) weeks after full bloom. There are a few varieties such as Spur Rome that can be stimulated to branch beyond this period. Nursery stock should be treated after trees attain a terminal height at which the first lateral scaffold branches are desired (i.e., greater than 30 cm).

Latex applications. Since this treatment is intended primarily for stimulating lateral growth from vegetative buds on one-year-old dormant wood, applicaton of Promalin should be made in late April and early May depending on season and locality. A useful guide is to make the application just as the terminal buds on shoots or spurs are beginning to break. Applications after lateral buds have broken may cause some injury to the tender shoot tips and fail to promote continued shoot growth from that point.

Application Considerations

Since Promalin is a plant growth regulator that must be absorbed by the plant to be effective, best performance can be expected with good absorption conditions. Furthermore, not all varieties respond equally well to Promalin; Spur-type McIntosh and Empire respond very well, Delicious is intermediate and Northern Spy and Paulared are almost unresponsive.

Do not treat trees of low vigor. Results will always be disappointing. Promalin will not stimulate growth or branching on low-vigor trees or trees suffering from drought, winter injury or low fertility. Promalin is mot effective when used on healthy, vigorously growing trees.

Promalin at the rates recommended can thin the crop the year of application and prevent flower bud formation for the following year. Therefore, whole tree treatments should be limited to young non-bearing trees. However, a localized application on one-year-old wood in either latex paint or by a directed spray may be done without reducing flower bud formation on spurs. Localized applications would be useful to stimulate branches for a 2nd or 3rd whorl of scaffold limbs or to stimulate branching on portions of a limb.

Promalin is not effective in stimulating branching on limbs with blind wood. Most branching that occurs following a Promalin application results from stimulation of growth of healthy spurs having a large leaf area or from large buds on 1-year-old-wood.

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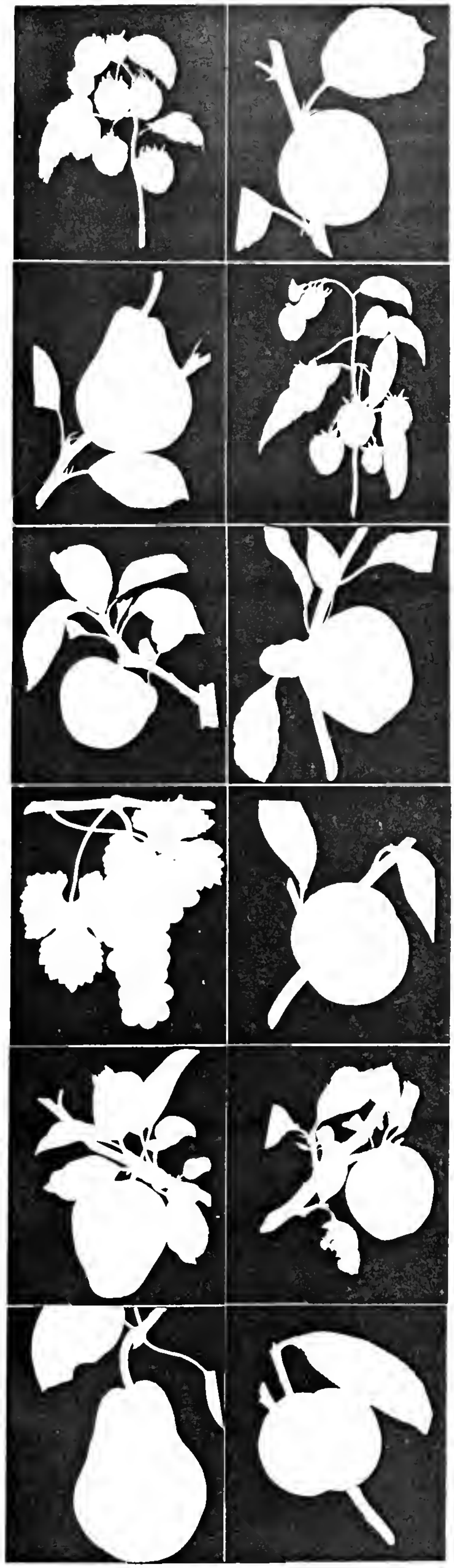

PREPARED BY
DEPARTMENT OF PLANT AND SOIL SCIENCES

COOPERATIVE EXTENSION SERVICE, UNIVERSITY OF MASSACHUSETTS, UNITED STATES DEPARTMENT OF AGRICULTURE AND COUNTY EXTENSION SERVICES COOPERATING.

EDITORS
W. J. LORD AND W. J. BRAMLAGE

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LEAF ANALYSIS SERVICE AND STANDARDS FOR NUTRIENT LEVELS

William J. Lord
Department of Plant and Soil Sciences

Leaf analysis is an effective guide to more economical and efficient fertilizer practices; and as an aid in diagnosing specific problems in individual orchards. The accuracy of diagnosis depends upon accuracy of sample collection. Thus, it is important that the procedures described below are followed.

The leaves are analyzed for nitrogen, potassium, phosphorous, calcium, magnesium, manganese, iron, copper, boron, zinc and sodium. Nutrient sprays of calcium, manganese, zinc, copper, and boron leave residues which make analyses for these micronutrients meainingless without carefully washing the leaves prior to wilting, to remove the residue. Washing procedures to remove this residue require specific laboratory procedures which cannot be provided by or compensated for by this service. Therefore, leaves from trees sprayed with these micronutrients cannot be used for micronutrient analyses.

Sampling Procedure

1. Sampling Individual Trees to Diagnose Problem. (Leaves from each tree constitute the sample.)

   Select a minimum of 3 trees of the same variety in a block showing the condition in question. Then as an aid in diagnosing, select a minimum of 2 trees of this variety not showing the condition in question. Now sample each tree separately--- the leaves from each tree will constitute a sample. A leaf sample consists of: apple trees (50 leaves per tree); peach tree (80 leaves per tree).

   Analysis of leaves from individual trees in a block is more expensive, but is more meaningful than a composite sample from several trees.

2. Composite Sample to Diagnose Problem. (Leaves from several trees are combined into one sample).

   Obtain 10 leaves from each of 5 or more trees of the same variety in a block showing the condition in question and put them together as one sample. Then, obtain a similar sample from trees not showing the condition in question.

3. Composite Sample to Determine General Nutritional Level. (When no problem is apparent and the knowledge of the general nutritional level is desired.)

Select 10 trees of the same variety which represent, as nearly as possible, the general vigor and crop load of the block being sampled. Collect 10 leaves from each tree to make up a single sample.

Sampling Instructions

1. Collect all leaf samples between July 15 and August 15. Sample when leaves are dry.

2. The leaf samples should be restricted to the healthy leaves on trees suspected of being deficient of some nutrients. All leaves should be free from insect, disease, or mechanical injury. Be sure the trees are free of mouse injury.

3. Select all leaves from the middle of current terminal or lateral shoots. Do not select spur leaves. Not more than two (2) leaves should be taken from any one shoot. Sample around the periphery of the tree at a mean height of five feet from the ground.

4. Remove the leaves in such a way that the stem of the leaf is attached.

5. Label or make a map so that the trees sampled can be located at any time in the future. This will enable you to sample the same tree in tow or three years to determine any change in nutritional status as a result of a fertilizer program adjustment.

6. Place the leaves in bag purchased from the *SOIL AND PLANT TESTING LABORATORY, 240 BEAVER STREET, WALTHAM, MA 02254.*

Standards For Nutrient Levels

On the next 2 pages are our leaf analysis standards for nutrient levels in: (1) young, non-bearing apple trees; (2) bearing apple trees; and (3) peach trees. When using these standards as a guide for fertilization, remember that the crop size on the trees at time of sampling influences greatly the nutrient level of the leaves. For example, leaves taken from an apple tree with a large crop may be 0.2 to 0.3% higher in N than when the same tree has a light crop. The factors affecting nutrient content of the foliage and fruits of apple trees were discussed in the winter 1982 issue of FRUIT NOTES (Vol. 48).

Table 1. Leaf analysis standards for nutrient levels in young, non-bearing apple trees.

Element	Shortage[1] (Below)	Optimum[2] (Within)	Excess[3] (More than)
Nitrogen (N)	2.00%	2.00-2.50%	2.50%
Potassium (K)	1.00%	1.20-1.50%	1.50%
Calcium (Ca)	1.00%	1.25-1.80%	?
Magnesium (Mg)	0.20%	0.25-0.40%	0.50%
Manganese (Mn)	20 ppm	25-75 ppm	75 ppm
Boron (B)[4]	25 ppm	35-50 ppm	80 ppm
Copper (Cu)	4 ppm	6-10 ppm	10 ppm
Zinc (Zn)	15 ppm	25-50 ppm	50 ppm

[1] Shortage: Corrective measures needed.

[2] Optimum: Applications should be continued as present rate or increased to tree age.

[3] Excess: Amount applied should be decreased or eliminated.

[4] Don't be concerned about low B levels until trees begin to fruit. Young trees, particularly those on weak size-control rootstocks, are easily injured by B.

Table 2. Standards for nutrient levels in leaves for bearing apple trees.

Element	Shortage[1] (Below)	Optimum[2] (Within)	Excess[3] (More than)
Nitrogen (N)[4]	1.70%	1.80-2.00%	2.20%
Potassium (K)	1.00%	1.20-1.50%	1.50%
Calcium (Ca)	1.00%	1.25-1.80%	?
Magnesium (Mg)	0.20%	0.25-0.40%	0.50%
Manganese (Mn)	20 ppm	25-75 ppm	75 ppm
Boron (B)	25 ppm	35-50 ppm	80 ppm
Copper (Cu)	4 ppm	6-10 ppm	10 ppm
Zinc (Zn)	15 ppm	25-60 ppm	50 ppm

[1] Shortage: Corrective measures needed.

[2] Optimum: Applications should be continued at present rate or adjusted according to anticipated crop size.

[3] Excess: Amount applied should be decreased or eliminated.

[4] N levels of 2.0-2.50% for non-bearing trees and trees of firm-fleshed varieties (Empire, Spartan, Delicious, Idared, etc.) are satisfactory. On Golden Delicious 1.70-1.80% is best.

Table 3. Standards for nutrient levels in peach leaves[1].

Element	Shortage[2] (Less than)	Optimum[3] (Within)	Excess[4] (More than)
Nitrogen (N)	3.00%	3.00-3.50%	3.70%
Potassium (K)	1.25%	1.50-2.50%	2.50%
Calcium (Ca)	1.35%	1.35-1.50%	?
Magnesium (Mg)	0.25%	0.35-0.50%	0.50%
Boron (B)[5]			
Copper (Cu)	5 ppm	7-10 ppm	10 ppm
Manganese (Mn)	25 ppm	90-110 ppm	110 ppm
Zinc (Zn)	15 ppm	25-50 ppm	50 ppm

[1] Young trees should make about 18 inches of new terminal growth annually; 12-15 inches are sufficient for mature trees.

[2] Shortage: Corrective measures needed.

[3] Optimum: Applications should be continued at present rate of adjusted according to anticipated crop size.

[4] Excess: Amount applied should be decreased or eliminated.

[5] Peach trees are very sensitive to excessive B. According to Ernest Christ, former Extension Specialist of Pomology at Rutgers University in New Jersey fertilizer with 5 pounds of borax per ton is satisfactory for peaches. No additional B is ever needed or added.

GYPSY MOTH AS A PEST OF HIGHBUSH BLUEBERRY IN MASSACHUSETTS[1,2]

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Highbush blueberry, _Vaccinium corymbosum_ L., is one of many plant species occasionally used as food by the gypsy moth (GM). In most years, it escapes serious damage because GM larvae prefer to feed on deciduous trees such as oak, willow, poplar, apple, and certain types of birch. From 1979 to 1982, however, GM larvae were numerous enough to defoliate millions of acres of deciduous forest in the Northeast. Supplies of preferred foliage were exhausted in many locations, forcing partly developed larvae to seek non-preferred plants. Also, in the spring of each year, countless newly hatched larvae were blown from treetops within infested areas to previously uninfested sites.

As small fruits extension specialist, I wanted to learn what impact these unusual GM outbreaks have had on the Mass. highbush blueberry industry. At their annual meeting this past December, members of the Mass. Cultivated Blueberry Growers' Assoc. willingly filled out a questionnaire concerning their experiences with GM during the last 4 years. The following report summarizes and evaluates their responses.

The average highbush blueberry planting in southeastern Massachusetts occupies an area of 1.46 acres, ranging between ¼ and 4 acres. Plantings are rather uniformly distributed, with 4 being situated on or near Cape Cod, 5 in the New Bedford-Fall River area, 5 in the Franklin-Holliston area, and 8 in the Brockton-Plymouth area. The northwestern perimeter of the blueberry growing region seems to be formed by a line of 4 plantings extending from Dudley in the south to Carlisle in the north.

Of the growers who returned questionnaires, 37% reported having no problem with GM from 1979 through 1982. In most cases,

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[1]Many thanks are extended to the members of the Mass. Cultivated Blueberry Growers' Assoc., whose cooperative support made this evaluation possible.

[2]Mention of trade names does not constitute endorsement or recommendation for use.

their plantings were located on the Cape or along the southern coastal region. The remainder of growers experienced problems with GM in 1 or more years.

None of the plantings was infested in 1979, and only 2 plantings were infested in 1980, a year in which 5.1 million acres of forested land in the Northeast were defoliated by GM. However, in 1981, 71% of the blueberry plantings infested during a 4-year period experienced noticeable GM populations. The problem continued in 1982, when 6 of 17 infested plantings had sizable numbers of GM.

A common concern of growers is whether or not a planting infested with GM one season is likely to be infested the following season. Questionnaire responses do not provide a clear-cut answer. On one hand, 2 plantings infested with GM in 1980 were reinfested in 1981. On the other, only 1 of 12 plantings infested in 1981 was reinfested in 1982. These observations indicate that an answer should only be attempted for particular plantings after the following questions have been considered. Were areas around the planting treated with insecticides? Were surrounding woodlands defoliated by mid to late June or was a considerable amount of foliage left after GM feeding? Were GM moths observed in the woodlands and/or planting in August? Were egg masses observed in the woodlands or planting in the fall?

Another matter often pondered is whether or not the presence and composition of woodlands around plantings influences the likelihood of an infestation. Again, questionnaire responses do not enable a definite answer, but do provide a few clues. Regarding borders, responses showed that 15 plantings where GM was a problem had woodland on at least 1 side. Ten plantings not infested by GM likewise were bordered on at least 1 side. Contrary tc popular belief, the directional relationship of woodland to a planting had no apparent bearing on the likelihood of infestation. Interestingly, 2 plantings not bordered by woodland became infested with GM. It would seem, then, that woodland borders do less to affect the probability of an infestation than the presence or absence of GM in the general locale of the blueberry planting.

The composition of adjoining woodland does not seem to matter either, given that GM has accepted the tree species as food plants. In 15 of 17 infested plantings, woodlands consisted of deciduous species only or a mixture of deciduous and coniferous species. In 2 other plantings, however, infestations originated from solid stands of conifers, food plants that are known to be less favored by GM.

The actual damage done to plantings by the larvae was of interest. Growers were asked to estimate the percentage of blossoms lost when larvae consumed either blossoms or blossom stems. A summary of responses is given in Table 1. These estimates should be viewed as conservative because in many instances, control measures were undertaken during the initial stages of larval feeding. Clearly, GM reduced potential crops in 1981 and 1982 and temporarily superseded the blueberry maggot as the most important insect pest of blueberry.

Table 1. Feeding damage by gypsy moth larvae in southeastern Mass. blueberry plantings, 1980-1982.

Percent flowers consumed	Number of plantings		
	1980	1981	1982
9-25	0	5	3
26-50	0	1	0
51-75	0	1	3
76-100	1	1	0

Insecticide usage ranks alongside damage as a leading indicator of pest status. A glance at Table 2 should leave no doubt about the impact GM feeding had on the minds of most blueberry growers from 1980 through 1982. During that period, half of the growers who applied insecticide used Sevin^R, 5 treated with formulations of the bacterium, Bacillus thuringiensis, and 3 treated with malathion. On average, 3 applications were made prior to and during bloom by each grower, with 10 being the maximum number. Opinions about the results of these applications were mixed (Table 2). Dissatisfied growers lamented the insecticides' lack of residual activity and the ineffectiveness of Dipel^R and Thuricide^R against older GM larvae. Only positive opinions were recorded by lone users of methoxychlor, Guthion^R, and Imidan^R. A planting deliberately left untreated despite damaging levels of GM lost an estimated 75% of its flowers.

Insecticide applications during bloom are potentially harmful to native and rented pollinators. New Jersey has overcome the problem somewhat by obtaining a state local need registration for Dylox^R, an insecticide reported to be less harmful to pollinators than Sevin. The questionnaire alluded to this issue by asking if additional insecticides are needed in Massachusetts to control GM larvae during bloom. Ten growers responded positively, 10 were negative, and 7 had no opinion.

Table 2. Use and perceived efficacy of insecticides against gypsy moth larvae by Mass. blueberry growers, 1980-1982.

Insecticide	No. of growers	Opinion on efficacy Pos.	Neg.	Unsure
Sevin	11	9	2	0
Dipel/Thuricide	5	1	3	1
Malathion	3	2	1	0
Methoxychlor	1	1	-	-
Guthion	1	1	-	-
Imidan	1	1	-	-

In summary, GM has been the most important regional insect pest on highbush blueberry during the last 2 years. It has infested about 65% of the plantings in southeastern Massachusetts, causing considerable loss of crop via consumption of flowers and flower stems. It has compelled growers to apply insecticides an average of 3 times per season to reduce losses. Its distribution and population levels in the region have not been predictable from year to year; however, the south coastal region seems to have been least affected.

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MARKETING YOUR FRESH FRUITS AND VEGETABLES

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How would you like to increase your income from growing fresh fruits and vegetables? If you would (and who wouldn't) the key to doing so might very well lie in improving your marketing program. There is no question that marketing is an important consideration... possibly <u>the</u> most important. The technical aspects of producing fresh fruits and vegetables have become quite scientific. As a result, growers are able to control most pests and diseases and, with a bit of cooperation from the weather, are able to produce good crops. Unfortunately, it takes more than a good crop to be financially successful because the products often don't market themselves. The old adage about a better mouse trap is a familiar one, but not very useful in many cases today. If you only built a better mouse trap, what very well might happen is that, instead of the world beating a pathway to your door, the pathway could grow full of weeds. The reason is competition. In most situations in the U.S. there is not just one mouse trap builder per area, but instead several, perhaps many. That means that buyers have a choice to make and, if all the mouse traps are of reasonably good quality, that choice may be based upon something other than the quality of the mouse trap (e.g., convenience of availability, price, nature of customer service, etc.); that is marketing.

Mouse traps and fresh fruits and vegetables may have little in common, but the basics of effective marketing programs for the two products would be surprisingly similar.

Important as the topic of marketing is, it is difficult to be very specific to a group of growers because there is usually no single, best solution for all. Individual situations are enough different to call for somewhat different marketing programs in each case.

Many of the differences in the marketing programs of individual growers are small or subtle, and might easily be overlooked - but those fine differences are important. That "fine tuning" often marks the difference between success and failure. As suggested earlier, to be successful, each grower must be better than other growers in some respect that consumers view as important; that is, he must give customers some reason to come to his place of business and buy his products, rather than to buy from another seller. In marketing jargon, that is called a "differential advantage". It is necessary because a business firm does not automatically get some particular quota or amount of business just by its existence - it has to be earned - over, and over and over again. The president of a small food chain in Massachusetts says that doing business with food shoppers is like a long romance - - you must romance them, and romance them, and romance them -- continuously. A large successful pick-your-own strawberry operator says you have to reach out to customers; you can't sit back and wait for them to come to you because of your superior product.

Furthermore, no individual seller can expect to attract all types of buyers. Some seldom ever buy from roadside stands, some never pick their own, and so on. It is important to identify and focus your attention upon that set of shoppers that represents the best potential market for you - - your "target market".

And so, a first recommendation might be -

1. Get to know your customers and those in your target group - who they are and what their needs and preferences are - and then extend your business toward them by trying to meet those needs and preferences.

Marketing success is largely a matter of attitude. Let your customers see a positive attitude; make it clear that you appreciate their business.

But simply reaching out to potential customers is not enough - you must have something to offer. That "something" should be a "good" product. Don't forget that a "good" product is not limited to the physical product itself, but includes an assortment of services that are involved in the sale of the physical product. Some specific examples will help to illustrate this point.

-have products available in reasonably abundant quantities and of "good" condition. Incidentally, it is very important to judge quality from the customer point of view. For example, many shoppers think that a McIntosh or Red Delicious apple must be solid red to be of "good" quality, and that tomatoes should be uniformly red and perfectly round, and that "good" sweet corn must be bi-color. Growers, of course know that those characteristics are not exactly necessary to a "good" product but, until customer attitudes and preferences have changed, they will not be completely satisfied unless those conditions are met.

-make sure your equipment and facilities used in selling the product are clean and well-appearing.

-provide adequate supervision and orderly handling of customers from the parking area to the checking out area.

-use signs generously to:

1. lay out policies and regulations
2. post prices, etc.
3. give directions to product locations, to the check-out area, etc.

And remember, signs are one part of the image that a business projects to customers; make certain that your signs represent you well.

-in handling customers be sure to give the impression that you really want to satisfy them with your product.

For pick-your-own operators there are some additional considerations. Surveys of pick-your-own customers indicate that they appreciate the availability of toilet facilities, that ready-picked fruit and/or other crops for sale adds variety and convenience that is appreciated by pickers, and a special area provided for children (playground and/or picking area) will enable pickers with children to be more relaxed, and will help to avoid conflicts with other pickers and damage to crops and plants.

And so, the second suggestion offered is -

2. Provide customers with a really "good" product (including related services)-a product that will please them.

The third suggestion is -

3. Price realistically and with conviction. This means a "fair" price - not too high and not too low - and don't be timid about it. No matter how low prices might be set, some customers would surely complain that they are too high. Unfortunately, that is the nature of some customers. But if, in fact, your prices are fair there is no reason to feel apologetic or to "pussy foot" about them. Quite the opposite; customers are more likely to feel assured that prices are reasonable when sales personnel are quite positive and forthright in talking about them.

   To do a good job of setting prices, a grower must know his costs well, to know what price is necessary. Doing so has become difficult in recent years, with herky-jerky but generally rapid changes in operating costs. As a result, a grower must work his records harder than ever before to be certain of maintaining a financially healthy position.

It is also important to keep abreast of market conditions to have a sense for prices elsewhere in the market and, therefore, what customers will consider to be a reasonable price. Probably the most important prices to stay in touch with are those at the wholesale market and at supermarkets in your area. Many growers object to the suggestion of using supermarket prices as at least part of the basis for setting their own. However, it is a supermarket that is the principal competitor for most growers who are retailing, and because of frequent visits there, it is supermarket prices that most shoppers are likely to be familiar with. Furthermore, using supermarket prices as a pricing guide does not necessarily mean following them exactly.

Special mention should be made of the problem of pricing for a "bumper crop". As background, a very brief lesson in the economics of demand and supply would be helpful. For most agricultural products, a relatively small change in the quantity available in the markets results in a relatively large change in market prices. That is, a 10 percent decrease in the supply of a particular commodity would result in a price increase of more than 10 percent, and vice-versa. In the jargon of economics, that condition is referred to as a relatively inelastic demand. The demand for most agricultural products is of that nature and that is a major part of the reason that many of our farm programs, used to support agricultural commodity prices, operate on the basis of government purchase of surplus supplies. Removing a relatively small quantity of a commodity from the marketing system, results in a relatively larger increase in the market price for that product.

For individual growers that means that prices usually would have to fall by a fairly large amount to clear the market in times of a modest increase in market supplies available. In other words, price-cutting or price-wars must be quite severe for very large crops to stimulate consumer buying enough to sell the entire crop. Likewise, during those same times, selling less, by grading more selectively or simply not taking the surplus to the market, would have a relatively greater effect onthe market price and, therefore, would increase total revenue. Most growers have probably noticed this effect in times of short crops resulting from adverse weather conditions, etc.

Of course, for this result to occur, essentially all growers must follow the same practice so that market supplies are, in fact, reduced. Each grower must choose to follow such practices independently and voluntarily, however, since agreements of this nature among producers would be a voilation of antitrust laws.

Realistically there is not a single price, but instead, probably a narrow range of prices that could be used successfully. Where in that range a grower sets his price is a matter of policy and philosophy, and also a matter of long run plans. Some marketers have a philosophy of taking all they can get - charging "what the market will bear" - while others are content to get what they need. Obviously, if you plan to be in business for some time it is important that your prices create a favorable image among shoppers, but must also provide a reasonable profit (return-to-your investment in the business) in addition to a satisfactory wage for the time devoted to that part of the business.

Most growers perfer a single price for all customers. Certainly, that is a simple and straightforward policy and may help to avoid hassles over who is entitled to a reduced price. Personally, I prefer a multiple-pricing system that offers customers an incentive to buy larger quantities for preserving, especially in times of large crops.

No matter how good your product, nor how attractive your price, it will all go for naught if consumers don't know about it. Advertise freely in newspapers and on radio - even TV for large operations. Also explore all possible opportunities for free publicity via press releases, feature articles, public service broadcasts, etc. Some other suggestions that might bear consideration are -

- consider preparing a "standing ad", that is ready to be used, before the marketing season. During the harvest period it is often difficult to find time to prepare an ad, but that could be just what is needed during the time of surplus supplies. Having an ad prepared in advance might, under those circumstances, be very helpful.

- consider special promotions such as a strawberry festival, a cherry pie baking contest, a corn roast, an apple festival, etc.

- print up hand-out materials on the handling and preparation of the commodities you sell, with recipes.

- use telephone recorded information on prices, hours of business, etc., when the volume of telephone inquiries is high.

The fourth suggestion offered, then, is -

4. <u>Promote your business adequately</u>

Recapping the suggestions offered -

- get to know your customers and extend your business to them

- provide all customers with a "good" product

- set prices realistically and with conviction

- promote your business

To be sure, the preceding discussion is a brief and simplified treatment of the subject of marketing. Much has been omitted and of the suggestions offered, most could be discussed in much greater detail. However, it was not the intent of this article to "dot all of the i's and cross all of the t's" with respect to marketing, but rather, to briefly review some of the important considerations for a successful marketing program. Serious attention to the suggestions offered should help most growers to develop a more effective and, therefore, more profitable marketing program for their operation.

SPUR BLIGHT OF RASPBERRIES

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Spur blight is a disease of raspberries caused by the fungus Didymella applanata. The fungus infects buds, nodes and sometimes the internodal regions of raspberry canes during the summer. The disease surreptitiously depresses berry yields, for canes are seldom killed, yet some bearing nodes and transport tissue on each cane may be destroyed. Serious epidemics can reduce yields by 30%, though light infections may not depress yields at all. It is also thought that spur blight makes canes more susceptible to winter injury.

Symptoms

Spur blight first appears on new canes, usually near the base, in late spring or early summer. In Massachusetts, the first lesions should appear in June. Brown or purplish spots develop around areas where leaves are or were attached. These spots may enlarge to cover the cane for 4 or 5 inches, but usually lesions are limited to an area around the leaf petiole. These lesions turn to gray areas with tiny black spots on the cane in the second (fruiting) year. Buds in the affected area are weak, and some buds fail to develop at all. Laterals in the area are weak and yellowed, and may wither and die.

The grey lesions are similar to those caused by another disease, anthracnose. However, anthracnose has a characteristic bulls-eye pattern of dark rings in the lesion. Spur blight lesions are more scattered, and are almost always associated with leaf nodes.

Disease Cycle

The spur blight fungus produces two similar kinds of fruiting bodies. These occur together on lesions. There are differences in the length of time during which each type of fruiting body releases spores. However, spores of one type or the other are present from early spring to late fall.

One type of spore is called an ascospore, which is produced in a fungal fruiting structure called a perithecium. Perithecia are found in lesions on second year canes. The majority of ascospores are released when new canes are emerging in April or May. The spores are released largely during and after rain, though low levels may be released by dew. Most ascospores are released by the end of June. While these spores cause new infections on first year canes, they do not cause all primary infections, and they are not the only type of overwintering spore.

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The authors would like to thank Paula Saucier for the illustration, and Dr. William Lord for advice on pruning techniques.

A second kind of spore is released over a larger part of the growing season. These spores are called pycnospores and they are borne in another type of fruiting body called a pycnidium. Pycnidia appear as tiny black pustules in the old infections. As with the ascospores, the pycnospores mature over the winter and are ready for release during the next season. Pycnospores are mature and may be released from March to October. However, the bulk of the pycnospores appear to be released from June to mid-August. It is during this period that most new infections occur, indicating the importance of these spores in the disease process.

Once released, both types of spores are wind-carried to the leaves and buds of canes. Senescent tissue is most susceptible. One theory states that the lower leaves are preferentially infected because they begin to senesce in June. The infection then travels down the leaf stem and infects the node. Others feel that buds and laterals in the lower part of the planting provide relatively moist niches for fungus development.

Once the spores have germinated they infect and injure or kill an area around the leaf petiole and its base. There is little information as to what stimulates pycnidial formation versus perithecial formation. The fungus overwinters in the infected tissue producing pycnidia and perithecia. The next spring these structures release spores which infect new plants. The life cycle is shown in Figure 1.

Management

The first decision a grower should make is whether there is a serious spur blight problem in a planting. As mentioned, serious outbreaks can reduce yields by 30%. If the problem is causing economic damage, there are a number of steps which can help manage the disease. When growing summer-bearing raspberries in the narrow hedge-row system, cut out old canes immediately after harvest. Also remove weak and diseased canes, and thin the rows. The rows should be no more than 1 ft. wide at ground level. There should be about 25 canes growing in every 10 feet of row. Good weed control is also essential for maintaining good aeration and spur blight control.

1. Insure proper ventilation in the planting. This is important in managing other fungus diseases, particularly fruit and cane blight (Botrytis) and anthracnose (Gloeosporium). Too dense a row inhibits drying and spray penetration, and encourages fungal development.

2. Do not overfertilize, or push growth too fast. Raspberries are a vigorous plant and respond well to fertilization. However, too much growth causes dense foliage (see 1. above) and increases senescence in the lower leaves. This increased number of senescent leaves increases the number of places where infection can occur. There is a practice which advocates applying a controlled amount of contact herbicide to the first flush of cane growth in spring to reduce overall growth and promote cane health through the rest of the year. This practice is still experimental, but illustrates how

a slower growing raspberry plant will often have less disease problems.

3. Apply fungicides at the correct intervals. Fungicides (Table 1) are useful in reducing spur blight when applied as protectants during the growing season, and as eradicants on dormant canes.

During the growing season, use captan or ferbam. Apply the first spray when new canes first appear. Apply subsequent sprays at 14 day intervals, up to 2 weeks before harvest. If rain is particularly heavy, that is, in excess of two inches, it may be necessary to reapply the fungicide before 14 days have elapsed. This treatment usually requires 4 or 5 sprays in a season. The most critical stage is at early bloom. A spray should be scheduled at early bloom for maximum effect.

At bud swell, and when canes are dormant in late fall, a lime sulfur treatment may be applied. Bordeaux (3-3-50) may be applied when new canes are 8 to 12 inches high. These applications are designed to kill the fungus in bearing canes.

Future Developments

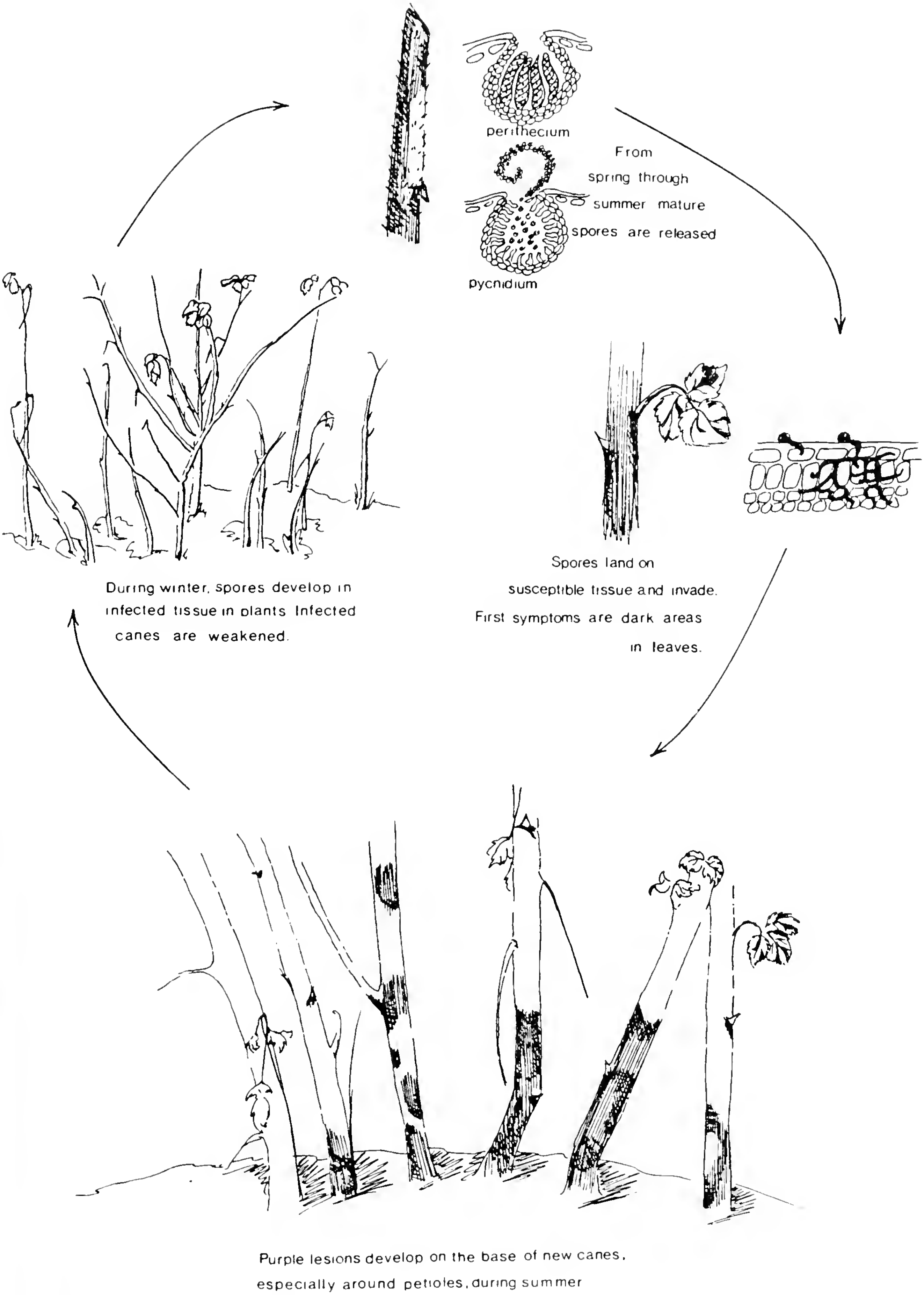
Unfortunately, there are no raspberry varieties resistant to spur blight. However, sources of resistance have been found, and resistant varieties are being bred. Resistant varieties should provide the best solution to spur blight problems.

Table 1. Fungicides for Spur Blight

Dormant and Early Spring		
Fungicide	Amt/100 gal*	Timing
Lime sulfur or	1 to 4 gal	No later than bud break
Bordeaux	6 lbs spray lime plus 6 lbs copper sulfate	No later than 12 in. of growth on new canes
Bud Break Through Harvest		
Fungicide	Amt/100 gal*	Timing
Captan 50% WP or	2 lbs	At 10-14 day intervals; maintain good coverage especially at early bloom
Ferbam 76% WP	2 lbs	

*Apply approximately 200 gal/acre in mature plantings. In small plantings, spray until plant surfaces are throughly covered.

Figure 1. Disease cycle of raspberry spur blight.



NRAES-16 PLANNING FARM SHOPS

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With equipment needing maintenance and various construction and/or fabrication projects going on, every farm needs a good and efficient farm shop. A good shop consists of work areas for machinery, metal, repair, and woodworking along with a storage area. So to have a good and efficient shop means careful planning. Now careful planning means consideration of shop location on farmstead, type of structure, space requirements for each work area, and locating tools near their respective work area. As each area requires different tools, proper storage for easy accessibility must, also, be taken into account.

Northeast Regional Agricultural Enginerring Service (NRAES) has published a new booklet entitled, "Planning Farm Shops". In this booklet, NRAES very carefully covers various aspects involved in designing the proper shop for the need. It contains sections on building designs, utilities, space requirements, tool and parts storage, equipment and tool specifications, shop safety, plus an appendix on equipment templates. To elaborate more, let's look into what each section has to consider.

Section one is on building design. Subjects covered in this section deals with the fundamental components of the shop's structure as well as shop location and orientation. After locating the shop, the type of building frame has to be chosen. Structural materials to be used in construction has to be thoughtfully selected especially in light of making the shop fire resistant. How well insulated is the shop to be? What type of insulation should be used? What type and how many doors and windows should there be? What type of floor and should the possible use of a foundation be considered? All these aspects must be carefully and thoughtfully included in planning.

In the next section, the various utilities are discussed. After a detailed floor plan has been laid forth, the different environmental systems can then be intelligently planned in light of work area locations. Are enough electric circuits provided? Is the amperage and voltage enough to run the equipment in each area? Is the lighting sufficient for each area? Is an adequate heating system installed? If some type of plumbing is needed, is it sufficient to do the job? How about ventilation? Has it been properly provided for? If a hoist is to be installed, has the structural system been designed to carry the load? All these utilities are vital to any shop and need to be carefully incorporated into the design.

When considering space requirements, three basic types of work should be kept in mind. They are metal, engine and machinery, and wood. Within these types of work are various pieces of equipment. Each piece of equipment has three space requirements to consider. They are the equipment itself, operator's space, and workpiece space. So this section takes a look at planning templates, template arrangement rules, and equipment and area arrangement.

Storage of materials, tools, and parts are important to make a shop efficient. Where should materials and parts be stored? How are they stored? If they are used frequently, are they easily accessible? Are tools properly stored to preserve them? Are they easily accessible to their respective work area? These points are discussed in this section.

The next two sections deal with specifications of equipment power hand tools, and hand tools. Suggestions are given as to the quantity of tools and the capacity of various tools to cover possible projects that may well be carried out in the shop. Guidelines for lists of hand tools are given for various areas of maintenance and construction.

A small one-page section on shop safety gives some pointers in keeping the shop a safe place to work.

The appendix has templates of various pieces of equipment which can be cut out and used in laying out the shop floor plan. These are valuable aids in showing how large the shop must be for the equipment to be placed in it. In addition, it allows for the farmer to see exactly where electrical outlets, lighting, and other environmental systems should be located to make the shop function properly.

As you can see, there is a lot to consider when planning a farm shop. NRAES-16, "Planning Farm Shops" provides you with the essentials you need when planning a shop for your farm. This booklet may be obtained by writing to the *Cooperative Plan Service, Agricultural Engineering Building, University of Massachusetts, Amherst, MA.* 01003. There is a $2.00 charge for the publication. Make the check payable to the *Cooperative Extension Activity Fund.*

WHY, WHEN, AND HOW TO SUMMER PRUNE AND RESULTS TO EXPECT

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Last year we discussed the results of our summer pruning experiments (FRUIT NOTES 47(3):1-6, 1982). In the article below we have answered the following questions about summer pruning: (1) why, when and how; (2) what results to expect; and (3) advantages and disadvantages.

Why. Recent results from England, South Africa, Europe, and Massachusetts indicated that late summer pruning can restrict growth, increase red color on fruit, increase leaf Ca, reduce the incidence of bitter pit, increase fruit flesh Ca, and reduce internal breakdown in storage. In England Preston pruned by the established spur method. This involved the removal of strong laterals not needed for new branches and shortening of weak ones to 3 inches to induce spur formation. Laterals of medium vigor, mainly on the tree periphery, were not pruned. Subsequently, these were shortened to a spur, or removed when crowding occurred or they became too large. Laterals from spur systems or induced spurs were shortened to 1 inch. In Massachusetts, the trees were summer pruned by removing all current season's shoots. Terblanche et al. in South Africa removed all current season's growth of the bearing units as well as excessive shoot growth. Only sufficient shoots were left to serve as future bearing units. Utermark in West Germany drastically reduced leaf area by removing growth beyond the outermost fruiting spur on each branch.

The summer pruning techniques that enhanced fruit quality seem severe and time consuming, and contradictory findings have been reported. Thus, our experiments were designed to compare effects of summer pruning with winter pruning and to evaluate methods that fruit growers might adapt. The experiments were established on young bearing trees of: (1) McIntosh on seedling roots; (2) Cortland on M7a; and (3) Red Prince Delicious on MM106 rootstock.

When and How to Summer Prune. August is the best time to summer prune because of less regrowth than from earlier pruning. We believe that the need to summer prune can be reduced with containment and corrective pruning during the winter to restrict tree spread and height. The following procedures are suggested during dormant pruning.

1. Branches that crowd those of adjacent trees will have to be removed or cut back to a weaker side branch. (Cuts made only to maintain the desired outer profile of the tree compounds rather than alleviates tree containment problems. Such cuts will produce vigorous growth which by the end of the next growing season may extend as far as the original branch was before shortening, and may cause more shading within the tree than did the original uncut branch.)

2. Maintain conical tree shape by removing large limbs in the top third of the tree or cutting back to a very much weaker side branch.

3. Initiate a limb rotation program in the top 1/3 of the tree by retaining weak branches, spreading desirable watersprouts which in turn may have to be removed when they become too large.

4. Remove watersprouts which are not needed to protect branches from sunscald or to provide for branch renewal. Those retained for branch renewal generally require spreading.

5. Remove weak drooping branches which are severely shaded and have few fruiting spurs.

6. Reduce the height of excessively tall trees by stubbing to a strong outward growing lateral branch originating at a lower level on the leader.

7. Frequently a strong scaffold branch with a narrow crotch angle develops in the upper 1/3 of the tree. If this branch is not removed or its growth restricted, the tree will become a multiply leader tree. Trees of this type are much more difficult to prune when practicing containment pruning or lowering tree height.

8. Delicious trees are subject to weak crotches, and branches are prone to develop whorls and to droop. The ends of drooping branches should be removed back to a lateral growing in a somewhat upright position. This will shorten and stiffen the branches. The tip of the lateral on a pruned drooping branch should be higher from the ground than any other portion of the branch. This should reduce the problem of suckering.

9. Cortland produce many small lateral branches. Detailed pruning is required to reduce the number of these branches. Remove slender hanging branches. Thin out the remaining branches on each scaffold limb.

During August remove 1 to 3 year old wood that is causing shading. Concentrate efforts in the tree's periphery and particularly in the upper crown area of the tree. Remove watersprouts, risers and shorten drooping limbs that are too close to the ground. If the trees have not been pruned well during dormant pruning, it may be necessary to remove a few large limbs at their point of origin on the trunk in the lower two-thirds of the tree canopy. Avoid thinning or stubbing large branches in the top 1/3 of the tree. When these branches fall they cause bruising and drop of some fruit on the lower branches.

We have one grower in Massachusetts who has summer pruned with a tractor-mounted sickle bar for the last 3 or 4 years. He believes red color is increased on the hedged trees and that the practice reduces the cost for winter pruning.

Results. We compared the effects on growth and fruit quality from winter pruning and summer pruning. The fruit quality measurements include fruit size, soluble solids (sugar content), fruit flesh firmness, fruit flesh calcium content, and senescent breakdown during storage.

The corrective winter pruning or corrective winter pruning-plus-summer pruning procedures reduced the problem of tree crowding in the block of Red Prince Delicious trees. However, corrective winter pruning-plus-summer pruning in comparison to corrective winter pruning had little or no effect on growth or fruit quality.

Summer pruning has been suggested as a technique for devitalizing trees in crowded plantings. The overall growth of the Cortland trees, as indicated by trunk circumference increase, was reduced by summer pruning. Nevertheless, terminal growth the year following summer pruning was greater than on the dormant-pruned trees. The Red Prince Delicious trees also were not devitalized by summer pruning. The only consistent beneficial effect of summer pruning was improved red color of McIntosh apples from trees receiving the dormant-type mechanical hedging, or the cutting to the first fruiting spur summer pruning treatments.

Advantages of Summer Pruning

1. Increase red color development on some varieites.

2. Could provide work for employees experienced in pruning during the slow season, in some orchards, prior to harvest.

3. Reduce the amount of pruning necessary during the winter months.

Disadvantages of Summer Pruning.

1. Finding the time to prune.

2. It may not reduce terminal growth the year after pruning which is the primary cause of tree crowding.

3. In most cases, there may be either no effect of summer pruning or the responses may not be consistent from year to year, or they may be undesirable. Smaller fruits, lower soluble solids (sugar content), more storage scald, bitter pit and cork spot are examples of undesirable responses in our experiments.

4. Woolly apple aphids may colonize at the pruning cuts.

5. Some regrowth may occur after summer pruning and leaf drop is later on this wood. Delayed leaf drop is an indicator of delayed maturity of wood, which increases the risk of winter injury and has been one of the concerns with summer pruning. Raymond Granger, C.D.A. Research Station in Quebec reported that summer pruning, among other factors, appeared to increase severity of winter injury to apple trees during the winter of 1980-81.

6. The summer pruning practices of R.P. Marini and J.A. Barden in Virginia reduced the amount of bloom on 2-year-old wood.

Conclusions Majority of trees in Massachusetts are on vigorous-size controlling rootstocks and the responses to summer pruning, with the exception of improved red color, may be slow to develop. Summer pruning can reduce the amount of pruning necessary during the winter months and possibly improve work efficiency during the summer. However, it is doubtful that summer pruning will become a common practice except in a few situations of severe tree crowding. Summer pruning will be mainly practiced for tree training in non-bearing blocks and has the potential for improving fruit color in crowded bearing trees.

****

EXTENT OF DAMAGE BY MAJOR APPLE FRUIT INJURING INSECTS IN MASSACHUSETTS

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Department of Entomology

Now that the 5-year (1978-1982) pilot integrated pest management (IPM) program on apples has ended in Massachusetts, we take the opportunity to present here a summarized account of insect injury to fruit which we and the IPM field scouts encountered at harvest in the various IPM and check commercial orchards that were sampled.

The data in Table 1 have been reported previously as portions of other articles in FRUIT NOTES [V.44(1), V. 44(6), V. 45(6), V. 47 (1); V. 48(1)]. They are offered here, in condensed form, to provide an overview of the major insects which directly injure apple fruit in Massachusetts. They were obtained via on-tree surveys at harvest: 100 fruit per tree on 6-24 trees per block, depending on block size. Each sampled fruit was examined carefully, and any insect injury, no matter how slight, was recorded. The data include about 131,000 apples sampled over 5 years from 87 "good-cooperator" IPM blocks and about 64,000 apples sampled over 5 years from 40 check blocks. Sampled IPM and check blocks were scattered from east-central to west-central portions of the state.

The data show that total insect-caused fruit injury averaged 3.18% in the IPM blocks versus 3.80% in the check blocks. The 5 most injurious pests in the IPM blocks were, in decreasing order of importance, tarnished plant bug, plum curculio, San Jose scale, European apple sawfly, and apple maggot. Together, these 5 pests accounted for 98% of all insect-injured fruit in IPM blocks. These same 5 pests accounted for 95% of all insect-injured fruit in the check blocks, with plant bug again being the most injurious.

Do all insect injuries detected on trees at harvest by field scouts result in downgrading of fruit in the packing shed? To help answer this question, we refer to a packout survey published in FRUIT NOTES 46(3). This survey involved examination of about 400,000 apples by packing shed personnel and about 60,000 of the culls by Glenn Morin. It was conducted in 16 Massachusetts packing sheds on 1980-grown fruit. Some of the orchards and blocks sampled in the packout study were the same as those sampled for on-tree injury in 1980, but several were not. Although this lack of direct correspondence of sampled blocks does not permit accurate direct comparison of on-tree injury with packout injury, the substantial number of orchard blocks and apples sampled by each method may be suggestive.

The packout survey of 1980 fruit showed a total of 0.63% of the fruit culled owing to insect injury, or about 15% as much as the average of 3.9% insect injury from 1980 on-tree surveys in IPM and check blocks combined. In the packout survey, the most injurious insects, in decreasing order of importance, were tarnished plant bug (0.23%), San Jose scale (0.21%), plum curculio (0.10%), and European apple sawfly (0.07%). Together these 4 pests accounted for 97% of all insect-culled fruit at the packing shed. These were the same 4 pests found to be the most injurious in the on-tree survey. Apple maggot egglaying stings, difficult to see with the unaided eye but indicative of probable infestation by larvae in the fruit flesh, were very rarely detected in the packing shed, even though this insect caused injury to an average of 0.12% of tree-sampled fruit in 1980.

Together, these findings indicte that among insects which directly attack apple fruit, Massachusetts researchers, extension personnel, and fruit gorwers should be concerned primarily with the aforementioned 5 species. For the past several years, we and/or Drs. R.W. Weires and W.H. Reissig of New York have been conducting research on improved ways of monitoring and controlling plant bug, scale, curculio, sawfly, and apple maggot. We hope that continued research progress will result in decrease of future injury from these pests.

Table 1. Percent insect-injured fruit in on-tree surveys conducted in integrated pest management (IPM) and check orchards, 1978-1982.

Damaging insect	% injured fruit in[z,y]: 1978	1979	1980	1981	1982	Avg. % injured fruit
			IPM blocks			
Tarnished plant bug	1.60	2.74	1.44	1.25	1.12	1.63
Plum curculio	.17	.39	1.19	.61	.43	.56
San Jose scale	.03	.33	.72	.27	.84	.44
European sawfly	.68	.03	.24	.16	.87	.40
Apple maggot	.13	.12	.10	.05	.01	.08
Leafroller	.01	.01	.02	.05	.02	.02
Fruitworms	0	.02	.01	0	.01	.01
Codling moth	.01	0	.04	0	0	.01
Other	.01	0	0	.11	.01	.03
Totals	2.64	3.64	3.76	2.50	3.31	3.18
			Check blocks			
Tarnished plant bug	2.33	3.10	1.44	1.20	.83	1.78
Plum curculio	.17	.17	.87	.47	.26	.39
San Jose scale	.96	1.07	1.43	.23	1.86	1.11
European sawfly	.54	.04	.11	.02	.47	.24
Apple maggot	.08	.23	.14	.01	0	.09
Leafroller	.05	.04	.03	.01	.04	.03
Fruitworms	.59	.07	.07	.03	.01	.15
Codling moth	0	.01	0	0	0	0
Other	0	0	0	.04	0	.01
Totals	4.72	4.73	4.09	2.01	3.47	3.80

[z] Number of blocks sampled: IPM - 1978(8), 1979(16), 1980(18), 1981(20), 1982(25). Check - 1978(8), 1979(9), 1980(9), 1981(7), and 1982 (7).

[y] Number of fruits sampled: IPM - 1978(16,000), 1979 (32,000), 1980 (20,000), 1981 (30,000), 1982 (33,000); Check - 1978(16,000) 1979(18,000), 1980 (10,000), 1981 (11,000) and 1982 (9,000).

FRUIT NOTES

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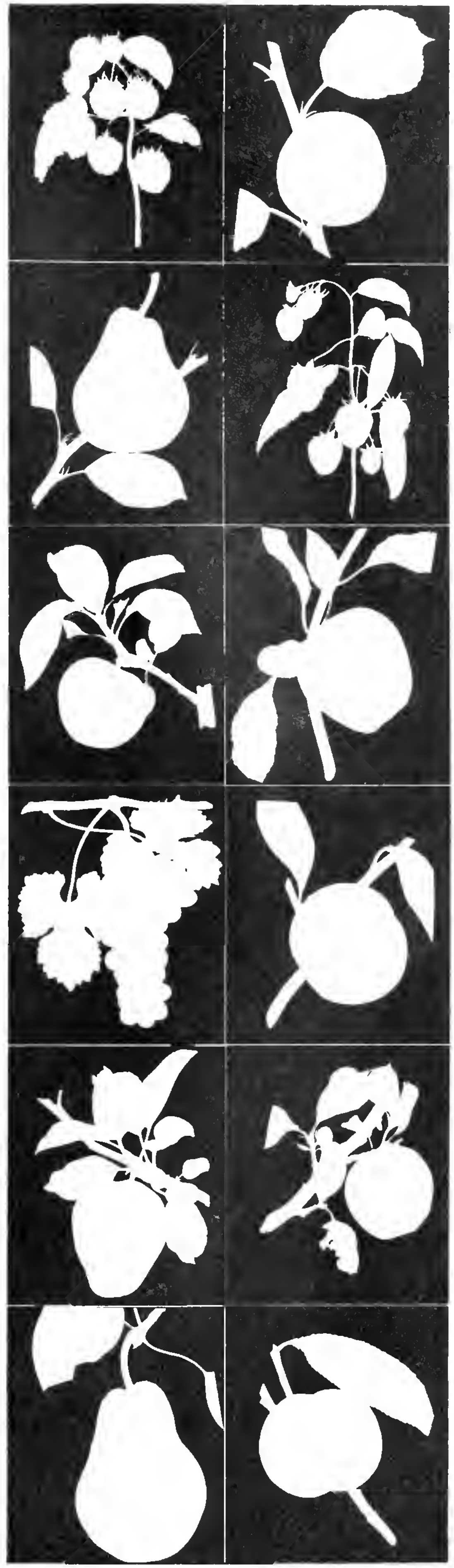

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FRUIT NOTES SUBSCRIPTION

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CYCLING FANS IN APPLE COLD STORAGE ROOMS CAN BE GOOD WAY TO CONSERVE ENERGY*

Gilbert E. Yost
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Energy used to operate fans in 'Red and Golden Delicious' apple cold storage rooms could be cut nearly in half by using a fan cycling scheme.

Refrigerated storage of apples in the Pacific Northwest requires a large amount of electrical energy. Cost of electrical energy has increased rapidly and future trends indicate it will go higher.

USDA's Agricultural Research Service and the fruit industry are looking for ways to reduce electrical energy input to save energy and reduce costs.

Fans and refrigeration must run continuously in storage rooms from harvest until the field heat is removed from the apples and proper storage temperature is attained. At this point in time, cycling fans and refrigeration could still maintain proper fruit temperatures and save energy (Fig. 1). Fans cycled half of the time use 52 to 60% of the energy used to run them continuously.

Five years of monitoring different fan cycling schemes such as 12-hours on, 12-hours off; 6-hours on, 6-hours off; 8-hours on, 16-hours off; and 16-hours on, 8-hours off, in storages ranging from "antiquated rooms to those featuring the latest state-of-the-art in construction and equipment", show that "over all" the 6-hours on, 6-hours off seems to be the best scheme.

Cycling 6-hours on, 6-hours off fits well with storage management. This scheme compensated for the outside air temperature fluctuations in the fall and spring and maintained the proper average fruit temperature in different rooms in which it was tested.

The cycling scheme could be scheduled around "peak load" hours of the local utility company (some utility companies have a special rate for customers that do not use power during these times) and this adjustment would not interfere with the maintenance of the fruit temperature.

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* This article appeared in the January 15, 1983 issue of the GoodFruit Grower. Reprinted by permission of the author.

In a 1000-bin (800 pounds per bin) room held at 30-32°F there are 800,000 pounds or 400 tons of apples. According to "Modern Refrigeration and Air Conditioning" by Althouse, Turnquist and Braccinao, the heat of respiration of a ton of apples at 32°F is 700 BTU's in 24 hours and 1/3 horsepower fan motors give off 4250 BTU's per horsepower per hour.

Assuming this room contains twelve fan motors, the heat produced by the motors would be 408,000 BTU's in 24 hours while the heat of respiration would be only 280,000 BTU's for the same time period. There would be 1.45 times more heat produced by the fan motors than by the heat of respiration from the apples. There are other factors involved but this example illustrates one of the major areas for energy cost savings.

On-going research at the USDA Tree Fruit Research Laboratory in Wenatchee, Washington includes monitoring and recording of 'Red and Golden Delicious' fruit temperatures during commerical regular and CA apple storage rooms. The data collected over a five year period showed:

(1) once a room was loaded with bins of apples the air pattern established at the time remained the same throughout the storage season.

(2) average fruit temperatures were maintained between 31-32°F in cold rooms tested when the fans were run continuously 1/3, 1/2, and 2/3 of the time (by maintaining the fruit temperatures, adjusting the cycling time to compensate for the physical conditions of the room, and maintaining proper fruit temperatures, the most efficient cycle time can be established).

(3) there was a fruit temperature gradient from the coldest to the warmest sensored apple of 3-4°F;

(4) in rooms where the coils were located above the bins, with air being blown out over the bins and filtering down through the fruit and bins and then pulled back through the stacks of bins to the coils, the apples in the top bins were the coldest;

(5) the fans and refrigeration could be off up to 36 hours before average fruit temperature rose 1°F (this could vary depending upon the physical condition of the rooms);

(6) data from fruit quality evaluation tests indicted no significant difference was detected between apples held in noncycled rooms over the cycled rooms (however, during periods of extreme cold weather (0° to -10°F or colder) for several weeks it would be a wise practice to run the fans continuously to restore some of the heat being lost from the room to the outside atmosphere.

Most apple storages use cold room air temperature readings as a guide to apple temperatures, but these do not give a true picture during storage.

Many cold storage rooms hold over a quarter-million dollars worth of apples, and whether or not the rooms are cycled, both air and apple temperatures should be monitored.

A system to do this could be to (1) use nine bins with an apple probed for temperature monitoring placed about 6-inches deep in each bin, and put bins in the top layer of the stack of bins, three across the back, three across the middle and three across the front of the room; (2) use at least two air temperature probes, one in front of the coils and one behind the coils or in the return air flow of the room; (3) connect all air and fruit probes to a recording device that automatically prints out temperatures at least four times every 24 hours; and (4) use several regular thermometers for "back-up" temperature readings in case of electronic failure.

This type of cold room instrumentation can give management a better insight on which to base their storage operation decisions for each type of cold room.

Fan and refrigeration cycling will work. It will save energy, lower energy costs and still maintain optimum apple temperatures during storage.

Editors note - The author would like to express his thanks to the Washington State Tree Fruit Research Commission, Tree Top, Inc., Pacific Power and Light Company, City of Cashmere Light Department, Blue Star Growers, Snokist Growers, Skookum, Inc., Stemilt Growers and to the personnel of the USDA-ARS, Tree Fruit Research Laboratory for their cooperation in this study.

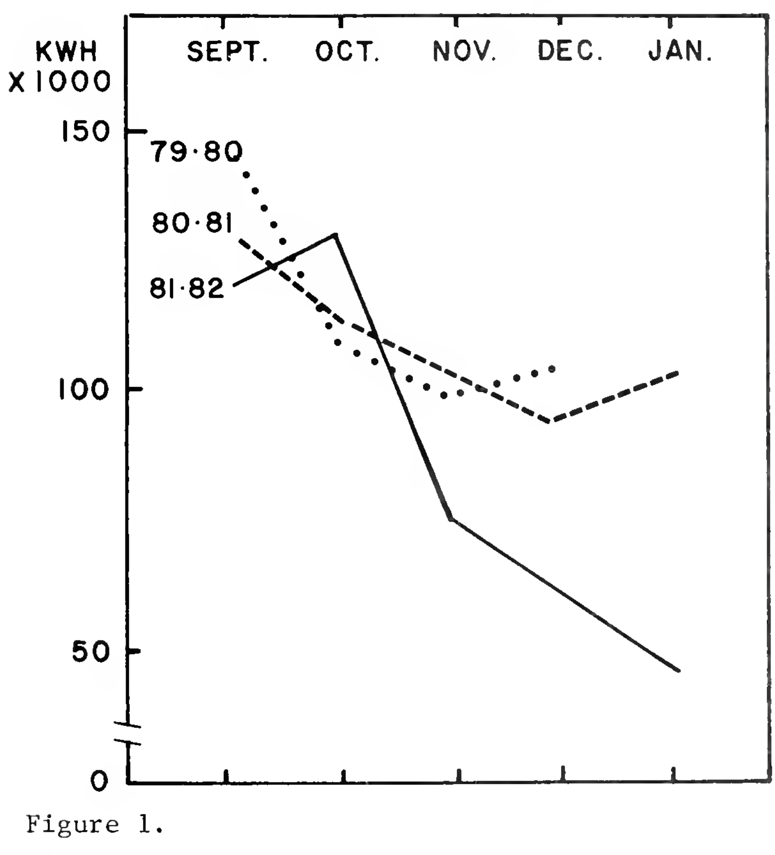

Figure 1.

Figure 1. This chart shows the amount of energy used in a six-room apple storage facility for three seasons. After the initial fruit cool-down period the fans and refrigeration were cycled at 6-hours on, 6-hours off during the 1981-82 season. During the months of November, December and January of the 1981-82 season a savings of approximately 100,000 KWH over the same months of the 1980-81 seasons was evident. This would amount to a $1000 savings if the power rate was one cent per KWH.

EFFECTS OF MINERAL NUTRITION ON KEEPING QUALITY OF MASSACHUSETTS McINTOSH: RESULTS OF A FOUR-YEAR SURVEY

W.J. Bramlage, M. Drake, S.A. Weis, and C.A. Marmo
Department of Plant and Soil Sciences

During the past 4 years we have been sampling commercial McIntosh orchards in Massachusetts and comparing the mineral concentrations in fruit at harvest with their keeping quality after storage. Full details of the procedures and of the results with apples from regular air storage have been published in the Proceedings of the 1983 Massachusetts Fruit Growers' Association, Inc. Annual Meeting; only the thrust of those findings will be presented here.

Between 1979 and 1982, a total of 172 orchard blocks of McIntosh were sampled. Samples came from 6 counties in Massachusetts. Fruit samples for analyses were taken 2 weeks before harvest, and at the start of commercial harvest 2 bushels of fruit were taken from each block. These 2 bushels were stored at the Horticultural Research Center in Belchertown, 1 bushel at 32°F in air storage, and 1 bushel in CA storage. Only results for air storage are reported here.

The air-stored fruit were removed in late January or early February and placed at 70-80°F. After 1 day they were tested for firmness and after 1 week they were examined for the occurrences of breakdown, scald, rot and bitter pit. Bitter pit was so infrequent that data for it have been omitted. The average Ca and Mg concentrations were quite uniform across the 4 years, and the concentrations of K and P were only slightly more variable (Table 1). The concentrations of N changed dramatically, however, falling by nearly 50% between 1979 and 1981. The cause of this decline is not known, but no comparable reduction of leaf N has been observed during this period.

The ranges of mineral concentrations among orchards are also shown in Table 1. For Ca, in each year there were very broad ranges, with some samples containing twice as much Ca as other samples. Many of these orchards used calcium chloride foliar sprays during this period, which likely contributed to this wide range. For K, P and N there were approximately 50% ranges, i.e., some samples contained 50% more of the element than other samples. For Mg, less than a 50% range existed in all years but 1980. Thus, Ca was the most variable element in fruit from these orchards.

Table 1. Averages and ranges of concentrations of 5 minerals (ppm, dry wt. basis, outer cortex tissue) in McIntosh apples from commercial orchards in Massachusetts, 1979-1982.

Mineral	1979[z]	1980	1981	1982
		Average		
Ca	145	153	145	152
K	4909	5459	5300	5100
P	360	438	358	392
Mg	243	283	256	262
N	2665	2227	1500	1500
		Range		
Ca	103-183	101-240	110-252	105-208
K	3880-6110	4200-6750	4000-6400	4000-6000
P	291-444	335-551	288-482	343-460
Mg	214-278	241-367	216-288	222-310
N	2300-3300	1700-2900	1000-1800	1250-1870

[z] Numbers of samples: 1979 = 34; 1980 = 49; 1981 = 41; 1982 = 48.

Relationships between mineral concentrations in fruit at harvest and the occurrences of breakdown, scald, and rot after storage are illustrated in Table 2. For each element, 4 groups of samples were established at arbitrary points within the range for that element, in order to demonstrate the patterns of relationships that appeared to exist.

Samples with increasing Ca concentrations developed decreasing amounts of breakdown after storage. In addition, with increasing Ca concentrations, the frequencies of scald and of rot also seemed to decline, though to a lesser extent than did the amount of breakdown.

Most of the orchards sampled produced fruit with moderate concentrations of K, but a few samples were relatively high in this element. These high-K samples appeared to develop slightly more breakdown and substantially more scald and rot than the rest of the samples, but statistical analyses showed that due to large variations within these groupings, only the effect on scald was real.

As with K, most orchards produced fruit containing moderate concentrations of P. However, a few samples had relatively low P, and statistical analyses showed that these samples developed relatively large amounts of breakdown and rot. For Mg, a few

Table 2. Relationships between concentrations of 5 minerals in McIntosh apples, and the occurrences of internal breakdown, scald, and rot in samples from Massachusetts orchards after storage in 32°F air for 5 months followed by 1 week at 75°F., 1979-1982.

Ppm, dry wt.basis	Number of samples	Breakdown (%)	Scald (%)	Rot (%)
		Calcium		
Less than 126	27	30	59	9
126-150	69	15	51	6
151-164	34	9	42	6
Greater than 164	42	7	37	6
		Potassium		
Less than 4750	30	13	46	7
4750-5200	62	13	43	7
5201-5800	60	15	47	6
Greater than 5800	20	21	61	13
		Phosphorus		
Less than 325	15	20	63	9
325-400	93	12	45	5
401-450	42	15	37	9
Greater than 450	22	7	46	10
		Magnesium		
Less than 241	26	17	45	7
241-270	89	17	49	7
271-300	44	13	47	9
Greater than 300	13	7	46	10
		Nitrogen		
Less than 1500	45	19	51	4
1500-2000	57	16	43	7
2001-2500	42	12	50	10
Greater than 2500	27	8	47	6

samples contained relatively high concentrations, and these samples developed relatively small amounts of breakdown and rot, although the effect on rot was not evident in the averages on Table 2 due to the presence of a couple of high-rot samples in this group. There was also a significant relationship between N concentration in fruit and the occurrence of breakdown, with higher N being associated with lower frequency of breakdown.

Fruit firmness is a crucially important quality characteristic for apples, especially McIntosh. It is therefore important to know if mineral composition of the fruit affected firmness. There was no significant relationship between any of these elements and fruit firmness, either at harvest or after storage. Thus, differences in fruit firmness among these orchards could not be attributed to differences in their mineral composition.

In 1980 and 1981, 5 micronutrients within the fruit were also surveyed: boron (B), zinc (Zn), manganese (Mn), iron (Fe) and aluminum (Al). The relationships between their concentrations in fruit and quality of the apples after storage were generally quite low. The strongest relationship was between low B and increased breakdown in 1981 (though not in 1980), but this effect was much less than that of low Ca on breakdown.

The 4-year time period and the wide geographical distribution of the orchards sampled in this survey produce an excellent view of the effects of fruit mineral composition on the storage life of Massachusetts McIntosh apples. These findings indicate to us that inadequate Ca in fruits is the primary nutritional factor influencing quality of McIntosh apples in Massachusetts, and that this factor is expressed mostly in the occurrence of breakdown after storage. Although excessive N and K in the fruit can cause severe reduction in fruit quality, very few samples in our survey appeared to be excessively high in these elements. Few samples contained Mg concentrations that appeared to impair fruit quality, and while low P did seem to be detrimental, only a small number of samples contained detrimentally low P concentrations.

The relationship between low Ca and occurrence of breakdown is further illustrated in Figure 1, where post-storage breakdown in each of the 172 samples was plotted against its Ca concentration. Regardless of their concentrations of other elements, samples very low in Ca (e.g., less than 130 ppm) almost invariably developed more than 10% breakdown, which we consider to be unacceptable quality. In contrast, samples high in Ca (e.g., more than 175 ppm) almost never developed 10% breakdown. At intermediate Ca concentrations, it appeared that the fruit were susceptible to breakdown but whether or not it developed was determined by other factors, one of which may have been the concentration of another element. It appears that when Ca concentration was high, the apples were resistant to breakdown regardless of the concentrations of other elements.

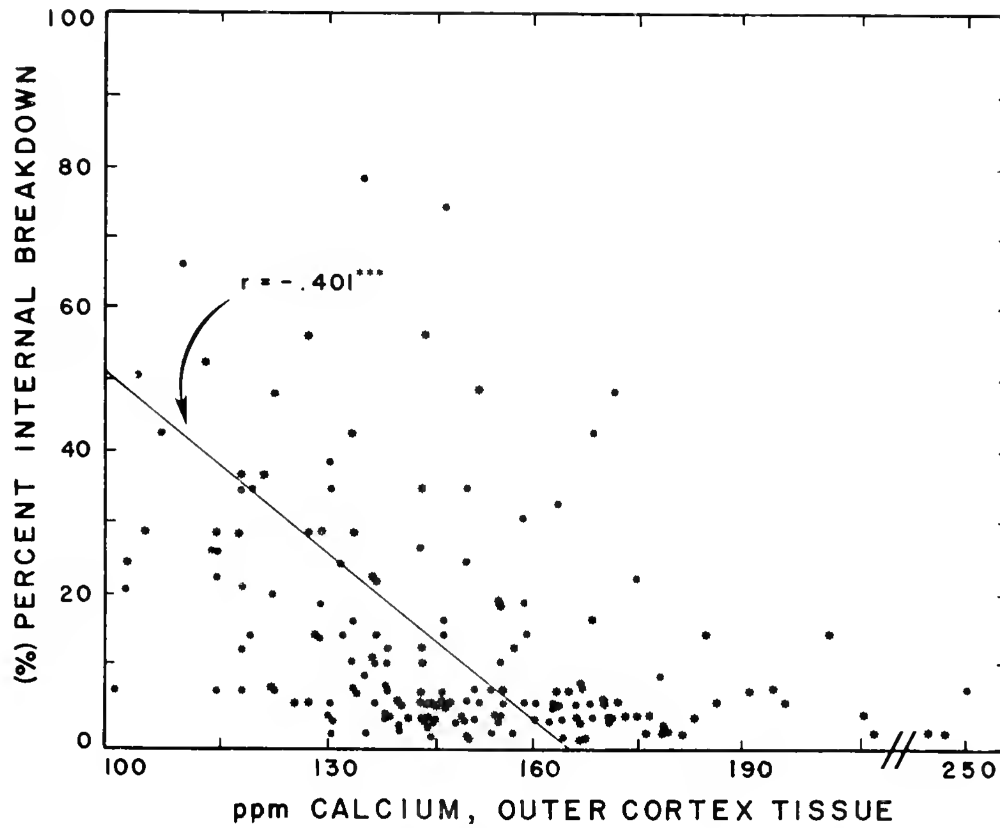

Figure 1. Scattergram showing percent breakdown after air storage in relation to the Ca concentration in fruit at harvest for each of the 172 commercial samples surveyed, 1979-1982.

Our study reaffirms the importance of establishing adequate Ca concentrations in McIntosh apples if they are to be stored for long intervals. There are 2 feasible approaches to this: foliar and post-harvest applications of Ca. Application of a total of approximately 75 lbs. of $CaCl_2$ per acre during the growing season can raise fruit Ca concentrations by about 50 ppm, and a postharvest dip in 4% $CaCl_2$ can increase it by about 35 ppm. It is evident that many commercial samples did not contain adequate Ca concentrations and that they would have benefited from the above treatments.

The effects of mineral nutrition on apple quality recorded here are restricted to the occurrence of disorders (breakdown and scald) and rot. Probably the most significant attribute of McIntosh quality after storage is the firmness of the fruit, and fruit firmness was not influenced by variations of any of the minerals surveyed. An excessively soft fruit is unacceptable, whether or not it develops disorders, and softening of the fruit is controlled primarily by harvest and storage management. Regardless of their mineral concentrations, apples harvested overmature, cooled improperly, or stored at too high a temperature or at the wrong atmospheric composition are likely to exhibit inferior quality after storage. The best of mineral compositions does not reduce the need for careful harvest and storage management.

THE APPLE MARKETS FROM 1967 THROUGH 1982, LOCALLY AND NATIONALLY

William J. Lord
Department of Plant and Soil Sciences

We have summarized yearly since 1967 the apple production in the United States and in Massachusetts, and the F.O.B. prices at Country Shipping Points in Massachusetts for 120 counts, U.S. Fancy or better McIntosh apples[1]. This information, which is presented in Table 1, indicates some of the factors that affect the profitability of a marketing season.

Marketing Seasons

1967-68 and 1968-69. Nationally these were "short" crop years and prices for Massachusetts grown apples were good. The fruit were in good condition and the demand for CA McIntosh was strong.

1969-70. The national crop was the second largest in 30 years. This contributed to lower wholesale prices for Massachusetts-grown apples than for the 2 preceding marketing seasons. Apple growers in the western states of the U.S. produced about 17 million more bushels in 1969 than in 1968 but received $41 million less for their crop[2]. In Massachusetts, "Soft McIntosh Problem" was encountered after CA storage and wholesale prices remained low for the entire season.

1970-71. The hot summer and fall reduced fruit quality in New England, Appalachia and Hudson Valley and many growers had low packouts because of poor fruit color and condition. In Massachusetts the returns for the large sizes of Delicious were better than in 1969-70 and prices for CA McIntosh finished strong.

1971-72. The 3rd consecutive national crop greater than 50 million was produced. U.S. growers asked the Secretary of Agriculture to appoint a team to study the marketing problems of the apple industry because of low net returns during these years. (A report of the team's findings with their recommendations as to needed action was published in 1972. The team did an excellent job of identifying the marketing problems of the apple industry, most of which still persist.)

Slow color development in Massachusetts delayed the harvest and marketing season and resulted in the harvest of too many large, soft, poorly colored apples. Massachusetts growers harvested

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1 Taken from the Special Apple Market Report published by the Division of Markets, 100 Cambridge St., Boston, MA.

2 The Good Fruit Grower, Sept. 15, 1970.

through the entire month of October. Prices for McIntosh apples from regular storage averaged only slightly higher than in 1970-71 and most growers lost money on bagged apples. During May and June, 1972, some Massachusetts growers again encountered the "soft McIntosh Problem". Low prices for CA-McIntosh through the remainder of the marketing season reflected the market concern about fruit softness.

1972-73. A small crop was harvested in Massachusetts and in the U.S. as a whole. Prices in Massachusetts were $0.75 to $1.00 higher for regular storage McIntosh than during the previous year. Stored McIntosh kept exceptionally well, no soft McIntosh were encountered and prices reflected this quality.

1973-74. The U.S. apple production was higher than in 1972 but the New England apple crop was the smallest since 1956 because of frost and poor pollination weather. Massachusetts experienced extremely hot weather from August 27 through September 4, 1973 and fruit probably softened rapidly. After September 4, the weather became favorable for color development.

Due to a short McIntosh crop, a light crop in eastern U.S., and an increasing demand for juice and sauce, prices were very favorable for apples from regular storage. Most growers made money on their bagged apples, which is not a common occurrence.

In early March of 1974, some storage operators again encountered soft McIntosh, especially with larger sizes. Although the problem was not as serious as other years the market reflected its concern.

1974-75. The national crop again exceeded 150 million bushels and in New England it was 30% larger than in 1973. McIntosh apples in Massachusetts were smaller than usual, but the harvest season was favorable for good color development.

Prices for regular storage McIntosh were only slightly higher than during the previous season. The prices for bagged and juice apples were lower than in 1973, and those for CA McIntosh reflected the soft-McIntosh problem encountered the previous year. Meanwhile, production and marketing costs increased drastically because of the energy crisis.

1975-76. The national crop was a record 178 million bushels with 52 million from Washington alone. The early crop forecast for New England was a 15% increase from 1974. However, rains delayed harvest and drop was excessive in some orchards. Consequently, storage holdings in Massachusetts were less than the previous season.

Prices for 120 counts were $0.75 to $1.00 less than during the previous season for regular storage McIntosh and somewhat less for those from CA storage. Consequently, growers who sold mainly wholesale lost money.

New York and Washington growers also had no profit from the record apple crop of 1975. New York had its largest apple crop in 50 years, but apples were left unpicked because of heavy carry-over of processed apples, the bumper crop, and financial problems of processing plants.

1976-77. The national crop decreased to 154 million bushels, but in Massachusetts it was somewhat larger than during the previous year. Prices for both regular and CA storage McIntosh in Massachusetts were very favorable throughout the 1976-77 marketing season. No soft McIntosh were encountered and prices of those from CA reached $11.00 in May and June.

1977-78. A national crop in excess of 160 million bushels was harvested. The New England crop was up 10% over 1976. In Massachusetts frost reduced the Delicious crop. Wholesale prices in Massachusetts were about the same as in 1976 for regular storage McIntosh but a strong demand for CA apples pushed prices higher later in the season.

The 1977-78 marketing season was the 2nd consecutive profitable year for most Massachusetts growers. The market for apples continued to improve during the late 1970's because of increased demand for fresh fruit and a growing demand for apple juice and cider.

1978-79. The national crop was about 10% higher than in 1978 with the increase being greater in the eastern and central states than in the western states. Harvest in Massachusetts was 10-14 days later than in 1977. However, weather during harvest was ideal with warm days and cool nights and no rain.

Marketing started about 10 days later than usual in Massachusetts, but movement was good and the prices received were higher than during the previous marketing season.

1979-80. Massachusetts crop was down about 10%, whereas the national crop was larger. Some drop of McIntosh was experienced in late-August but weather became cooler and drop was not troublesome thereafter. Many growers had an "umbrella" crop of McIntosh, thus they harvested many less fruits than originally anticipated.

Apple prices remained at the same level as in 1978-79. However, no soft McIntosh were encountered from CA storage and the price for these apples in April and May finished strong.

Nationally, this was the 4th consecutive large national crop marketed without encountering the burden of over supply. One reason these large crops were manageable was the strengthening of the export market. Market opportunities developed in the Middle East, Latin America, and the Far East. In 1979-80, U.S. apple exports reached 12.4 million bushels. In the 1960's the U.S. was exporting only about 2 million bushels, with Canada taking close to half of those.

1980-81. The U.S. apple industry encountered an oversupply due to a national crop in excess of 210 million bushels. However, the crop size in Massachusetts was similar to that of the previous year. The harvested fruit was small in some Massachusetts orchards due to dry weather. The season was 10-14 days late but rain did not interfere with harvest.

Apple prices were quite favorable for 120 count McIntosh in September (approximately $11.00) but they declined to about $9.00 by early December. Basically, the poor movement and decline in prices was caused by the supply pressure from Michigan and Washington. The prices for 120 counts increased $0.50 with the opening of CA storages but remained at this level for the remainder of the marketing season.

1981-82. It was estimated that the New England apple crop would be 20% less than in 1980. Massachusetts experienced a freeze on April 22 and most orchards had poor pollinating weather at bloom. Thus, few orchardists had a large crop.

New York state apple crop decreased from 26 million in 1980 to about 19 million in 1981. Production also decreased in Michigan, Ohio, and Pennsylvania.

Prices for U.S. Extra Fancy McIntosh 120 count started at $11.00 in September, increased to $12.25 in October and $13.25 in December. McIntosh were scarce in April and CA McIntosh finished in middle May at $14.75 for 120 counts.

The large Washington state crop and small fruit size hurt the New England's bagged Delicious market. The Washington crop suppressed sales in the 1982 crop of Paulared.

1982-83. Less apples were harvested than anticipated because of the presence of small, seedless fruits on trees in many Massachusetts orchards. Fruit color developed rapidly in late August and Friday prior to Labor Day (Sept. 3) some growers picked McIntosh apples for CA storage. Unfortunately, color developed slowly thereafter. The early market in September was "soft" in Massachusetts because of carry-over of the 1981 Washington crop. The carry-over hurt the sales of Paulared and September sales of McIntosh.

This and other factors including a large national crop of apples and oranges, poor fruit color, and storage disorders were largely responsible for the unfavorable prices during the 1982-83 marketing season (Table 1). In October, 1981 prices quoted for McIntosh Extra Fancy 120 counts in the Special Apple Market Report averaged $11.00 and by December had risen to #13.25. In contrast, apples started at $8.75 in October, 1982 and prices were virtually unchanged fro the remainder of the 1982-83 marketing season.

Summary

For the 5-year period from 1964-68 the national crop averaged about 132 million bushels. From 1973-77 it averaged 158 million, a 19% increase. The average production for the 5-year period 1976-80 increased to 178 million, 12% over that of 1973-77. The production nationally fluctuated from a low of 128 million bushels in 1967 to a high of 210 million bushels in 1980. To the contrary, apple production of Massachusetts remained quite stable from 1967 through 1982.

Over supply occurred during the 1969-70, 1970-71, 1975-76, 1980-81 and 1982-83 marketing seasons. Due to heavy plantings, especially in Washington, it is possible that we may again have devastating surpluses which will depress prices, increase wastage, reduce interest in new plantings and cause orchard abandonment.

During the period from 1967 through 1982 many factors affecting the profitability of a marketing season were evident. These include the size of the national crop, the regional distribution of the crop, weather prior to and during harvest, the keepability of stored apples, the demand for processing apples, the export market and the earliness or lateness of the marketing season.

Table 1. Apple production in the United States and for Massachusetts and F.O.B. prices at country shipping points in Massachusetts, 1967 through 1982.

Year	Crop size (million bu.)		Avg price for season ($)		CA price	
	U.S.	Mass.	Reg. Storage	CA	Start of season	End of season
1967	128	2.5	4.58	5.83	5.00	6.75
1968	129	2.1	5.00	6.28	5.75	7.00
1969	159	2.4	4.17	4.46	4.60	4.50
1970	151	2.6	3.75	5.10	4.75	6.00
1971	152	2.7	3.59	3.19	5.10	5.25
1972	139	2.2	5.18	6.31	5.60	7.50
1973	147	1.8	7.23	7.85	7.75	8.15
1974	154	2.2	7.64	8.02	8.00	8.40
1975	179	2.0	6.72	7.70	7.35	8.00
1976	152	2.2	7.89	7.70	8.65	11.00
1977	164	2.1	8.16	9.59	8.75	13.00
1978	182	2.4	9.24	9.98	10.25	11.25
1979	193	2.3	9.28	7.81	9.75	13.40
1980	210	2.3	9.52	9.50	9.50	9.50
1981	182	2.0	12.27	14.41	13.75	14.75
1982	195	2.4	8.78	8.73	8.25	9.75

CIDER NOTES

Kirby M. Hayes
Department of Food Science and Nutrition

A question that often arises is how to make good cider. Although there is no easy answer, or hard and fast rules, two of the most important factors to consider are maturity and variety.

Maturity

Firm, ripe apples--those that are ripe enough to eat out of hand--make the best cider and give the highest yield. Immature or overripe apples lower the quality. Early-maturing varieties should be allowed to ripen sufficiently to yield a high-quality juice.

Variety

The best cider is usually made from a blend of different varieties of apples. A blend provides an appealing balance of sweetness, tartness, and tang, as well as aromatic overtones.

A single variety of apple seldom makes a satisfactory cider. However, "McIntosh" has been used alone successfully, but only at the peak of its maturity.

Sometimes the desired fullness and balance can be obtained from two varieties. A blend of three or more varieties is better. Using several varieties, permits greater latitude in varying the proportions to obtain the desired blend, and also allows practical management of the available supply.

Many commercially important varieties may be separated into four groups according to their suitability as cider material: Sweet subacid, mildly acid to slightly tart, aromatic and stringent. A strict classification is not possible because many varieties have a number of different flavor characteristics. For example, "Delicious" may be listed in both the sweet subacid and aromatic groups. Moreover, varieties differ in their characteristics from one area to another.

Varieties in the sweet subacid group are grown primarily for eating raw; they usually furnish the highest percentage of the total stock used for cider.

Varieties in the aromatic group have outstanding fragrance, aroma and flavor that are carried over into the cider.

Crabapples, in the astringent group, provide tannin - a constituent difficult to obtain in making a high-grade cider. The juices of this astringent group also are highly acidic. Only a small quantity of these apples should be used in the blend.

Use of the following list as a guide in selecting the right blend of varieties.

Sweet subacid group: Baldwin, Delicious, Cortland, Spartan, Empire, Macoun.

Mildly acid to slightly tart group: Winesap, Jonathan, Northern Spy, R.I. Greening, Roxbury Russet.

Aromatic group: Delicious, Golden Delicious, McIntosh, Empire.

By fitting the above suggestions to your operation, using sound clean apples, pressing in a clean mill, and storing and displaying the finished product under refrigeration, you can keep your customers coming back for more.

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POMOLOGICAL PARAGRAPH

What are genetic dwarfs? This question is common now that genetic dwarf varieties of peach, apricot, nectarine and apple are available to commercial orchardists. Genetic dwarfs are selections of natural mutants or mutants induced by radiation that produce trees smaller than typical. Thus, the dwarfing is induced by the scion variety rather than the rootstock. Trees of Starkspur Compact Mac and peach and nectarine varieties are very small and could be grown in a tub on a patio. The internodes on these trees are so short that the wood is flat and thickened. In contrast, trees of the genetic dwarf Compact Red Delicious (Cascade strain) has "normal" appearing wood because of greater internodal spacing and may be 10-12 feet in height when on a seedling rootstock. We are currently testing the Compact Red Delicious,Starkspur Compact Mac and some dwarf nectarine varieties at our Horticultural Research Center in Belchertown.

THE STARCH TEST GUIDE FOR APPLE MATURITY

William J. Bramlage
Department of Plant and Soil Sciences

Once apples begin to ripen, a large portion of the potential benefit from CA storage is lost, since CA has the capability of suppressing the beginning of ripening. It is therefore very helpful in harvest management to know which apples are and which are not yet ripening. The most precise measure of the onset of ripening is through ethylene analyses since ripening is accompanied by a huge burst of ethylene production. Unfortunately, methods for measuring ethylene production during commercial harvesting have been hampered by many technical difficulties and few observers feel that ethylene measurements are commercially feasible today.

It has long been known that as apples ripen, their starch is rapidly converted to sugar. Starch concentrations, starch patterns, and starch conversion rates vary among varieties and are influenced by environmental conditions, yet for some varieties the changes can be very clear and dramatic. McIntosh is such a variety. At the University of Guelph, in Ontario, extensive studies led to the development of a very simple procedure for measuring the progress of ripening in McIntosh by following the loss of starch from the fruit.

The test is based on the fact that starch, but not sugar, will react with iodine to form a blue-black color. To perform the test, a random sample of 10 to 20 fruit are cut open and half of each apple is immersed briefly in a shallow dish containing an iodine solution. The apples are allowed to sit a minute or 2 to allow the color to develop, and the color is then matched to a chart which tells whether the apples were "immature," "mature," or "overmature." For "finer tuning," each of these classes is subdivided into 3 numerical classes.

This very simple, rapid test allows growers to see for themselves the stage of development of their fruit. Periodic sampling of fruit from different blocks can give them an ongoing view of where ripening is occurring fastest, and help in determining when and where to pick. The test also can be a very important guide in deciding which fruit should be directed into CA storage. Certainly, batches of fruit in which a large percentage of the apples are scoring as "overmature" should not be placed in CA, as they are too ripe to hold up during and following storage.

All that is needed to perform the starch tests are (1) a chart with instructions; (2) some iodine and potassium iodide crystals; (3) a shallow dish; and (4) a pocketknife. A chart is available, entitled "Evaluating apple maturity. Using the starch-iodine test." It can be obtained free from Dr. E.C. Lougheed, Horticultural Science Department, University of Guelph, Guelph, Ontario, Canada N1G 2W1. The chart also contains instructions for testing apples.

The chemicals can be obtained from a pharmacist, who may have to order them for you. Although they are expensive, small quantities go a long way. The chart described above includes a recipe for making up the chemicals, but a simpler recipe has been suggested by Dr. M.E. Saltveit, Jr., formerly at North Carolina State University. It is as follows: "First dissolve 1 level teaspoon of potassium iodide crystals in approximately 1/8 cup clean water in a 1-quart container. Gently swirl the container until the crystals dissolve. Next, add 1/4 teaspoon of iodine and swirl the container until the iodine dissolves. Finally, dilute this solution with clean water to make one quart.

This solution is sensitive to light and should be kept in a dark container, such as a glass jar wrapped in aluminum foil. Fresh solution should be made every season."

The above chart is designed for use on McIntosh, and the brochure contains an accompanying chart for use with Delicious. North Carolina also has a brochure available with charts for Delicious, Golden Delicious, and Law Rome. ("Determining the maturity of North Carolina apples. The starch-iodine staining technique." Publication AG-282). It ws prepared by M.E. Saltveit, Jr. and Susan A. Hale, Dept. of Horticultural Science, North Carolina State University, Raleigh, NC 27650.

We strongly urge growers to try the starch-iodine test for apple maturity, and to see for themselves the clear changes that are portrayed by the tests. We believe that the tests will provide information that will make it easier for growers to make wise decisions during a very stressful period.

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POMOLOGICAL PARAGRAPH

Storage temperature for McIntosh in CA. The correct temperature for holding McIntosh in CA is 36-38·F. Growers operating their rooms at less than 36·F are increasing the risk of low temperature injury, as occurred during the 1982-1983 storage season. Symptoms of low temperature injury this past storage season were a brownish-gray discoloration around the stem-end of the apple and/or internal browning of the flesh near the core of the apple.

POSTHARVEST CALCIUM CHLORIDE TREATMENT

William J. Bramlage
Department of Plant and Soil Sciences

Our orchard surveys have shown that approximately one-third of the commercial samples of McIntosh apples in Massachusetts are at such low calcium (Ca) concentrations that they possess a high risk of developing breakdown after storage. Most other samples contain Ca concentrations that carry a lower risk of breakdown, but they could still benefit from some additional Ca.

There are 2 feasible ways of successfully applying Ca to apples: tree sprays and postharvest drenches. Even when a conscientious tree-spray program has been followed, apples can usually still benefit from postharvest treatment. Thus, postharvest Ca treatments have potentially wide benefit for the fruit industry.

A postharvest Ca application is viewed as a food-additive process by the Food and Drug Administration. That agency has stipulated that "Brining Grade" calcium chloride, containing 94% $CaCl_2$, is acceptable for postharvest use. The technical flake $CaCl_2$ commonly used for tree sprays is still acceptable for tree sprays, but it may not be used for postharvest treatments. Therefore, anyone wishing to use postharvest $CaCl_2$ treatments must obtain the Briner's Grade material, which is now readily available from suppliers.

$CaCl_2$ may be combined with scald inhibitors and fungicides in the postharvest treatment solution. Cornell University has recommended the following mixture for postharvest treatment of McIntosh:

21 lbs of $CaCl_2$ per 100 gal of water
½ lb of Benlate* or 16 fluid ounces of Mertect*
1 lb of Captan
1000-2000 ppm DPA

We suggest that ½ quart of vinegar also be addded to this mixture in 100 gallons of water. The vinegar neutralizes the $CaCl_2$, which otherwise makes the solution alkaline. There is evidence that the alkaline solution may cause the fungicides to break down rapidly in solution, and the addition of vinegar can protect against their alkaline degradation.

* Trade names

In use of postharvest $CaCl_2$ drenches, it is important to understand that little or no Ca enters the fruit during the drenching process. The purpose of the drench is to leave a residue of $CaCl_2$ on the fruit. Ca is slowly absorbed by the apple from the residue during storage. Therefore, the drench is never followed by a rinse, which would remove the residue. Furthermore, for Ca to be absorbed from the residue, the residue must not dry out. The apples should not be allowed to air-dry before storage. If the storage is operating at the desired relative humidity (90-95%), the residue should not dry out. However, if the storage is operated at less than 90% relative humidity the residue may dry out and no Ca uptake will occur as a result of the drench treatment.

We have encountered no difficulty from this residue when apples are removed from storage. It will be removed if apples are water-dumped, but even with hand-packed fruit no difficulty has been reported.

$CaCl_2$ drenches can cause fruit injury, which occurs as tiny black spots on the surface of the fruit. Generally, these spots are concentrated in the calyx cup of the apple and are not objectionable, although under some circumstances they may coalesce into more unsightly blotches or may occur at the lenticels on the cheeks. Do not exceed the recommended $CaCl_2$ concentration, as risk of this injury escalates rapidly at higher concentrations.

$CaCl_2$ is also corrosive, so equipment should be thoroughly cleaned at completion of treatment. However, with appropriate rinsing corrosion should not be a concern.

The purpose of the postharvest application of $CaCl_2$ is to reduce the risk of breakdown, rot, and scald during but especially after storage. The recommended treatment will not make fruit firmer, but will improve their ability to hold up during marketing. Treatments will be of greatest benefit to mature fruit destined for long-term storage. Overripe fruit cannot be expected to benefit significantly from a $CaCl_2$ treatment.

ACID RAIN AFFECTS APPLE MAGGOT FLY EGGLAYING

Anne L. Averill[1] and Ronald J. Prokopy[2]
Department of Entomology

Acid rain occurs when airborne sulfur and nitrogen oxides originating from combustion of fossil fuels are washed to the earth during rainfall as sulfuric and nitric acids. In addition to being a popular topic in magazines and newspapers, this phenomenon is a complex political issue: although Massachusetts has the most acidic precipitation in the country, many scientists believe that the bulk of our rain's contamination emanates from Midwestern smoke stacks. Residents of the Northeast have become progressively concerned and bitter as an increasing number of scientific studies demonstrate detrimental effects of acid rain, especially on aquatic ecosystems, soils, and crop and forest vegetation.

In the course of studies of apple maggot fly egglaying behavior, we noted a particularly intriguing effect of acid rain. Our observations suggested that a host fruit exposed to acid rain was less acceptable to the flies for egglaying than was an unexposed fruit. To test this possibility more thoroughly, we are hanging clean fruits in trees during each of this summer's rains, with some fruits protected from rainfall by plastic hoods. These fruits are brought to the lab, and by observing the number of flies which attempt egglaying, we can evaluate the influence of rain exposure on fruit acceptibility. Acidity (pH analysis) of each rain event is determined by Dr. O.T. Zajicek of the Department of Chemistry at UMASS. Thus far, most rains have fallen into 1 of 2 categories: those with pH values well below 4 (3.6-3.8) and those with pH values above 4. These categories largely reflect the dominant weather pattern at the time of the storm. Usually, the more acidic contaminated storms (pH 3.6-3.8) move into our region from the Midwest and the less contaminated storms move in from elsewhere. The data available to date (Table 1) show that apple maggot egglaying was not influenced when fruits were washed by rains with a pH above 4, whereas egglaying was significantly decreased when fruits were washed by rains of pH 3.6-3.8.

This phenomenon may be explained by the fact that apple maggot flies have contact chemical receptors (hairs) which are located on the bottom of their feet. Via these receptors, a fly may receive cues emanating from the fruit to control steps in fruit acceptance and egglaying. The presence of acids on the fruit surface may interfere with perception of these cues, or may actually damage or destroy the chemical receptors.

Whatever the explanation for our observations, it is possibly to our advantage, and to the disadvantage of the apple maggot fly, that acid precipitation is most severe in the summer months during peak fly activity.

---

[1] Graduate Student
[2] Extension Entomologist

Table 1. Percent arriving apple maggot flies attempting egglaying into fruits exposed to summer rain storms. Non rain-exposed fruits were protected from rain under plastic hoods.

Rain with pH 4.0-4.2	% Attempted egglaying[a]	Rain with pH 3.6-3.8	% Attempted egglaying[b]
Non rain-exposed fruits	50	Non rain-exposed fruits	65
Rain-exposed fruits	55	Rain-exposed fruits	46*

[a]Average of 6 storms
[b]Average of 3 storms
*Significantly less than egglaying into non rain-exposed fruits

NEW PUBLICATIONS AVAILABLE

Two new publications are available to the public.

One, entitled "Postharvest disorders of apples and pears," was prepared by S.W. Porritt and M. Meheriuk of the Agriculture Canada Research Station, Summerland, British Columbia, and by P.D. Lidster of the Agriculture Canada Research Station, Kentville, Nova Scotia. It contains excellent color prints of various disorders along with very useful information about the disorders. It is available free, as Publication 1737, from the Communications Branch, Agriculture Canada, Ottawa, Ontario K1A0C7.

The second publication was prepared by G.D. Blanpied and R.M. Smock of Cornell University and is entitled, "Storage of fresh market apples." It contains a great deal of information on current thinking about apple storage management, and is available as Information Bulletin 191 for a fee from Distribution Center C, 7 Research Park, Cornell University, Ithaca, New York 14850. The fee is $4.50 per copy. Send a check or money order payable to Cornell University. Be sure to print your name, complete address, and ZIP code clearly on your request for the publication.

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EDITORS
W. J. LORD AND W. J. BRAMLAGE

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1984

A Report on the 1983 Apple IPM Program

W.M. Coli[1], R.J. Prokopy[1], and W.J. Manning[2]

1983 was a year of transition for Apple IPM in Massachusetts, during which program emphasis shifted from providing scouting and pest management advisory services for a limited number of growers toward a stronger educational and information transfer effort for all the state's growers as well as support of private sector IPM implementation.

Grower interest in and support of IPM continued to be excellent, with informal surveys indicating that over 2/3 of the state's total apple acreage is presently under some form of integrated management (e.g. private sector scout/consultants, grower scouting, careful attention to proper timing of pesticide application, or selection and use of IPM-compatible pesticides). In FY 1983, growers contributed $3200 toward the continuation of the program and apple IPM specialist position -- a substantial committment when one considers that many of these same growers also paid @$20/acre for private scout/consultant services. Further, a mechanism was established to lease to private parties 9 hygrothermograph units.

Extension faculty and professional staff conducted or participated in 12 IPM training sessions (usable for pesticide certification credits) (4 in each of the three major fruit-growing regions of the state.)

[1]Entomology Department
[2]Plant Pathology Department

Acknowledgments: We wish to thank Ms. Kathleen Leahy for scouting and computer-related assistance.

Special thanks to Glenn Morin and Roberta Spitko for providing a substantial portion of the harvest injury survey data which is compiled in Table 2.

In addition, the Entomology IPM Specialist performed weekly scouting in six commercial orchards to collect data and samples on insect/mite and disease pest status. With the cooperation of Plant Pathology staff (Mr. Dan Cooley and Dr. W. Manning), Mr. Coli was primarily responsible for maintaining a frequently updated (2 x weekly), computer-based message system accessable by terminals in regional fruit specialist offices. These messages also contained information gathered by other extension staff (Jim Williams, Tom Green and Ron Prokopy), private sector scouts (Glenn Morin, Roberta Spitko, Breck Parker, Wayne Rice and Ed Roberts Jr.) and from weekly access to New York State's excellent computerized information system (SCAMP). Regional specialists sent this information to growers via weekly newsletters and 24 hour code-a-phone devices (over 1370 calls were made to these code-a-phones in 1983, an increase of 20% in utilization over 1982). Numerous favorable grower comments have been received concerning the quality of the 1983 pest messages and their value to growers as management aids.

Table 1 is a graph of weekly totals of calls received on Jim Williams' and Karen Hauschild's code-a-phones during the 1983 season (data from Dom. Marini's region are not available since his code-a-phone has no counter.) Total calls received in these regions were 1222. There are several interesting points to note in this graph, including:

1. A six-fold increase in use from week 1 to week 2 as the pest control season began in earnest, particularly with regard to frequent wetting periods and changes in fungal spore maturity.
2. A substantial drop in calls during bloom, followed by a major peak in usage during late May - early June. This peak coincides with the

approaching end of primary scab season, as well as the onset of sprays against plum curculio and 1st generation leafminer larvae.

3. Another peak during the week of June 21 when 1st generation San Jose scale (SJS) crawlers first became active.
4. Increased calling from July 12-July 19 following the first reported apple maggot (AMF) capture in an early developing commercial orchard (7/11).
5. A final period of high usage from July 26 to August 9, a time of decision-making with regard to 2nd generation leafminer (LM) in many areas.
6. It is somewhat surprising to note the relatively low number of calls received thereafter, in spite of the impending activity of 2nd generation San Jose scale crawlers.

Other IPM-related information was published in the form of four "Fruit Notes" articles, a paper presented at the annual meeting of the Mass. Fruit Growers Association (co-authored by S.A. Weis, Plant and Soil Science and Dr. J.M. Clark, Entomology) and a symposium talk presented to the Eastern Branch ESA Meetings in Hartford Connecticut (co-authored by F. Drummond, T. Green and R. Prokopy, Entomology Dept). The Entomology Specialist, in collaboration with Dr. Clark, recently applied for and received a $1200 grant from the M.F.G.A. to perform laboratory work to further investigate effects of spray mix pH on pesticide stability and effectiveness.

An additional accomplishment was the receipt of a $6850 grant from USDA to be used to publish a photographic manual of IPM techniques for use on apples in New England. This publication, an expansion of the Apple Insect/Mite Photo manual which many growers have seen at IPM training sessions, will contain over 100 4-color photographs with text on major insect/mite, disease and vertebrate pests of apples as well as a segment on integrated management of orchard cover crops.

Insect Pest Injury, 1983 - Direct Pests - Table 2 contains results of on tree harvest injury surveys conducted by extension and private sector IPM personnel. It is interesting to note that tarnished plant bug (TPB) again accounted for the majority of fruit injury observed just prior to harvest. However, with the exception of a few blocks where TPB injury to individual fruit was severe (similar to "cat-facing" injury on peaches), much of this "injury" would pass through a grading line with no effect on fruit grade.

While many growers appear to be achieving good San Jose scale (SJS) control, largely due to improved monitoring and better spray coverage, SJS ranked second in importance in monitored blocks (range 0-4.3% injury) in 1983. As was the case last year, SJS crawlers continued activity well into September, when pre-harvest interval considerations made treatment impossible.

European apple sawfly (EAS) injury was about at average levels for the last 5 years (0.40% in IPM blocks, 1978-1982). In 1983, however, much EAS injury consisted of a "dimple" in the fruit calyx, which would likely not affect fruit grade.

Green fruitworm (GFW) injury, which will probably result in fruit culling, was up from 5-year averages, largely due to suspected resistance to Guthion and Imidan in several blocks. Growers who experienced substantial injury from GFW in spite of pink and/or petal fall sprays of OP compounds should consider use of other materials (carbamates, for example) in the spray program next year. Most other direct pests were of minor importance in 1983.

Indirect Pests - Injury from 2 indirect pests, white apple leafhopper (WAL), and aphids, was substantial in some blocks. 2nd generation WAL populations reached outbreak levels immediately prior to McIntosh harvest in at least one monitored orchard (active stages exceeding 10 per leaf). Injury to leaves and excrement on fruit was extensive in this case. A further problem was the annoyance factor of leafhoppers flying into picker's faces during harvest. While aphids were controlled by predators at many sites this year, substantial sooty mold growth on honeydew (as high as 43% of fruit in one case) can probably be explained by lack of significant rain showers in many areas.

Pyrethroid insecticides (e.g. Pydrin) provided excellent control of leafminers in almost all cases. Interestingly, growers who used pyrethroids averaged only 1.6 percent TPB injury versus the state average of 2.52%, reinforcing our earlier research plot data which suggested that pyrethroids may be excellent materials for integrating controls of a key direct pest (TPB) and a key indirect pest (ABLM/STLM). Growers who applied carbamate materials against 1st generation miners generally experienced excellent control results. Where 1st and 2nd generation controls were not adequate, 3rd generation moth flight was quite large, as expected. A few growers applied sprays for miners of this generation, even though such sprays may be more harmful then helpful.

Spider mites (European red mites, two spotted mites) were a problem at many locations throughout the year, due to hot, dry weather. Frequent reapplication of miticide was needed in some cases to achieve control. Even where controls were applied, some locations experienced late mite outbreaks with renewed hot weather in early September. Levels of our major mite predator Amblyseius fallacis, were lower than normal this year possibly owing to low overwintering numbers of this beneficial mite or to the effects of pyrethroid or carbamate insecticides directed at other pests.

Plans for 1984 - It appears that funding for apple IPM, as well as for IPM programs begun in Mass. in 1983 in other commodities, will continue at present levels in 1984. Based on this premise, we plan to continue with a similar apple IPM effort, focusing particularly on the IPM training sessions and maintenance of an extensive, frequently updated, tree fruit pest message system. We welcome grower suggestions and comments on the pest messages to ensure that grower needs are met.

As mentioned above, we expect to publish a field manual of IPM techniques prior to the 1984 growing season. We feel that this publication will provide growers with a comprehensive field reference to identification, life histories, damage, monitoring and control measures for the major New England apple pests.

In addition, Massachusetts will be one of a group of states participating in a national study on IPM program impact. This study, under the leadership of Virginia Polytechnic Institute, will examine overall social and economic benefits of IPM implementation to the state's apple growers. We will be one of two states in the Northeast (New York is the other) to focus on apples. It is hoped that this study will provide information which will be useful in justifying further Federal support for IPM and in determining areas where program modifications are required to be more responsive to private sector needs.

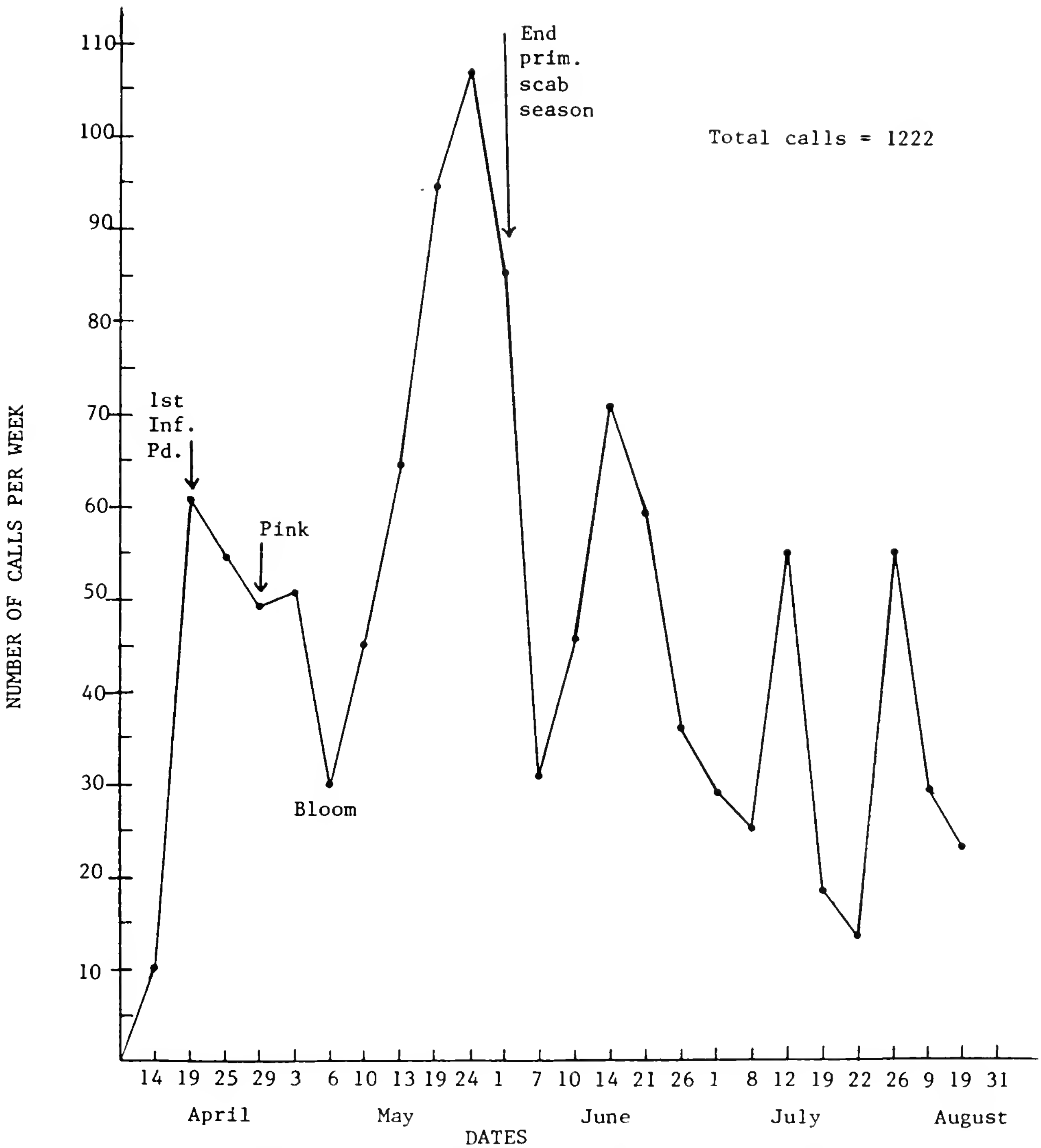

Table 1. Code-a-phone use, Northeast and Western regions, 1983.

Table 2. Percent insect injured fruit in on-tree surveys of 48 IPM commercial orchard blocks. 1983[1]

Insect pest	
Tarnished plant bug	2.52
San Jose Scale	0.49
European apple sawfly	0.41
Fruitworms	0.38
Plum curculio	0.17
Leafrollers	0.07
Apple maggot	0.03
Codling moth	0.00
Total Injury - Direct Pests	4.07
White apple leafhopper	0.22
Sooty mold	1.06
Total Injury - Indirect Pests	1.28

[1]Data from 38 blocks receiving private IPM scouting/consultant services from New England Fruit Consultants, Mr. Glenn Morin and Dr. Roberta Spitko. Samples consisted of 50 fruits per tree on 6-16 trees per block.

Data from 10 other commercial blocks collected by Extension IPM staff. Samples consisted of 100 fruits per tree on 4-10 trees per block.

VARIATIONS IN TREE FORM IN AN EIGHT-YEAR-OLD SPUR-TYPE McINTOSH PLANTING

C.G. Embree
Agriculture Canada, Kentville, N.S.

Editor's Note. The growth habits of Macspur and Morspur trees are variable in Massachusetts. Thus, it is of interest to note that the same difficulty is being encountered with Starkspur Ultra Mac under Nova Scotia conditions.

Nova Scotia apple growers have a keen interest in the spur-type strains of commercial apple cultivars. When considerable size control is provided by the cultivar a more vigorous reliable rootstock such as the locally grown Beautiful Arcade seedlings can be used. These trees are not expected to outgrow the widely adopted 155 (14 x 20) planting system. Beautiful Arcade is a seedling stock that has performed well in experimental trials and orchards in Nova Scotia, being productive, smaller than many other seedlings, hardy and a promoter of early yields with McIntosh and Cortland.

Early indications of spur-type variants of McIntosh from B.C. coincided with the development of a mother orchard for the production of virus-free, true-to-name propagation material by the Nova Scotia Fruit Growers Association. Following investigations of the various strains it was decided that the Dewar strain was most appropriate for this region. Negotiations with Mr. Dewar led to his forwarding a sample of scion wood to the Research Station for testing with possible inclusion in the mother orchard.

Fig. 1. Dewar McIntosh on Alnarp II in P. Van Oostrum Orchard planted in 1974 exhibiting spur-type growth habit. Photo taken May, 1983.

The scion wood was grafted on Alnarp II roots at about 14" above the rootzone and grown in a nursery for one year. They were planted in a growers' demonstration trial in the spring of 1974. Trees were spaced at 15 x 22 at 50 trees per row in two adjacent rows. Early productivity has been good, as have been fruit color and size, when compared with other trees in the block. However, the strain has since been sold to Stark Brothers Nursery and released as Starkspur Ultra Mac.

Variation in growth habit has become obvious in the Nova Scotia planting (Figures 1 & 2). In 1983 trees with considerable branching and side shoots represented 21% of this planting. Forty-six percent of the trees had typical spur-type growth habit with virtually no side branches on the main limbs. The remaining 33% of the trees had some degree of spur-type character but some side branching was also present. Detailed records of the number of spurs per meter of growth and the amount of extension growth will be recorded in 1984 prior to pruning.

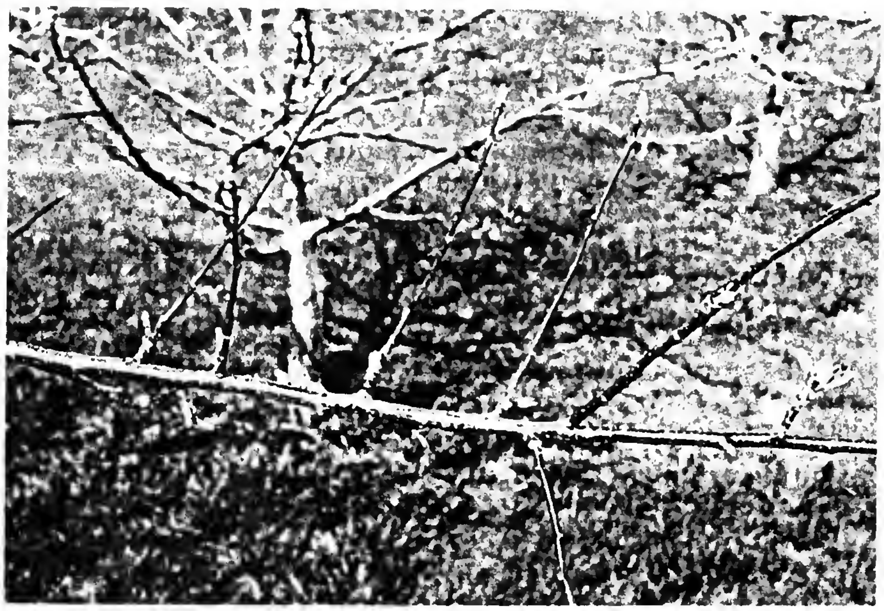

Fig. 2. Dewar tree in same block as shown in Figure 1 but with standard type growth habit (non-spur).

Reports of variation in spur-type tree from have been observed in other strains and cultivars in Nova Scotia orchards but no ratings have been done at this time.

It is of interest to note that some trees in this block had little or no bloom in 1983. This is also true of Idared on MM111 and Spy on M26. It should be noted that the soil in this planting is quite coarse and excessively drained. This coupled with the very dry harvest season and heavy crop in 1982, appears to have accentuated an inherent biennial bearing tendency. Concerns of this tendency in the spur types are described in 1973 publication titled, "Spur-Type Apple Trees" and is available from the author.

HEIGHT CONTAINMENT ON SPARTAN AND IDARED TREES

William J. Lord and Anthony W. Rossi
Department of Plant and Soil Sciences

In the January/February, 1980 issue of FRUIT NOTES we discussed our progress with height containment of Spartan and Idared trees on M7a rootstocks. The objective of this demonstration was to answer 2 questions: (1) What is a suitable pruning method for containing tree height?, and (2) What is the influence of height reduction on yield? Below we have: (1) summarized previously reported findings through harvest in 1979, (2) included our data and observations for the last 3 years, and (3) described containment pruning.

Summary of Previous Findings Through Harvest, 1979

Limb rotation in the top third of the crown of Spartan and Idared trees on M7a rootstock was a suitable procedure for containing tree height. The pruning demonstration was initiated in February, 1976, and after dormant pruning in February, 1979, the average height of the control trees was 2.5 feet greater than that of the height-restricted trees. In spite of the height difference, yields were not consistently reduced from 1976 through 1979 on the height-reduced trees (Table 1).

Table 1. Influence on yield from height reduction of Spartan and Idared trees[z].

Year	Spartan[y]		Idared[x]	
	Height reduced	control	Height reduced	control
	Bushels/tree			
1976	6.0a[w]	8.0a	6.2a	7.5a
1977	4.0b	5.3a	4.1a	4.8a
1978	10.4b	12.5a	10.2a	12.4a
1979	9.6b	12.2a	8.9b	11.4a
1980	6.5a	6.3a	8.2a	9.5a
1981	14.0a	16.3a	9.3b	11.7a
1982	13.1b	14.4a	14.2b	15.2a
Cumulative yield	64b	76a	61b	73a

[z] Trees planted in 1964; trial started in February, 1976.

[y] Tree height 3/79: Control, 11.4 ft.; height-reduced trees, 8.9 ft. Height 3/82: Control, 12.5 ft.,; height-reduced trees, 8.5 ft.

[x] Tree height 3/79: Control, 10.6 ft.,; height-reduced trees, 8.3 ft. Height 3/82: Control 11.8 ft.; height-reduced trees, 8.1 ft.

[w] Means in any row for each variety followed by different letters are significantly difference at odds of 19 to 1.

Results Through Harvest of 1982 and Conclusions

Containment pruning to restrict tree height continued to be successful. The height difference (measured at top of central leader) between the control Spartan and Idared trees and the height-restricted trees of these varieties now averages 4.0 and 3.7 feet, respectively. Although the influence of height restriction on yield still is not consistent (Table 1), the cumulative yields for the 7 years have been 12 bushels less per tree on the height-restricted trees.

The harvest crew has expressed its preference for the height-restricted trees but the yield reduction may be unacceptable to most growers. Theoretically, yields per acre of the height-restricted and control trees would be similar if the shorter trees were spaced 20% closer. For example, the trees in this trial are spaced 20 feet x 30 feet (72 trees/acre). To increase tree numbers by 20% (86 trees/acre) one would plant the trees at 18 x 28 foot spacing.

Containment pruning will work on many varieties but certain varieties are much more vegetative than others. We have encountered no difficulty in maintaining the Idared and Spartan trees on M7 at 8.3 feet and 9 feet, respectively. However, tree height of 9 feet is too low for the innate vigor of non-spur Delicious on M7 at our Horticultural Research Center. In contrast, spur-type trees of Delicious on M7a could be easily maintained at 9 feet (height of central leaders).

Procedures Suggested to Contain Tree Size

1. Branches that crowd those of adjacent trees will have to be removed or cut back to a weaker side branch. (Cuts made only to maintain the desired outer profile of the tree compounds rather than alleviates tree containment problems. Such cuts stimulate vigorous growth and by the end of the next growing season, the limb may extend as far as the original branch did before shortening, and may cause more shading within the tree than did the original uncut branch.)

2. Maintain conical tree shape by removing large limbs in the top third of the tree or cutting them back to a very much weaker side branch.

3. Initiate a limb rotation program in the top third of the tree by retaining weak branches or spreading desirable water sprouts, which in turn may have to be removed when they become too large.

4. Reduce the height of excessively tall trees by cutting them back to a strong outward growing lateral branch originating at a lower level on the leader.

5. Frequently a strong scaffold branch with a narrow crotch angle develops in the upper third of the tree. If this branch is not removed or its growth is not restricted, the tree will become a multiple leader tree. Trees of this type are much more difficult to prune when practicing containment pruning or lowering tree height.

6. Delicious trees are subject to weak crotches, and branches are prone to develop in whorls and to droop. The ends of drooping branches should be removed back to a lateral growing in a somewhat upright position. This will shorten and stiffen the branches. The tip of the lateral on a pruned drooping branch should be higher from the ground than any other portion of the branch. This should reduce the problem of suckering.

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POMOLOGICAL PARAGRAPH

William J. Lord
Department of Plant and Soil Sciences

Increased Interest in Cherry Growing. Interest in cherry growing has increased in Massachusetts because of labeling permitting use of Mesurol* for repelling birds. While sour cherries are relatively winter hardy, sweet cherries may be severely injured, if not killed, by low temperatures. However, sweet cherries can be grown successfully with limited amounts of nitrogenous fertilizer. To eliminate or reduce injury to sweet cherry trees caused by low temperatures, the soil under the trees should not be cultivated.

Sour cherry trees are smaller than sweet cherry trees and are better suited for U-pick operations. At this time we cannot recommend the use of dwarf rootstocks for either sweet or sour cherry trees.

Several sweet cherry varieties you may want to consider are Emperor Francis, Schmidt, Hedelfingen and Windsor. Montmorency is the most popular sour cherry variety; other varieties are EArly Richmond, English Morello, North Star, and Meteor. North Star and Meteor produce much smaller trees than the other varieties.

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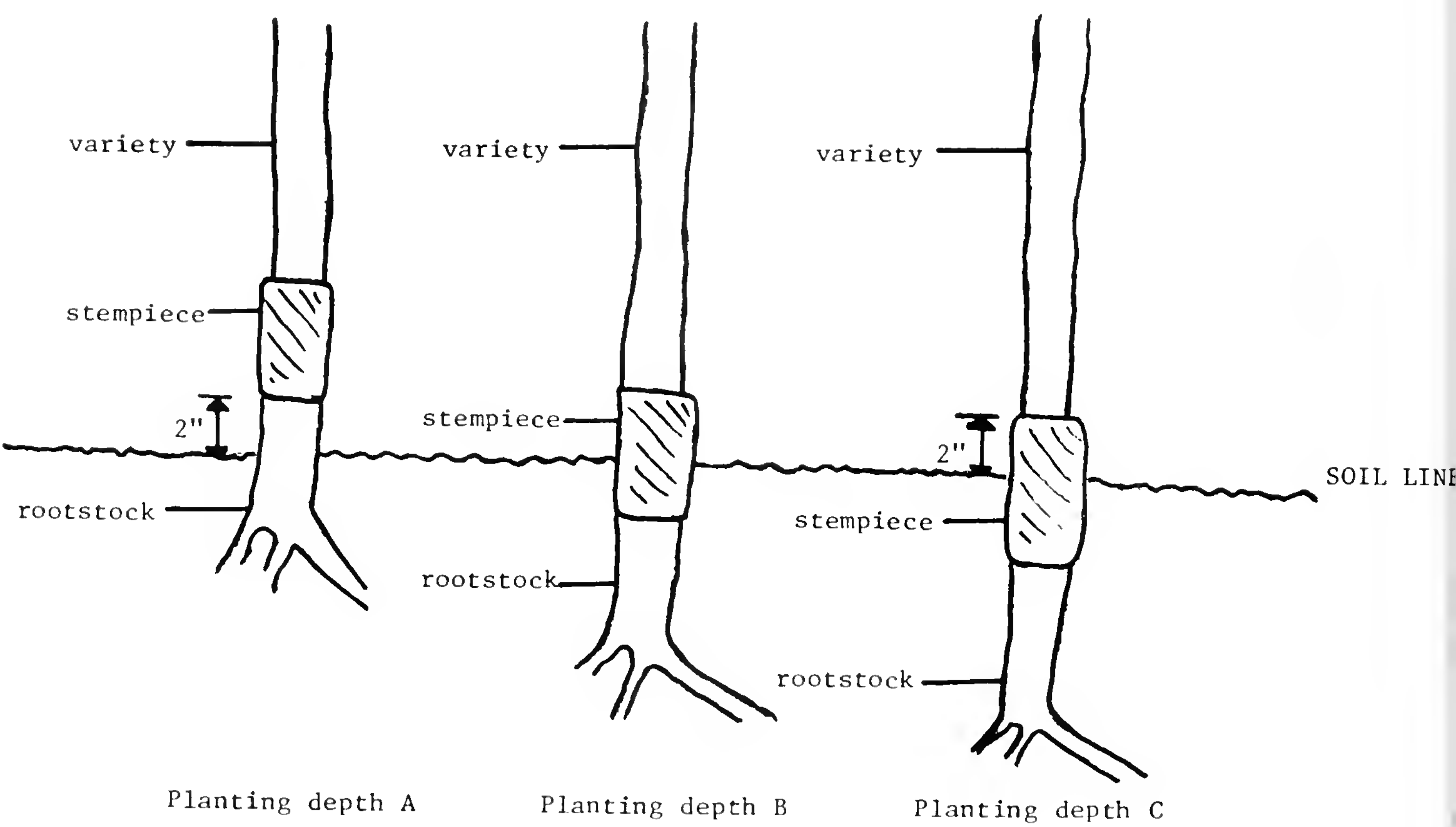
* Trade name

RESPONSE OF INTERSTEM TREES TO PLANTING DEPTH

William J. Lord[1] and Joseph Costante[2]

The responses of Empire, Rogers McIntosh, Macspur and Oregon Spur Delicious trees on M9/MM106 or M9/MM111 to planting depth were investigated in an experiment initiated at the Green Mountain Orchards, Putney, Vermont in 1976 by Joseph Costante, Extension Fruit Specialist and the senior author. The planting depth treatments were: (A) the soil line approximately 2 inches below the stempiece/rootstock union; (B) the soil line at the mid-section of the M9 stempiece; and (C) the soil line approximately 2 inches below the stempiece/variety union (see diagram below). The stempiece on the trees was 7 inches. The information below summarizes the findings at the completion of the study in November, 1982.



Cultural Problems.

Tree training difficulties were experienced particularly with Empire because the central leader lost its dominance. Leader leaning, which was corrected by staking, appears associated with the growth characteristics of Empire on interstem trees on M26 rootstock rather than due to cropping. None of the trees needed staking because of poor anchorage.

Trees at planting depth (A) (the soil line 2 inches below the stempiece/rootstock union) showed stempiece abnormalities, i.e., flattening and twisting, apparently because the presence of burrknots interfered with cambial growth.

The burrknots on the M9 stempieces on trees particularly at the (A) and (B) (the soil line at the mid-section of the stempiece) planting heights were the entry sites of apple bark borer larvae in 1981. These were eradicated manually by probing for the larvae with a knife as well as scraping with a wire brush. Observations here, and at other locations have led us to conclude that the problem is associated with the use of mouse guards made of plastic which impede adequate coverage of pesticide sprays on the tree trunks.

Growth and Yield

Burying or partially burying the stempiece tended to decrease the number of root suckers and increase the trunk cross-sectional area (TCA) and yield efficiency, but did not affect tree height and spread. Trees with the stempiece exposed had smaller trunks than those with the stempiece buried, but trees with the stempiece partially exposed did not differ in TCA from those at the other planting depths. Trees with the stempiece exposed produced the most root suckers regardless of the cultivar/interstem/rootstock combination. These findings support the claim of Carlson in Michigan that deeper planting reduces the tendency of interstem trees to produce root suckers.

Since root suckering was most severe when the stempiece was exposed, the question was posed whether the amount of suckering affected tree growth. There was a negative correlation between number of suckers and trunk circumference ($r = -.15$, $p = .02$). Because tree size varied across rootstock and cultivars, each rootstock and cultivar were evaluated separately. The number of suckers correlated negatively with trunk circumference for M9/MM106 ($r = -.23$, $p = .01$) and the Macspur ($r = -.33$, $p = .01$) and McIntosh ($r = -.48$. $p = .001$). Ferree in Ohio reported a positive correlation between number of root suckers and trunk circumference on interstem trees with the lower union of the stempiece 5 cm above the soil line.

The trees were slow in coming into production partly due to poor tree quality at planting and poor growth in the orchard. The first crop was harvested from the Empire, Macspur, and McIntosh trees in 1980 and from Oregon Red Spur Delicious in 1981. Thus, the yield data was still inadequate at the completion of the study in 1982 for a good evaluation of the influences of planting depth on yield and this problem was confounded by the fact that the orchardist inadvertently harvested the Macspur and McIntosh in 1982. Preliminary data for the Empire and Delicious show that trees with the stempiece exposed have produced less per TCA than those with the stempiece buried. Yield efficiency of trees with the stempiece partially exposed was not different from the others. Both the growth and limited yield data support the suggestion that interstem trees will be weakened and bear less if the stempiece is above the soil line.

The rootstock and/or cultivar had more effect than planting depth on several factors. Tree spread was greater for trees on M9/MM106 than on M9/MM111. Delicious trees were smaller and had less bloom than the other cultivars. Macspur had less branch spread than McIntosh or Empire.

Roots from burrknots were present on all but 3 trees with the stempiece buried. Conditions were considered very favorable for rooting from the burrknots because the soil had been heavily mulched with hay since 1980 and rain was ample for optimum growth. Nevertheless, 26% of the stempieces had only short, fibrous roots less than 18 cm in length. Since the trees were not dug up, the original roots could not be observed but it does seem that this rooting may be too limited to entirely replace the original roots as was observed by Rogers and Parry in England. Rootstock and cultivar had no influence on the amount of rooting.

After 7 growing seasons, interstem trees of Oregon Spur Red Delicious are smaller and less productive than similar trees of Empire, Macspur and Rogers McIntosh. It appears that because of the upright branching nature and small leaf surface, the spur-type Delicious strain is slow to develop.

Summary

Production of root suckers by interstem trees can be reduced by deeper planting. Our limited observations lead us to conclude that interstem trees will require more care than those on vigorous size-controlling rootstocks and that the stempiece is a site for possible difficulty with weather, rodents, insects and disease. Further testing is needed before we can recommend planting of interstem trees other than for trial.

USING W CLIPS TO TRAIN FRUIT TREES

George M. Greene[1]
Associate Professor of Pomology
Pennsylvania State University
Fruit Research Laboratory, Biglerville, PA

Most fruit growers are familiar with the use of spring-type clothes pins to spread young 2-4 inch long shoots of upright growing apple cultivars. The use of this technique will help good crotch angles to develop and will help prevent dead bark from becoming trapped between the central leader and the lateral scaffold limbs.

Unfortunately many upright growing cultivars need additional branch spreading in years 3 through perhaps 6. Most fruit growers are familiar with the use of wooden spreaders (with nails in the ends) to spread laterals away from the central leader into a more horizontal position. This spreading tends to reduce the vigor and increase the fruitfulness of the spread branch. In addition, if lateral branching can be encouraged on the spread scaffold limbs, trees will tend to be more productive since more sunlight can be intercepted by the enlarged tree canopy. The author saw W clips being used in England in 1979 to spread branches but no source of the clips in the U.S. was known. However, hop growers in Washington use this style of clip to help construct the string trellises to support hop

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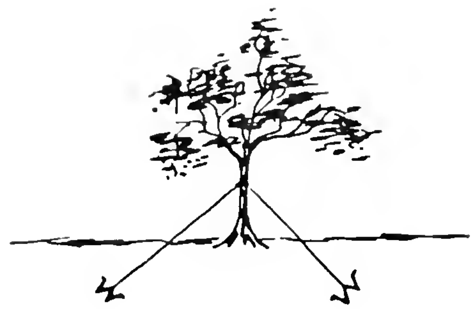
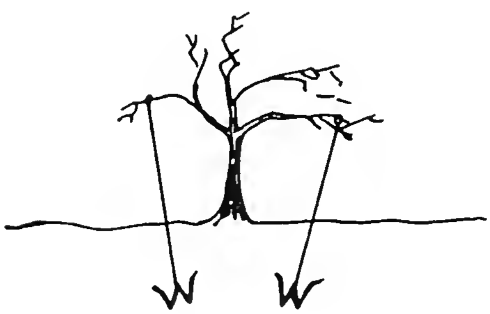
[1] Pennsylvania Extension Hort Series II: 140, 1983. Reprinted by permission of the author.





plants. For fruit trees, the clips can be used to hold plastic baler twine in the ground to spread scaffold limbs and to hold erect, young trees that have leaned. A loop is placed in the end of the twine and the loop is placed onto the W clip that has been placed on the end of the applicator. In the spring when the soil is moist, the W clip can fairly easily be forced 6-10 inches into the ground. The plastic baler twine can then be used to straighten up a tree trunk or to spread a branch. The advantage the W clips over wooden spreaders is that the point of application of the spreading force can be placed anywhere along a limb. By moving the point of spreading force further out on the limb, some of the spreading action can be placed onto the limb itself and less placed on the crotch. The flexibility in being able to move the point of attachment seems to be a major advantage over wooden spreaders. In addition, for those growers interested in spreading peach and other Prunus species, the W clips and baler twine have an advantage in that no nail holes are made in the bark where cytospora canker could enter the tree.

On the negative side, the twine coming out of the ground up to the branches must not be hit with equipment. Using an offset nozzle at the end of the weed boom should allow herbicides to be applied without hitting the trees.

Supplies: W clips - 2000 per carton, 22 lbs.
Applicator - 4 lbs.

Source: Hop Growers Supply Co., Inc.
PO Box 325
Toppenish, Washington 98948
Attn: Jim Owens
Phone: (509)865-3731

Cost:[1]

1 carton (2,000 W clips)	-	$18.40
1 clip applicator	-	10.90
U.P.S. on clips	-	10.06
U.P.S. on applicator	-	3.51
Handling	-	10.00
		$52.87

[1] Editor's Note: Cost of supplies based on quotes received July, 1983. At press time we were informed that Orchard Equipment and Supply Company, Conway, MA 01341 sell W clips and twine.

EFFECTS OF MINERAL NUTRITION ON KEEPING QUALITY OF CA McINTOSH IN MASSACHUSETTS

W.J. Bramlage, M. Drake and S.A. Weiss
Department of Plant and Soil Sciences

In the previous issue of FRUIT NOTES (Fall Issue, 1983) we reported results from a four-year study showing relationships of mineral nutrition to keeping quality of McIntosh apples kept in air storage. We now have the results from this study showing how mineral nutrition is affecting keeping quality after CA storage.

As described previously, 172 orchard blocks were sampled over a 4-year period. One bushel of apples from each block was stored in CA at 3% O_2, 5% CO_2, and 36°F for approximately 8 months, then kept 70-80 degrees F. After 1 day firmness was measured and after 1 week the apples were examined for the occurrence of breakdown, rot, scald, and bitter pit. However, scald and bitter pit were too infrequent on these samples for any relationships to mineral concentrations in the fruit to be established.

Maintaining fruit firmness is vitally important to quality of McIntosh after storage. In these tests firmness was measured at harvest and after storage. As we reported previously for air storage, mineral concentrations had no relationship to firmness after CA; all correlation coefficents were non-significant. Fruit maturity at harvest and postharvest conditions, not mineral concentrations, are what regulated fruit firmness in these tests.

Although the fruit were stored 3 months longer in CA than in air storage, the CA samples generally developed less breakdown and rot than did the air-stored samples because CA greatly slows down changes in apples. Therefore, with smaller amounts of these problems, relationships of minerals to them tended to be lower than were the relationships to the same problems after air storage. This is illustrated in Table 1. Correlation coefficients express these relationships in such a way that the larger the number (whether it is positive or negative), the closer is the relationship. It can therefore be seen that in nearly every case, the relationship between a mineral and a problem is somewhat less for CA-stored than for air-stored samples.

Table 1 shows that mineral concentrations affected the occurrence of rot after storage. In this relationship, P concentration was more important than that of Ca. However, rot can generally be controlled by use of fungicides in postharvest treatments, which were not used in these tests.

For breakdown after CA-storage, Ca was twice as important as any other element. This relationship is shown graphically in Figure 1, where the percent of the fruit that developed breakdown after CA storage is plotted in relationship to the Ca concentration in the sample at harvest. This graph is virtually identical to the one presented in our previous article on Air-stored fruit. As pointed out then, samples very low in Ca (e.g., less than 130 ppm) almost always developed breakdown in more than 10% of the fruit, while samples high in Ca (e.g., more than 175 ppm) almost never developed breakdown in 10% or more of the fruit. Between these extremes, the lower the Ca the more likely the fruit were to develop excessive amounts of breakdown, although other factors probably determined whether or not these intermediate-Ca apples actually developed breakdown. These results show once again the importance of Ca in preventing breakdown of McIntosh apples during and after long-term storage.

Table 1. Correlation coefficients relating mineral concentrations in apples at harvest to occurrences of internal breakdown and rot after storage in air at 32°F for 5 months, or after CA storage at 36°F for 8 months.

Element	Breakdown after		Rot after	
	Air storage	CA storage	Air storage	CA storage
Calcium	-.40***	-.37***	-.19**	-.14*
Phosphorus	-.33***	-.16*	-.31***	-.27***
Magnesium	-.22**	-.14*	-.22**	-.14*
Potassium	+.12	-.13*	.00	.00
Nitrogen	-.35***	-.18**	+.06	-.17*

Asterisks indicate the statistical odds that a real relationship exists:

*Odds of 19:1; **Odds of 99:1; ***Odds of 999:1

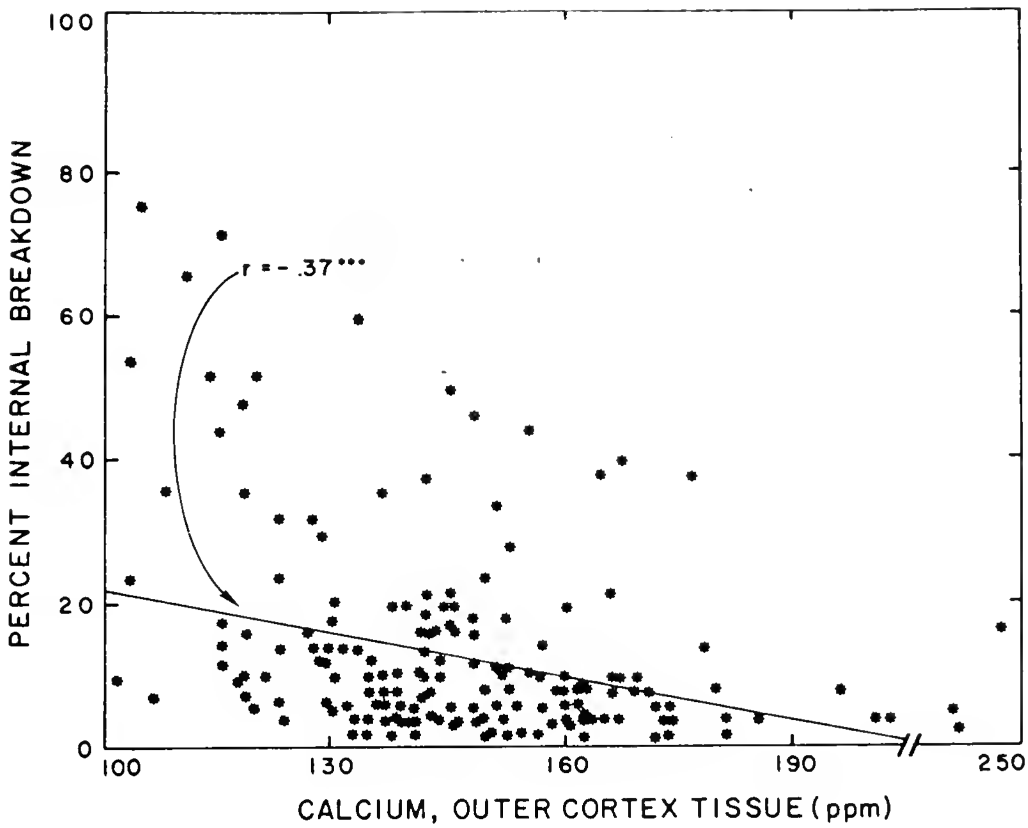


Figure 1. Relationship between occurrence of internal breakdown in McIntosh apples after CA storage and the concentration of calcium in the samples at harvest. Points represent 172 samples taken over a 4-year period.

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POMOLOGICAL PARAGRAPH

William J. Lord
Department of Plant and Soil Sciences

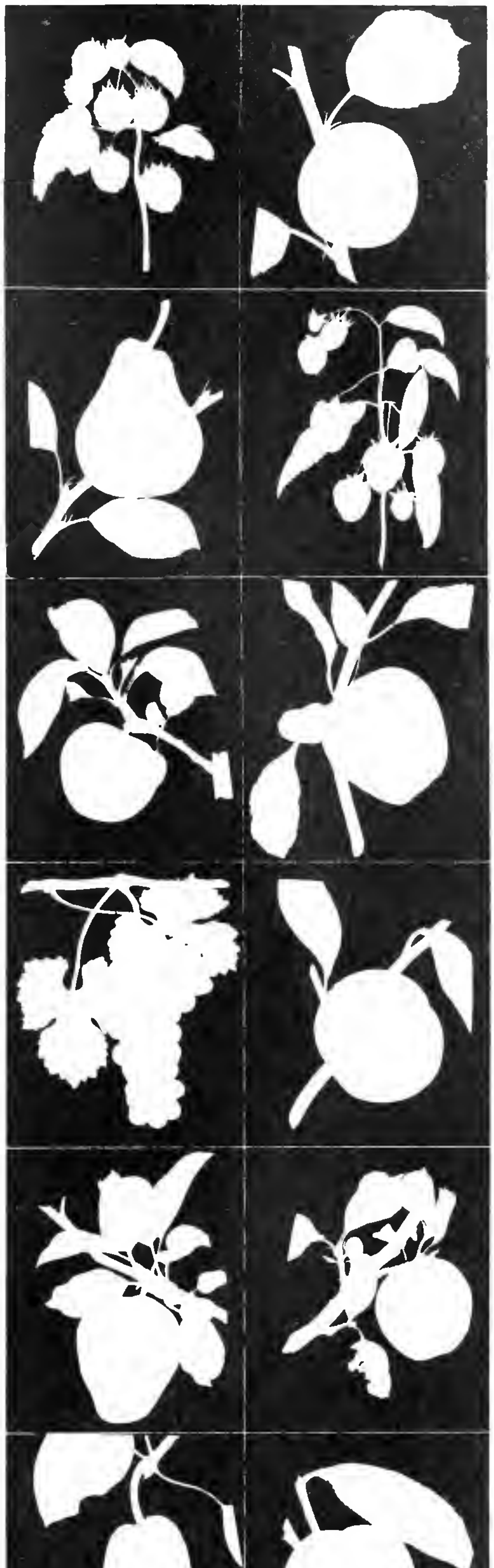
Differences between M7 and M7a. Occasionally we are asked what is the differences between Malling (M)7 rootstock and M7a rootstock. The rootstocks are similar except that M7a has been selected for its freedom from the so-called "latent viruses". These are viruses that are commonly present in apple varieties and include stem pitting, chlorotic leaf spot, platycarpa scaly bark and apple stem grooving.

FRUIT NOTES

PREPARED BY
DEPARTMENT OF PLANT AND SOIL SCIENCES

COOPERATIVE EXTENSION SERVICE, UNIVERSITY OF MASSACHUSETTS, UNITED STATES DEPARTMENT OF AGRICULTURE AND COUNTY EXTENSION SERVICES COOPERATING.

EDITORS
W. J. LORD AND W. J. BRAMLAGE



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HEADING CUTS ON APPLE TREES REDUCE YIELDS

W.J. Lord, R.A. Damon, Jr., J. Sincuk, and K.E. Slosser[1]

University of Massachusetts

In the past there was a general agreement in most fruit growing areas in the East on the basic principles and procedures recommended for training young apple trees. A central leader or modified central leader tree was usually favored, such a tree had the scaffold branches spaced 8 or more inches apart and spirally around the leader. To develop this tree thinning cuts were most often used; heading cuts were suggested only when necessary to balance the length of the scaffold limbs. We define pruning cuts as follows: **Heading,** reducing the length of 1-year-old wood by 25%; **Stubbing,** reducing the length of the branches with cuts made into 2-year-old or older wood; **Thinning,** removing an entire shoot or branch at its junction with another shoot, branch or leader. Since the early 1970's pruning by heading cuts increased drastically in apple orchards throughout northeastern United States. On young, non-bearing trees, heading cuts are being used to stiffen branches, increase the length of the extension shoot of structural limbs, and particularly to increase secondary branching from structural limbs. In bearing orchards branches are headed to control size and shape of trees particularly when too closely spaced. The cuts are made with hand held tools and machines.

During the last 7 years we have made extensive studies of growth and fruiting responses of Redspur Delicious trees to heading cuts. Our findings are summarized below.

Methods and Materials

The trees used in this experiment were planted in 1976, during the first growing season pruning was limited to the removal of branches arising within 18 inches of the ground. In March, 1977 the following pruning treatments were established and continued through 1982: (1) control[(conventional) Fig. 1a]; (2) thinning limbs to develop tiers and dormant heading cuts on 1-year-old wood [(Tiers and Heading) Fig. 1B]; and (3) minimum pruning (Slender

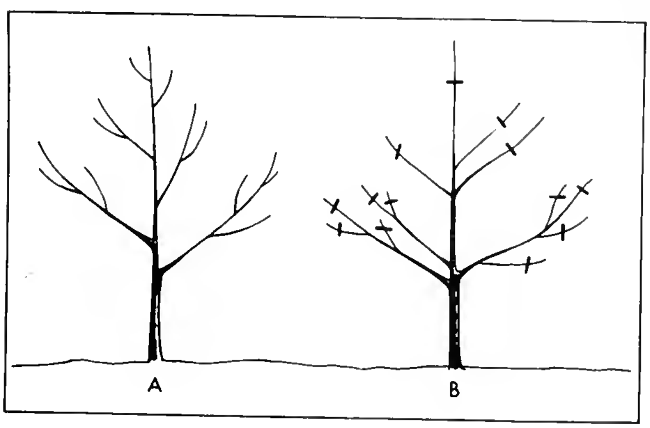

Fig. 1A. Two year old tree being pruned by standard pruning procedures. The lowest limb should be 18 to 20 inches from the ground, all others spaced 4 to 8 inches apart vertically on the trunk and each one about 90° around the trunk from the one below it.

Fig. 1B. Two year old tree being pruned as suggested by the USDA. It has 2 layers of limbs. The leader will be headed annually [heavy marks (—) indicate heading cuts]. The one year old wood on the branches is headed annually until branches on which this wood is borne start to fruit.

[1]Extension Fruit Specialist, Statistician, and Technical Assistants, respectively.

Spindle). All trees were trained to the central leader, free-standing pyramidal form. Limbs that required positioning were spread to a 45° to 60° angle to promote strong crotches and early bearing.

Procedures followed in training trees to the Conventional system were as follows: (1) removing branches with narrow crotch angles; (2) removing undesirable branches to eliminate whorls and thus permitting only 1 branch to develop at a given level; (3) maintaining the dominance of the leader by suppressing or removing competing leaders; and (4) restricting too rapid development of certain structural (scoffold) limbs by stubbing-back to an outward horizontal shoot or branch. The objective was to develop a central leader tree with structural limbs symmetrically arranged around the vertical axis of the leader and spaced 8-12 inches verticallywith none directly above one another. Most cuts were thinning and stubbing cuts.

Trees trained by the **Tiers** and **Heading** system received heading cuts on 1-year-old wood each dormant pruning season, starting in March, 1977, to shorten by 25% (a) the extension shoot of the central leader; (b) the extension shoot of each structural branch; and (c) each lateral shoot longer than 20 cm on structural branches (Fig. 2) . These cuts

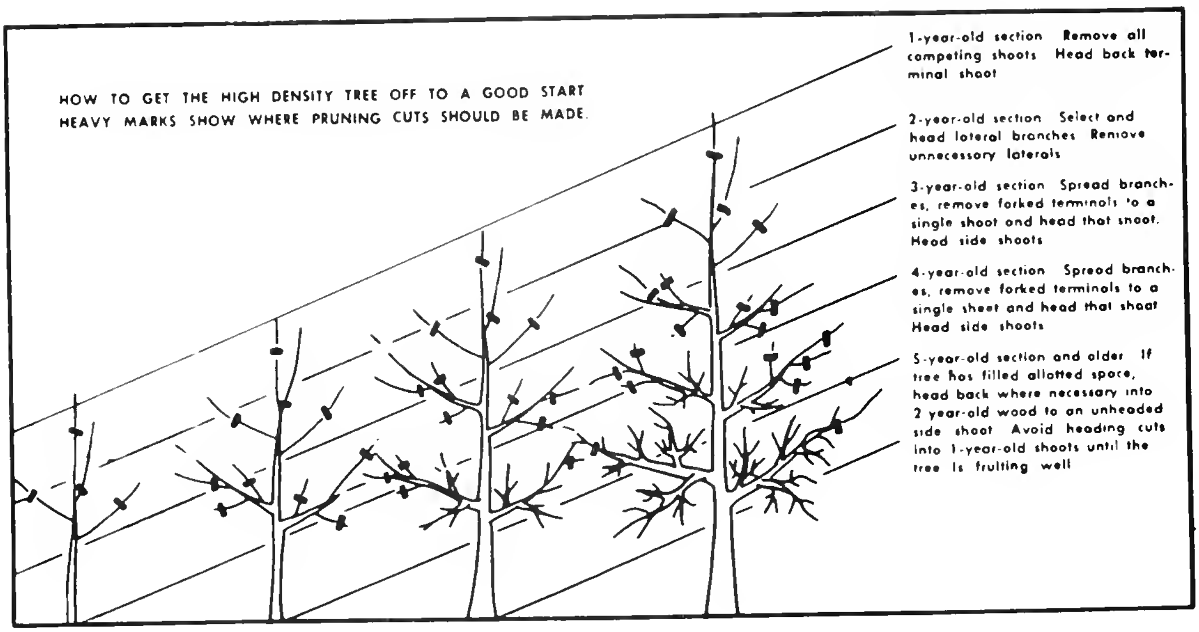

Fig. 2. A diagram of the "constructive training" program suggested by Dr. D.R. Heinicke in USDA *Agriculture Handbook No. 458* entitled "High Density Apple Orchards—Planning, Training and Pruning." (Reproduced with permission of the author.)

were made to encourage development of lateral shoots which eventually became structural branches originating from the central leader or secondary branches as suggested by D.R. Heinicke and illustrated in Fig. 2. The lateral shoots on the central leader were thinned to create tiers of structural limbs spaced 20 to 24 inches apart. The headed wood generally produced a cluster of vigorous shoots directly behind the cut during the following growing season. Each summer when these shoots were 4 to 6 inches long, one was selected for the permanent extension shoot and 2 competitors were removed by hand to simulate the growth on a non-headed branch and to prevent excessive proliferation of the extension shoots.

On Slender Spindle trees the strong vertical leader was removed during dormant pruning and a weaker, upright-growing competitor was retained for the new extension shoot to weaken growth in the top of the tree. All lateral branches developing from

Fig. 3. Structural branch from 'Redspur Delicious' trees on which no heading cuts have been made. The secondary branching is shorter than on the branch shown in Fig. 4 but it has more fruit spurs and has been more productive.

the central leader were utilized unless they had narrow crotch angles or competed with the central leader.

Fig. 4. Structural branch from 'Redspur Delicious' tree on which heading cuts were made annually for 4-consecutive years. The white lines mark where heading cuts were made. The bearing surface on this limb is slightly greater than on the "typical" non-headed branch shown in Fig.3 but the procedure eliminated many potential fruiting spurs.

Results and Discussion

Heading all of the 1-year-old shoots during dormant pruning followed with removal of 2 shoots directly below each heading cut during the growing season to leave 1 terminal extension shoot, increased lateral growth some years but not others (Fig. 3 and 4). However, yields were reduced on the **Tiers** and **Headed** trees in comparison to the Conventional and Slender Spindle Trees (Table 1).

Table 1. Effects of pruning systems on tree size, and yield of redspur Delicious trees on M26.

Variable	Year	Pruning Treatment		
		Conven-tional	Tiers & heading	Slender spindle
Increase in trunk circum. (cm)	1977	3.73a[z]	3.06b	3.41ab
	1978	3.62a	3.44a	3.72a
	1979	2.74a	3.04a	2.68a
	1980	3.04a	3.13a	3.20a
	1981	3.32a	3.10a	3.54a
	1982	2.50a	3.09a	2.48a
Yields (bushels)	1979	0.2ab	0.1b	0.3a
	1980	0.8a	0.4b	0.8a
	1981	1.0ab	0.8b	1.2a
	1982	3.4a	2.6b	3.5a
Cumulative Yield (bushels)	1982	5.4a	3.9a	5.8a
No. scaffold limbs/tree	1982	13a	12a	13a
Tree height (ft)	1982	10.8a	11.7a	10.7a
Tree spread (ft)	1982	9.6a	8.2b	10.0a

[z]Mean separation in rows by Duncan's range test, 5% level.

The decreased productivity of the **Tiers** and **Headed** trees was clearly a result of the heading-back cuts since the number of structural limbs per tree and tree size at the completion of the study, with the exception for branch spread, were smiliar among treatments (Table 1). The spread of the **Tiers** and **Headed** trees was less than that of Conventional and Slender Spindle trees because the branches were more up-right due to lighter cropping. **Heading** cuts reduced the length of 1-year-old wood, forced some lateral buds to produce vigorous shoots rather than flower buds; and removed the most productive section of the wood because the apical sections have more blossom clusters and fruit than the more basal sections of wood.

Our findings agree with a similar study conducted by Lord and Sincuk (2) with Spartan apple trees and with experiments of Elfving and Forshey in New York state (1). The latter workers used heading cuts of various severity on vigorous 1-year-old wood of a non-spur Delicious. Increased severity (removal of a greater fraction of 1-year-old wood) produced increased shoot growth from 1 and 2-year old wood. Fruitfulness decreased as severity increased.

It is of interest to note in Table 1 that yields on the Conventional and Slender Spindle trees were comparable. However, the annual practice of removing the strong extension shoots of the central leader and using a weaker upright growing competitor as the new extension shoot on Slender Spinle trees to produce a zig-zag growth pattern was discontinued after the 1979 dormant pruning season due to difficulty in maintaining leader dominance. Trees on M26 seem to react more to unfavorable growing conditions tha those on more vigorous-size controlling rootstocks and the central leaders often require support but we also encountered problems with apical dominance with Spartan trees on M7a rootstock trained as Slender Spindles (2). These results and observations in a trial with Gardiner Delicious on MM106, M7a and M26 suggest that pruning the leaders to develop a zig-zag growth pattern and to reduce growth should be delayed on free standing trees until the leader nearly attains the height desired for the tree.

Summary

In todays economic climate of high interest rates growers must obtain a return on capital investment as soon as possible. The key to early fruiting is the planting of a well-feathered (branched) tree and the rapid development of a productive bearing surface. The grower has little control over the quality of the nursery stock, except to reject inferior trees; but has no one to blame but him/herself if early yields are reduced by improper pruning, especially an excessive number of heading cuts. Emphasis should be on training rather than pruning young trees since fruiting is the key to control of vegetative growth.

Certainly, some pruning is necessary but the majority of cuts should be thinning rather than heading cuts on trees of all ages. Thinning cuts usually improve light penetration into the tree, thus increasing carbohydrates that encourage flower bud initiation. Heading cuts encourage vegetative growth which may increase shading in the interior of the tree and reduces fruitfulness.

Fruiting decreases from the exterior to the interior of the tree and much of the wood 4 years or older may have few, if any, flowering spurs. Thus, the 2- and 3-year-old wood is of great importance to the fruitfulness of apple trees and should be subjected to only modest pruning using thinning rather than heading cuts.

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POMOLOGICAL PARAGRAPH

William J. Lord
Department of Plant and Soil Sciences

Soil and Plant Tissue Testing. Occasionally we receive inquiries from persons from other states about having leaf samples and/or soil samples analyzed at the Suburban Experiment Station in Waltham, Massachusetts.

The service is avilable to all persons regardless of residence. To receive containers for soil and/or leaves, individuals desiring this service should complete and mail the following form with a check made payable to **Soil Testing laboratory.** Send form and check to Suburban Experiment Station, 240 Beaver Street, Waltham, MA 02254.

Soil is analyzed for pH and elements. Leaves are analyzed for 16 major and minor elements.

Order form

Please send me the following kits:

Soil _______ **@ $5.00 each.**

Leaf sample _______ **@ $10.00 each.**

Enclosed please find $__________**.**

Name:____

Address ____

____ **zip** ________

RECOMMENDATIONS FOR FERTILIZING APPLE TREES AND INCREASING CALCIUM CONTENT OF FRUIT

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Department of Plant and Soil Sciences

NITROGEN (N)

Many apple orchards are established in sod although we suggest eliminating the sod by plowing and disking or if the soil is extremely stony, by herbicides. If the site has been properly prepared and pH and nutritional problems have been corrected, no fertilizer may be needed the year of planting. However, trees planted on hay fields or pastures without extensive land preparation should receive N. Those planted on land previously in forest generally should receive a fertilizer containing both major and minor elements.

Non-bearing trees. Lime but not fertilizer or manures can be put in the planting hole with the roots. Fertilizer, a complete fertilizer, or one containing N, potassium (K_2O) and minor elements, should be applied after a rain has firmed the soil around the roots of the newly planted tree. Fertilize at the rate lf 1/3 - 1/2 pound of ammonium nitrate (33% N) or its equivalent by spreading lightly in a wide circle around the tree (8 to 12 inches from the tree trunk).
12 inches from the tree trunk).

Table 1. Fertilizers, their nitrogen (N) content, and pounds that must be applied to equal a certain amount of actual N.

Fertilizer	% N	Approximate pounds that must be applied to be equivalent to the following pounds of actual N.		
		0.3 lb	0 .6 lb	1.0 lb
Urea	45	0.7	1.3	2.2
Ammonium nitrate	33	0.9	1.8	3.0
Sodium nitrate	16	1.9	3.8	6.3
Calcium nitrate	16	1.9	3.8	6.3
5-10-10	5	6.0	12.0	20.0
8-16-16	8	3.8	8.0	12.5
10-20-20	10	3.0	6.0	10.0

It is extremely important to obtain good growth on the trees in their non-bearing years. However, water rather than N may be the limiting factor some years on some sites.

N is usually applied at high rates to stimulate growth of trees while non-bearing. For example, at our Horticultural Research Center in Belchertown, MA, young, non-bearing trees may receive 0.3 - 0.6 lb of actual N/tree whereas bearing trees receive 0.0 - 0.3 lb of actual N/tree.

After the year of planting, fertilizer, either nitrogen (N) alone, a complete fertilizer, or a fertilizer containing N and potassium (K_2O) and minor elements, should be applied 3 to 4 weeks prior to bloom and at a rate of 1/3 pound of ammonium nitrate or its equivalent for each year of age.

Reduce or omit N on young, vigorous McIntosh trees when they start to bear fruit, if the trees appear very vigorous, to avoid excessively large, poorly colored apples. With this cultivar and all other cultivars, start participating in the Leaf Analysis Program when the trees start to fruit in order to determine the fertilizer requirements of the trees. (Information concerning the Leaf Analysis Program and specific details on orchard fertilization can be obtained from your County Extension Service.)

Bearing trees. There is no way to go broke faster than by producing high yields of soft, green apples that bruise easily and keep poorly. On older, bearing McIntosh trees, N levels of 1.8 - 2.0% appear optimum. If the leaf analysis shows that the N level is above 2.0%, adjust the fertilizer program according to tree vigor, productiveness and fruit color, as experience indicates. High leaf N levels fall very slowly even when no additional N fertilizer is supplied because large reserves of the element accumulates in the soil, sod and tree. Therefore, it may take several years to bring an excess N level down to the normal level.

Our data shows that the total amount of N being applied is usually more important concern to fruit quality than whether the N is supplied by applying ammonium nitrate, sodium nitrate, calcium nitrate, etc.

Fertilizer Placement Under Bearing Trees. The mass of the secondary root system of apple trees lies between 2 and 3 feet in depth and within half the distance from the tree trunk and its dripline. This explains why our studies show that more efficient use of N and other elements can be obtained by application within a limited area closer to the tree trunk rather than by application near the tree's dripline or a broadcast application under the entire spread of the tree. Recent studies in England show that under herbicide-strip management and with a wide in-row spacing, as in common in Massachusetts, there was little N uptake from the grassed alley.

POTASSIUM (K)

Generally N is the only element required by non-bearing trees. However, experience has shown that K is needed by non-bearing trees on land cleared from forests and on sites with sandy or gravelly soil, or very acid soil.

Not all horizons in the soil are equally able to supply nutrients to the tree. The concentration of most elements are highest at the soil surface and decrease with depth, but the rate of decrease differs between elements. For example, there is a strong vertical difference in K status in soil, K being highest near the surface.

Under drought conditions the permeability of the roots to water uptake decreases very rapidly; reduction in water permeability reduces the uptake of all ions. In Massachusetts we are particularly concerned about K and B deficiency and reduced fruit size in drought years as was experienced during the summer of 1983.

Total K absorbed and the total dry matter produced is similar for fruiting and non-fruiting trees of the same size but in heavy-cropping trees K is translocated into the fruits. Thus, the demand of a larger crop for K is great and both the tree and fruit may be deficient in this element.

Tree requirements for K. K_2O* needed to meet the K requirements based on potential yields are as follows: (a) less than 15 bushels: 1.3 lbs/tree; (b) 15 to 25 bushels: 1.3 - 2.7 lbs/tree; and (c) more than 25 bushels: 2.7 - 4.3 lbs/tree. The K_2O requirements can be supplied by applying muriate of potash, a "complete" fertilizer or Sulpomag**. Increasing the K level in the trees will further reduce Mg. Therefore, Sulpomag is suggested when trees are low both in K and Mg because the elements must be kept in balance. This fertilizer contains not less than 21% of potash (K_2O), nor less than 53% of sulfate of magnesia. Mature trees below normal in K will require 200-300 of K or 600 lbs of Sulpomag per acre. FERTILIZERS SIMILAR TO SULPOMAG MAY BE AVAILABLE AND EQUALLY SUITABLE.

CALCIUM (Ca)

If Ca is below normal, continue to apply 3 tons of limestone per acre every 2 to 3 years. Where high magnesium lime was used in the last application, the use of a more soluble high Ca, low Mg lime (5 - 7% MgO) will act more rapidly and will provide more Ca.

Apply foliar sprays of $CaCl_2$, beginning 3 weeks after petal fall and repeat at 2 week intervals totaling 6 to 8 applications. Apply 6 pounds $CaCl_2$ per acre per spray until mid-July. After mid-July apply 8-10 pounds per acre per spray. Continue foliar $CaCl_2$ until fruit are ready for harvest. Use a technical grade of $CaCl_2$ such as Allied Chemical Dow Flake, 77-80% $CaCl_2$. Other brands may be equally suitable.

Experience in Massachusetts has shown that $CaCl_2$ can be combined with pesticide sprays. However, some growers have observed that the combination of Captan or Guthion (azinphosmethyl) 50 WP and $CaCl_2$ may increase foliar burn. DO NOT MIX $CaCl_2$ AND SOLUBOR SPRAYS! ALWAYS DISSOLVE $CaCl_2$ IN A PAIL OF WATER and add this last, when the spray tank is nearly full, to insure that the $CaCl_2$ is completely dissolvedbefore spraying begins.

Foliar $CaCl_2$ sprays may be applied as dilute (300 gallons/acre) or up to 10X concentration (30 gallons/acre) . In our research, apple flesh Ca was increased more by concentrated than by dilute sprays.

$CaCl_2$ sprays can cause burn of leaf margins. Foliar injury has been more serious on McIntosh than on Delicious or Cortland. Apple leaves are less susceptible to $CaCl_2$ burn after mid-July. McIntosh growing on M7 may be more susceptible to foliar burn than those on standard rootstock. Weak or injured trees may be more susceptible to $CaCl_2$ burn than healthy trees. To reduce the chance of leaf burn, DO NOT REPEAT A FOLIAR $CaCl_2$ SPRAY UNLESS ONE-HALF TO ONE INCH OF RAIN HAS FALLEN SINCE THE LAST APPLICATION.

We also urge growers to seriously consider supplementing $CaCl_2$ sprays with post-harvest $CaCl_2$ dips or drenches especially fruit intended for long-term storage. A postharvest Ca application is viewed as a food-additive process by the Food and Drug Administration. That agency has stipulated the "Brining Grade" $CaCl_2$ containing 94% $CaCl_2$ is acceptable for postharvest use. The technical flake $CaCl_2$ commonly used for tree sprays is still acceptable for tree sprays, but it may not be used for postharvest treatments. Therefore, anyone wishing to use postharvest $CaCl_2$ treatments must obtain the Briner's Grade material, which is now readily available from suppliers.

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* Potassic fertilizers are usually guaranteed in terms of their content of the oxide of potassium (K_2O). The commonly used potash salts are the refined muriate or chloride containing 50-60% K_2O.

** Trade name

Calc$_2$ may be combined with scald inhibitors and fungicides in the post-harvest treatment solution. Cornell University has recommended the following mixture for postharvest treatment of McIntosh:

21 lbs of $CaCl_2$ per 100 gallons of water
1/2 lb of Benlate or 16 fluid ounces of Mertect
1 lb of Captan
1000 - 2000 ppm DPA

We suggest that 1/2 quart of vinegar also be added to this mixture in 100 gallons of water. The vinegar neutralizes the $CaCl_2$, which otherwise makes the solution alkaline. There is evidence that the alkaline solution may cause the fungicides to break down rapidly in solution, and the addition of vinegar can protect against their alkaline degradation.

In use of postharvest $CaCl_2$ drenches or dips, it is important to understand that little or no Ca enters the fruit during the treatment. The purpose of the drench is to leave a residue of $CaCl_2$ on the fruit. Ca is slowly absorbed by the apple from the residue during storage. Therefore, the drench is never followed by a rinse, which would remove the residue. Furthermore, for Ca to be absorbed from the residue, the residue must not dry out. However, if the storage is operated at lesss than 90% relative humidity the residue may dry out and no Ca uptake will occur as a result of the drench treatment.

We have encountered no difficulty from this residue when apples are removed from storage. It will be removed if apples are water-dumped, but even with hand-packed fruit no difficulty has been reported.

$CaCl_2$ drenches can cause fruit injury, which occurs as tiny black spots on the surface of the fruit. Generally, these spots are concentrated in the calyx cup of the apple and are not objectionable, although under some circumstances they may coalesce into more unsightly blotches or may occur at the lenticels on the cheeks. Do not exceed the recommended $CaCl_2$ concentration, as risk of this injury escalates rapidly at higher concentrations.

$CaCl_2$ is also corrosive, so equipment should be thoroughly cleaned at completion of treatment. However, with appropriate rinsing corrosion should not be a concern.

The purpose of the postharvest application of $CaCl_2$ is to reduce the risk of breakdown, rot, and scald during but especially after storage. The recommended treatment will not make fruit firmer, but will improve their ability to hold up during marketing. Treatments will be of greatest benefit to mature fruit destined for long-term storage. Overripe fruit cannot be expected to benefit significantly from a $CaCl_2$ treatment.

MAGNESIUM (Mg)

Mg deficiency is closely associated with very acid soils. The pH in most orchards is higher than 25-years ago because liming programs and the change from sulfur to organic fungicides; thus, Mg deficiency is now not common.

Dolomitic lime (high Mg lime) is the least expensive source of Mg for orchards. It can be applied anytime during the year. If the Mg level in leaves is below 0.25% apply 3 tons/A of dolomitic lime to maintain a soil pH of 6.0 - 6.5. If the Mg level is below 0.20%, we also recommend 2 or 3 Epsom salt sprays at 15 to 20 lbs per 100 gallons dilute at approximately petal fall, first, and second cover. We suggest that the Epsom salt sprays be applied as separate applications. However, pomologists in other fruit growing areas in eastern United States believe that Epsom salts are compatible with most pesticides up to 15X concentration.

MANGANESE (Mn)

Mn is the most frequently deficient element in apple trees. Mn deficiency should be corrected on trees showing considerable foliage damage. Although we have no definite proof, Mn deficiency appeared to be associated with excessive fruit drop on a few trees in orchard in 1977. Mn deficiency can be corrected by foliar applications of manganese sulfate or of a fungicide containing Mn. Apply manganese sulfate at about first cover at the rate of 3 lb per 100 gallons of water. If using a Mn-containing fungicide, 2 or 3 applications are necessary with timings about petal fall, first and second cover.

BORON (B)

B can be supplied to bearing apple trees either by foliar or soil applications. Use the most economical and convenient method. However, it is safest to apply all elements as a fertilizer except in emergency situations.

Soil applications of boron should be applied to orchards every 3 years. The rate of application per tree vary with tree age and size. In low density orchards, apply 1/4 lb of borax (11.1% actual B) or its equivalent under young trees coming into bearing, 1/2 to 3/4 pound to medium age and size trees and 3/4 to 1 lb to large or mature trees. Be sure to note the percent actual B in the fertilizer being used to supply this element. B containing fertilizers vary from approximately 11 to 21% actual B.

In medium and high density orchards (115 trees/acre or higher), it might be best to apply B on an acre basis. We suggest the following rates per acre of borax (11.1% actual B) or its equivalent: (a) trees 4 to 7 years of age - 12 lbs; (b) trees 8 to 15 years of age - 12 to 24 lbs; and (c) trees 16 to 30 years of age - 24 to 48 lbs.

When the soil application of B is followed by a wet spring, it may be advisable to apply 2 foliar applications of B the following year.

Many growers now rely on annual foliar applications of B. The usual practice is to add Solubor to the first 2 cover sprays. Fertilizer grades of borax may contain grit and should not be used in a sprayer. Mature trees should receive 4 pounds of Solubor per acre each year. Consequently, the goal is to apply about 2 pounds per acre in each of the 2 applications. For young orchards, the addition of 1/2 pound of Solubor per 100 gallons (dilute basis) to the first 2 cover sprays meets the B requirements of these trees. Reports of New York State indicate that sprays can be concentrated up to 8X with satisfactory results.

Leaf samples from orchards treated with Solubor have indicated adequate leaf B levels but the fruit was deficient in this element. Whether or not B applied as a fertilizer more adequately meets the B requirement of apples than foliar applied B is not known to us.

ZINC (Zn)

Based on optimum levels of Zn established by Dr. Warren Stiles, Cornell University (See FRUIT NOTES 47(2):20-26, 1982) some of our orchards continue to be low in this element. W. Stiles considers optimum Zn leaf levels to be 35 - 50 ppm with concentrations below 15 ppm being deficient. He has stated that "annual requirements for Zn are approximately 2 lbs per acre if applied as inorganic salts in dormant sprays or approximately 0.2 - 0.3 lbs of actual Zn applied as foliar sprays of EDTA chelates (3 to 5 lbs/acre). Amounts of Zn required to correct severe deficiencies may be 4 to 5 times these amounts. Zn-containing fungicides provide some benefit but are not adequate to supply the total need."

* *

CARE OF TREES ON ARRIVAL FROM THE NURSERY

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A local nurseryman expressed concern last year about grower care of trees prior to planting. He was particularly concerned with storage of trees with apples and about soaking trees in water for 2-3 weeks.

If trees from the nursery arrive in bad condition from drying in transit, pomologists years ago suggested soaking the entire tree in a brook or a pond for a day or two. We have seen no comments concerning the effect of soaking trees for longer periods of time! Due to the possibility of tree injury from the lack of oxygen, we suggest soaking the roots in water no longer than a day or two.

Our recommendations for care of trees on arrival from the nursery are as follows:

1. Check the trees to determine if tree count and cultivar/rootstock and size agrees with order and to determine if injury to the trees might have occurred in handling and shipping. Do this where it is cool and the roots will not dry out.

2. If planting conditions are not suitable, open the bundles of trees and store them in a cool, well-ventilated area and be sure the roots are kept moist, or heal them in a shady area, or cover the roots with wet soil, peat or sawdust in an open shed.

3. DO NOT STORE trees with apples or where they have been stored. It is possible that residual ethylene in the storage atmosphere might break dormancy of the trees and when planted they may fail to grow properly or even die. Pear trees are especially sensitive to injury.

4. If the roots of the trees are dry, soak the roots in water for 2-24 hours prior to planting.

PRACTICALITY AND LONGEVITY OF HARDPAN MODIFICATION

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About 40% of the soils in Massachusetts have a hardpan within 3 ft of the soil surface. Considering the fact that a large number of our orchards are located on drumlins (elongated or oval hills of glacial drift), I estimate that between 50 to 60% of the Massachusetts orchard soils have a hardpan within 3 ft depth. The presence of this pan is well known to most fruit growers as it often necessitates sub-surface tile drainage. The low water permeability is due to a high bulk density of the pan material. This often inhibits root proliferation as well, which may result in increased susceptibility to midsummer droughts and excessive frost heaving during the winter.

Modern, size-controlling rootstocks seem especially sensitive to the presence of this hardpan. The dwarfing effect not only occurs above-ground, but is also evident from a less prolific root system as compared to that of standard rootstocks. In addition, size-controlling rootstocks such as M7a are in full production after about 10-12 years, while the standard trees take much longer to become productive. The longer time period permits the establishment of an extensive root system before this becomes strained under the demands of a maturing fruit crop. Even though economic conditions dictate the need for early production, tree vigor and the need to sustain long-term production capacity necessitate the establishment of a healthy and extensive root system prior to the onset of production.

This article reviews the pertinent literature concerning the long-term persistence of soil profile modifications and discusses practical methods which may improve root vigor of fruit trees in hardpan soils.

A variety of experiments have been carried out in past years to evaluate the effects of soil profile modification on drainage, water availability, frost heaving and crop yield. In general, the deeper and more extensive the initial soil disturbance is, the better the results (Unger 1979). Various experiments (Mech et al. 1967, Bradford and Blanchar 1977) found that mixing the top soil with sub-surface layers, and additions of lime, fertilizer or even sawdust significantly increased yields of alfalfa and sorghum. It is reasonable to assume that such an improved growth environment also will foster the development of fruit trees, both above and below ground. Recent research reports (Unger, 1979) stress the importance of mixing the topsoil with the subsoil to obtain lasting results. Studies in New York indicated that modification of a hardpan by mechanical disturbance alone, resulted in re-establishment of dense soil layers in less than 11 years while buried topsoil remained less dense even after that period (Fritton and Olson, 1972). Researchers in Pennsylvania found that additions of organic matter will delay the soil's return to its original bulk density for a period of 7 to 8 years (Fritton et al. 1983). That study also reported the ineffectiveness of subsoiling and deep tillage when the topsoil was not mixed with subsoil.

The use of topsoil from old orchards for new plantings may be less desirable when the soil is suspected to contain large numbers of nematodes. Thorough mechanical mixing may reduce the nematode population susbstantially (R. Rohde, personal communication). Use of non-orchard topsoil, hay or peat will prevent a nematode problem and give the young trees a head start, although this method probably is more costly.

A comparison of various apple planting methods in West Virginia (Auxt et al., 1980) showed that tree vigor was best when procedures were used which resulted in a large disturbance of the soil. Trees planted by backhoe or tree planter were most successfully established, while a conventional 24" soil auger resulted in less tree vigor and anchorage. It was found that use of 12" or 24" augers resulted in significant soil compaction, which negatively affected tree growth. The West Virginia soils contained more clay than most Massachusetts orchard soils, but smearing of the soil can be a significant problem in this region as most of the trees are planted during early spring when the soil often is extremely wet.

While the long-term effects of soil profile modification are debatable, the short-term benefits are beyond doubt. These include improved drainage, aeration and water holding capacity, and less problems with frost heaving. When planting fruit trees it is generally a good practice to make the planting hole as large as possible. When the soil contains a hardpan at shallow depth this procedure is even more important to provide the tree with an environment for optimum growth. Mixing topsoil with the subsoil, and additions of lime, fertilizer and organic matter such as hay and peat, will prolong the effect of soil profile modification and thus lengthen the period of root prolification. Smearing of the soil should be prevented, but is especially important when augers are used. When smearing in the borehole is evident, remove the smeared surface with a knife. Never plant the trees in waterlogged planting holes. Wait until the soils dry out or plant the trees in the fall. If excessive wetness is a reoccuring problem at the future planting site, ensure proper drainage first and select rootstocks which can endure wet feet. Anybody can plant a tree. Planting of a tree which will last and prosper takes considerable time and care.

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THE APPLE MAGGOT IN MASSACHUSETTS, MICHIGAN AND WEST COAST STATES

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Massachusetts apple growers are all too familiar with the apple maggot and the type of fruit injury that this pest can cause. During our pilot integrated pest management (IPM) program on apples in Massachusetts from 1978-1982, we used sticky-coated red wooden spheres to monitor the time and extent of maggot activity in 16-60 commercial orchard blocks each year. Without exception, at least a few maggot flies were captured annually in each block. In some cases, several hundred were caught in a single block.

Our experience shows that 99.9% or more orchard maggot fly populations in Massachusetts originate from wild or abandoned host apple or hawthorn trees within a few hundred yards of the orchard. On only 2 occasions have we found maggot flies emerging from within a commercial orchard itself. In both of these, maggot-infested early-maturing varieties such as Puritan and Astrachan were not harvested the previous year.

Despite the continuous pressure that maggot flies exert on our Massachusetts orchards, only 0.08 and 0.09% of harvested fruit showed maggot injury in IPM and check orchards, respectively, during the 5 years of the pilot IPM program [see FRUIT NOTES 48(3)]. The principal reason for this comparatively low fruit injury is the high sensitivity of the adults to even low dosages of pesticide. Moreover, as shown by the work of Dr. Harvey Reissig of Geneva, New York, some pesticides such as Guthion are highly effective not only against the adults but also kill the eggs and young larvae, just beneath the fruit skin.

Our experience reveals that so long as growers rely on red sphere trap captures to determine need and timing of maggot fly sprays, there is very little chance of any injury occurring. Most of the maggot injury detected in Massachusetts has been on late varieties such as Delicious and Golden Delicious in cases where substantial fly immigration occurred 2 or more weeks after spraying ceased for the year.

Michigan apple growers in 1983 experienced more apple maggot injury than at any time during the past 2-3 decades. According to Michigan fruit entomologist Dr. Gus Howitt, fruit of late varieties such as Jonathan had more than 5% maggot injury in many orchards. Dr. Howitt told me that hundreds of thousands of bushels have been rejected for fresh fruit market and for processing because of excessive maggot injury.

Dr. Howitt attributed the severe maggot problem in Michigan in 1983 to the very dry summer, which precluded summer emergence of flies from overwintering pupae. Emergence didn't begin in full force until just after heavy rains in late August and early September. By that time, most of the summer-maturing fruits on wild or abandoned trees had fallen, thereby stimulating extensive immigration of flies into commercial orchards. The warm September was favorable for fly egglaying in late varieties. Also, red spheres were used by only a handful of Michigan growers to monitor fly activity, and most spraying had ceased by early to mid-August. This combination of events undoubtedly explains the maggot fly problem which occurred in Michigan. It should serve as a reminder to us that the comparatively little effort required to emplace and examine red spheres for monitoring maggot fly abundance can pay very large dividends.

Eastern and midwestern growers are not the only ones who must be concerned with apple maggot. In 1979, a homeowner near Portland, Oregon brought some rotting apples to the local extension service which were diagnosed as being heavily infested with apple maggot larvae. Subsequent trapping and fruit injury surveys on the west coast showed that apple maggot is more or less continuously distributed from southern Washington to northern California. Numerous wild apple and hawthorn host trees in presently infested areas appear capable of supporting substantial fly populations.

Just how far the fly can penetrate into the major apple growing regions around Yakima and Wenatchee in Washington is uncertain. The very dry summers in the Washington state fruit growing areas coupled with the relatively low numbers of wild host trees, are factors arguing against the widespread establishment of apple maggot much beyond the northern border of Oregon. Nonetheless, a concerted and expensive effort is now underway to maintain a buffer (fly-free) zone around the present infestation area in Washington to prevent any further northward movement. The buffer zone, about 15 miles wide, is trapped heavily (50-80 traps per square mile) for maggot flies. Imidan is sprayed extensively in locales surrounding sites of trap captures. In addition, there is an intensive host tree removal program within the buffer zone.

In Oregon, the apple maggot is now so entrenched (it may have been there, undetected, for 10-20 years prior to 1979) that no feasible means exists of exluding it from the vicinity of any of the apple growing areas. However, buffer zones, similar to those in Washington, have been erected immediately around certain locales of intensive apple growing, such as the Hood River Valley.

Possibly California apple growers believed the fly would never be so bold as to move south across the Oregon border. But on August 24, 1983 the first flies were detected in traps about 50 miles into California. Within 2 months, the area of known infestation reached about 150 miles south into California. Actually, it shouldn't be surprising that the apple maggot was found in California. During the past 30 years apple maggot (in the form of larvae in infested fruit) was intercepted by Border Station Inspectors more often than any other insect pest entering that state.

In mid-October, 1983 I was asked to chair a panel of scientists to go before officials of the California Department of Agriculture, growers, and the public to make recommendations as to what to do about this "sudden" invasion of the fly. Because of the near hysteria caused by the Mediterranean fruit fly invasion of California in 1981, I was very reluctant to accept this charge. But it proved to be a highly informative and relatively calm experience.

Our panel concluded that the apple maggot fly had probably been in California for at least 5 years. Scouts were finding it nearly everywhere they looked, although never in very large numbers at any one site. Possibly the apple maggot will have difficulty building into high populations in more southern regions such as California. At present, its southernmost distribution lies only a hundred miles or so north of one of the major California apple producing areas.

For several biologically-based reasons, our panel concluded that it was virtually impossible to eradicate the apple maggot from California, given its already widespread distribution in that state and neighboring Oregon and given the fact that a major part of the present area of infestation lies in the heart of the California marijuana growing region. Marijuana is the largest "agricultural" crop of California, even exceeding cotton, and is worth more than 1.3 billion dollars per year. It is very dangerous for state employees to explore terrain within this region (often laden with land mines to deter unwanted visitors) to seek out maggot flies and host trees to eradicate. Hence we recommended adoption of buffer zone procedures similar to those used in Washington and Oregon. Whether this recommendation will in fact be adopted remains to be seen.

Thus, 1983 was a big year for the apple maggot in Michigan, Washington, Oregon, and California. We are fortunate that 1983 was not a problem year for apple maggot in Massachusetts.

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Gala - An Apple Variety Worthy of Trial

James F. Anderson
Department of Plant and Soil Sciences

Gala, a variety from New Zealand has been receiving much favorable attention. This variety resulted from a cross between Kidd's Orange and Golden Delicious and was introduced in 1960. We have fruited Gala for 4 seasons. The fruit has been medium to large in size on these trees planted in 1978. The fruits are generally round-conic in shape. The skin is smooth and the color golden-yellow overlaid with about 80% red. The flesh is yellow crisp and has a very good flavor. The fruit in our Belchertown orchard has been harvested during the second and third week of September, the fruit hangs well on the tree. The fruit stores well for a fall apple. Gala appears to be a productive variety and merits trial by those growers operating farm markets.

THE USE OF PROMALIN TO IMPROVE THE SHAPE OF DELICIOUS APPLES

Duane W. Greene and William J. Lord
Department of Plant and Soil Sciences

Promalin is a plant growth regulator that has been used for several years in Massachusetts orchards to increase the length (L/D ratios or typiness) of Delicious apples (Figure 1). Promalin contains equal amounts of gibberellins (GA_4 and GA_7) and a cytokinin, 6-benzyladenine. We previously reviewed research results and made suggestions for the use of Promalin (FRUIT NOTES 43(3):4-7, 44(3):4-8 and 45(3):8-12). The purposes of this article are to summarize results from several years of research results with Promalin, and to make suggestions for successful use of Promalin to enhance the shape of Delicious.

Figure 1. The effect of Promalin on shape of Delicious apples. The apple on the left was treated with 1½ pt Promalin per acre and the one on the right was unsprayed.

Coverage. When using plant growth regulators it is generally emphasized that uniform spray coverage is essential for satisfactory results. This is especially true when using Promalin. In both 1978 and 1979 the greatest increase in L/D ratio occurred only when Promalin came in direct contact with the portion of the flower that develops into the fruit (receptacle and calyx end of the receptacle). Application to the pedicel (stem) was much less effective (Table 1).

Table 1. Effect of the site of Promalin application on the L/D ratio of Richared Delicious apples.

Treatment[z] (Microliters)	L/D Ratio* 1978	L/D Ratio* 1979
Check	0.93c[x]	0.91c
Petals, 25[y]	0.94c	0.91c
Petals, 150	0.99b	—
Receptacle surface, 25	1.03a	1.03a
In Calyx end, 25	1.03a	1.04a
Pedicel, 25	—	0.97b
Spur leaves, 250	—	0.90c

[z]50 ppm solution containing 0.05% X-77 applied at fullbloom. All blossom clusters reduced to one flower and then hand-pollinated with Early McIntosh pollen.

[y]A 25 microliter droplet was large enough to wet the receptacle or pedicel surface with no runoff.

[x]Numbers in a column followed by a different letter are significantly different at odds of 19 to 1.

Petals at the normal application time account for a substantial portion of the flower surface area. However, they appear to be relatively unimportant as a vehicle for absorption. Even 150 µl applied to the petals (the volume comparable to a dilute application) was only moderately effective at increasing the L/D ratios. Spur leaves were totally ineffective as sites of Promalin absorption. Therefore, not only must Promalin be directed uniformly to all parts of the tree but droplets must also come in direct contact with the receptacle of each flower for the maximum response.

<u>**Use of surfactants and adjusting pH of spray solution.**</u> Surfactants frequently increase the penetration of growth regulators. However, the use of surfactants is generally not recommended with growth regulators, since most formulated growth regulators (e.g., Alar 85, Fruitone N, etc.) already contain a surfactant. In contrast, the Promalin formulation contains no surfactant, so we thought that the use of a surfactant with Promalin might increase the Promalin effect on fruit L/D ratio. In addition, the ability of gibberellins to enter the plant may be regulated by spray pH. Reduction of the pH of the spray from near neutrality (pH 7.0) down to near pH 4.0 should enhance penetration, but field effects have not been well documented.

A trial was conducted using a combination of surfactants and a reduction in spray pH was done on Royal Red Delicious. Glyodin, Biofilm and Buffer-X served as surfactants and the pH was reduced in 2 treatments with the nutrient spray Sorba Mg. Buffer-X contains a buffer to reduce pH (pH 4.8 in this trial). The combined sprays of a surfactant with the commercial buffer tended to increase the L/D ratio beyond that produced by Promalin alone (Table 2). Growers must be cautioned, however, that the enhanced response with surfactants and/or buffers also increase the chance of thinning.

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* L/D = Length/diameter ratio. An apple with an L/D ratio of 1.04 is longer and more "typey" than one with a ratio of 0.90.

Table 2. The effects of surfactants and pH modification on the performance of Promalin applied to Royal Red Delicious, 1978.

Treatment[z]	Fruit per cm limb circ.	L/D ratio	Fruit weight (g)
Check	7.1a[y]	0.95c	154abc
Promalin	6.0ab	1.00b	142b
Promalin + Sorba (Mg)+ Glyodin	4.9bc	1.04a	146bc
Promalin + Sorba (Mg)+ Biofilm	4.8bc	1.03a	156ab
Promalin + Buffer-X	4.1c	1.02ab	161a

[z]1 pt of each chemical was used per 100 gal. of water. Treatments applied at rate of 125 gal/acre at petal fall of the king blossom.

[y]Numbers in a column followed by different letters are significantly different at odds of 19 to 1.

Fruit set following Promalin application. Within 2-3 days following a Promalin application, calyx swelling and closing is apparent, first on the king blossom and then on lateral blossoms. Promalin merely accelerates that which normally occurs on pollinated flowers. Ten to 12 days after application, Promalin appears to have increased fruit set. However, about 15 days after bloom, yellowing of the pedicels occurs on many of the developing fruit in the cluster. By 3 weeks after bloom most of the less vigorous fruit have dropped and within 4 weeks after bloom fruit set has been determined and subsequent drop is minimal.

Thinning due to Promalin application. It is well documented that Promalin can thin. However, in most cases where Promalin has thinned, label directions were not followed. Causes of thinning include:

1. Overapplication. The most frequent cause of thinning due to over-application is poor sprayer calibration. Portions of a tree also may be overthinned due to poor spray distribution within the tree. Lower, weaker spurs thin more easily than more vigorous spurs located in the tops of trees.

2. Application during hot weather. If Promalin is applied when temperatures exceed 85°F, the likelihood of thinning is dramatically increased.

3. Application on young trees. Treatment of young trees frequently results in complete removal of the crop. This is particularly detrimental on young Delicious trees just coming into bearing since even a small crop is quite useful to bring down branches, help slow growth and encourage consistent fruiting.

Nevertheless, thinning due to Promalin may also be more apparent than real. Promalin may merely accelerate young fruit abscission that would normally occur during the early 'June-drop' period. It would certainly appear that Promalin was increasing thinning if you assessed fruit set 2-3 weeks after bloom. However, in most situations, it appears that Promalin has advanced the 'June-drop' by about 2-3 weeks, thus giving only the impression of thinning. While Promalin can indeed cause thinning, caution should be exercised in concluding that this has happened on your trees.

Use of chemical thinning following Promalin application. Promalin applied by itself is capable of thinning. A chemical thinner, generally Sevin, is often used during the post-bloom period on Delicious. Frequently, increased thinning is observed when 2 different thinning agents are applied. Therefore, it is particularly important to know if Promalin-treated trees are thinned to a greater extent than unsprayed trees when chemical thinners are applied. We have attempted to answer this question with 5 different experiments over the past 4 years using both Sevin and NAA as chemical thinners. Results of a typical experiment are shown in Table 3. When applied as a dilute spray during the bloom period, Promalin thinned. Sevin thinned Promalin-treated or untreated trees comparably. In no experiment did the combination of Promalin with either chemical thinner reduce the crop load below that on trees treated with either Promalin or the chemical thinner alone. Very 'typey' fruit with large L/D ratios were harvested from both Promalin and Promalin-plus-chemical thinner trees.

Table 3. Effect of Promalin, Sevin, and naphthaleneticetic acid (NAA) on fruit set, fruit characteristics and yield of Double Red Delicious apples. 1982.

Treatment[z] (ppm)	Blossom clusters/ cm limb circum. 1982	Fruit per cm limb circum.	Fruit per 100 blossom clusters	Fruit wt. (g)	L/D ratio	Seeds/ fruit	Yield (bu/tree)
Check	10.1a	7.6ab	75.7b	169a	0.96b	6.3a	11.0a
Promalin 25	10.1a	5.1c	56.3bc	179a	1.04a	5.6b	8.9b
Promalin 25 + Sevin 1200	9.9a	4.1c	40.3c	176a	1.04a	4.5c	6.1c
Promalin 25 + NAA 6	9.6a	6.3bc	66.9b	123b	1.03a	1.7d	7.2bc
Sevin 1200	9.0a	4.7c	55.0bc	176a	0.96b	4.0c	6.5c
NAA 6	9.6a	9.1a	100.7a	122b	0.93c	1.9d	6.8bc

[z]Promalin applied 5/12/82 (full bloom 5/13/82) as a dilute spray with 1 pt/100 gal. Glyodin. Sevin and NAA applied as a dilute spray on 5/30/82.

Weather conditions following chemical thinner application were cloudy and moist thus favoring foliar penetration. Complete drying of spray droplets did not occur for 24 hours. Trees treated with NAA soon showed typical leaf epinasty (twisting) and the development and retention of many small and seedless 'pygmy' fruit became apparent. It is for this reason that NAA appears not to have thinned and that average fruit size on these trees was considerably smaller (Table 3). Although 'pygmy' fruit were observed only one year, this illustrates the potential danger of using NAA as a chemical thinner for Delicious.

It should be noted that Promalin did not increase fruit weight (Table 3). We have never observed an increase in fruit size following Promalin application unless the treatment caused significant thinning. The increase in fruit length caused by Promalin was accompanied by a corresponding reduction in fruit diameter. The reduced fruit diameter is attributed to a reduction in seed number.

Uniformity of Promalin response on the tree. The L/D ratio of fruits will vary considerably on a tree. This is due to the location of the fruit on the tree and their origin within the blossom cluster. The L/D ratio distribution of fruits from untreated and Promalin-treated trees is similar (Figure 2). This indicates that a Promalin application increases the L/D ratio of all fruits on the tree equally. Therefore, a grower can expect to find some rather flat-looking Delicious on Promalin-treated trees at harvest time although there should be fewer than on check trees.

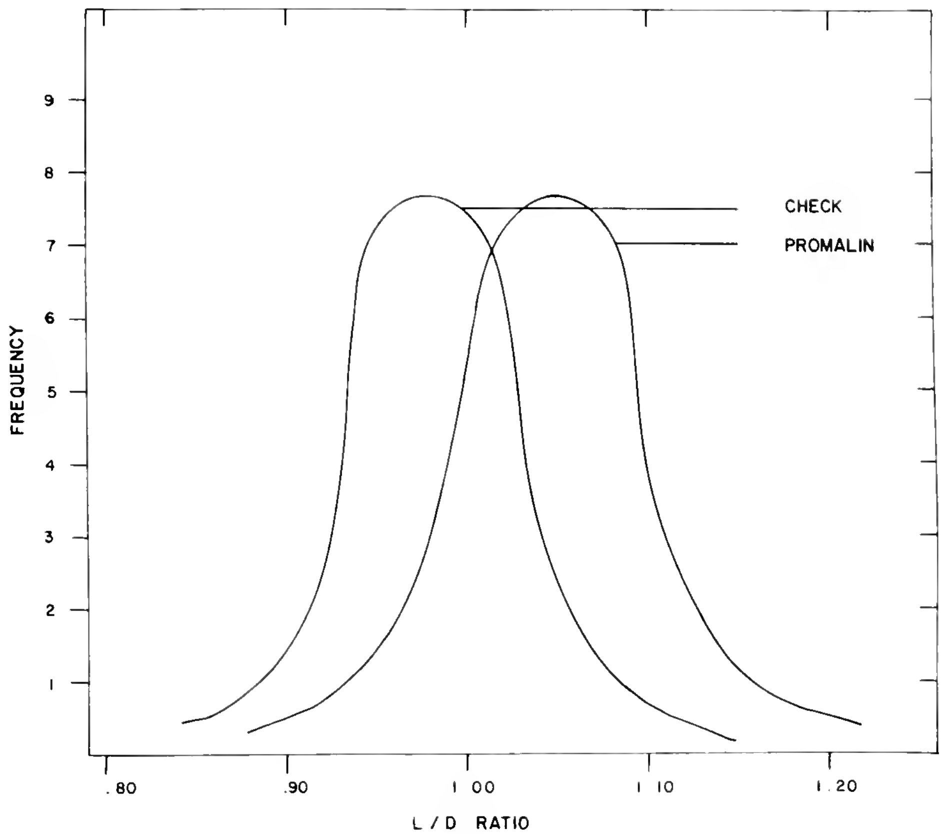

Figure 2. The L/D ratio distribution of fruits from trees receiving a 25 ppm dilute spray of Promalin and from Control trees.

Variable Promalin response. It has been observed that the L/D ratio following Promalin application is sometimes less than expected. We believe that there are at least two reasons for this. Weather, and especially high temperature during and following the bloom period, can influence fruit shape. Undoubtedly, part of the diminished response can be attributed to high temperature during and following Promalin application. It is known that temperature during and following bloom can have a direct effect on cell division and expansion in the calyx end of fruit. Based upon several experiments over several years where Promalin was placed directly in the calyx of fruit it is concluded that Promalin always elongates fruit. Promalin promotes at least 2 independent processes: fruit elongation and fruit thinning. In situations where a diminished response is observed, Promalin may be thinning from the cluster the fruit that have been elongated.

Effect of Promalin on pollinizers. Delicious is not the only cultivar that can be elongated with Promalin. If pollinizers are located within the rows of Delicious being sprayed you can expect elongation of these fruit also. Increased length of such cultivars as McIntosh and Cortland in most cases would not be desirable. Therefore, when applying Promalin attempts should be made to avoid spraying pollinizer trees where increased calyx-end length is not wanted.

Suggestions for Promalin use

1. Calibrate your sprayer. Thinning due to Promalin has often been traced to overapplication because of improper sprayer calibration and nozzle adjustment. The margin of error with Promalin is not great. The label suggests that Promalin should be applied in 100-200 gal/acre. Therefore, an error in application of only 50 gal/acre can result in a 50% increase in the amount of Promalin applied.

2. Do not apply more than $1\frac{1}{2}$ pts/acre of Promalin.

3. Do not apply Promalin when the temperature exceeds 85°F. Excessively warm temperatures may increase the thinning response without a corresponding increase in the shape response.

4. Do not apply Promalin on young trees. A good rule-of-thumb is not to apply this growth regulator on any tree until it is bearing heavily enough to consider chemical thinning.

5. Apply Promalin as soon after opening of the king blossom as weather permits. This is earlier than we have suggested in the past. It is our feeling that the reduced leaf surface at this earlier timing may reduce the possibility of thinning.

6. The addition of surfactants or spreader stickers increases both the fruit shape and thinning response to Promalin. On trees where bloom is heavy and the use of a chemical thinner is anticipated, the addition of a surfactant or spreader sticker is suggested.

7. Promalin may thin as well as accelerate the normal fruit abscission process. Therefore, before using a chemical thinner on Promalin-treated trees, check initial set to see if additional thinning would be desirable. It is possible that no chemical thinner is needed on Promalin treated trees. If a thinner is used on Promalin-treated trees it is unlikely that thinning will be excessive.

8. Leave a few untreated and representative trees in the Promalin-treated block. Initial fruit set, subsquent drop and fruit shape are never constant from year to year. Therefore, the only way to accurately assess the performance of Promalin in your orchard is to leave a few untreated trees in the same block to indicate what would have happened in the absence of the Promalin spray.

FREEDOM: A NEW DISEASE-RESISTANT APPLE

William J. Manning and Daniel R. Cooley
Department of Plant Pathology

The New York State Agricultural Experiment Station at Geneva has released a new disease-resistant apple named Freedom. The new cultivar is described by Professor Robert C. Lamb, Freedom's originator, as a "very productive, large attractive apple of good quality that can be used either for the fresh market or for processing." Like Liberty, Freedom (formerly NY58553-1) is immune to apple scab and moderately resistant to powdery mildew, but slightly less resistant to cedar apple rust and fire blight than Liberty.

Freedom blooms at midseason in Geneva and has been shown to be a good pollen source for other cultivars. Fruit ripen with Delicious, around October 5 at Geneva. They are described as being large ($3\frac{1}{4}$ in.), oblate, with 80% bright red stripes over yellow background. The fruit are medium fine, firm, tender and juicy, subacid, with cream-colored flesh. Freedom will hold in normal refrigerated storage until January.

Freedom will be available (patent is pending) through licensed nurseries or from the New York State Fruit Testing Cooperative, Geneva, N.Y. 14456. We plan to add it to our disease-resistant test block at Belchertown.

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PERFORMANCE OF DISEASE-RESISTANT APPLES

William J. Manning and Daniel R. Cooley
Department of Plant Pathology

In 1978, we planted a block of disease-resistant apples at the Horticultural Research Center at Belchertown. Fungicides have never been used in this block and only a minimal insecticide program has been followed. Fruit were harvested for the first time in 1982 and observations made and cultivar descriptions were published in FRUIT NOTES (Vol. 48 No. 1, Winter, 1983, pp. 6-8).

Performance evaluations of the disease-resistant cultivars were continued in 1983. Disease pressure was high in the spring due to long periods of cool wet weather and near drought conditions and high temperatures were experienced during the summer.

During the second week in August, leaves were examined for symptoms of black rot (frog-eye leaf spot) (Physalospora obtusa),cedar apple rust (Gymnosporangium juniperi-Virginianae), and scab (Venturia inaequalia). Twenty five leaves, on randomly-selected terminals, were evaluated on each of 3 trees. Leaves were counted as having significant symptoms if 2 or more spots of black rot, cedar apple rust or scab were observed per leaf. Results were expressed as % of leaves with symptoms per 75 leaves examined (Table 1).

Table 1. Evaluation of disease-resistant apples in Massachusetts, 1983.

Cultivar	Leaf symtpoms*		
	Black rot	Cedar apple rust	Scab
Imperial McIntosh	13	0	100***
Liberty	21	0	0
Macfree	46	0	0
Nova Easy-gro	24	0	0
NY613452	35	4	0
Priscilla	10	0	0
Sir Prize	10	48**	0

*% of 75 leaves on 3 trees with 2 or more spots/leaf.

**5 or more spots/leaf.

***Both leaves and fruit.

All of the leaves and fruit of Imperial McIntosh had significant scab lesions, while all others were completely free from scab (Table 1). Sir Prize is very rust susceptible, and respond accordingly. A few small, non-functional rust lesions were noted on NY613452. Foliar black rot symptoms were more extensive than in 1982. An occasional apple with black rot was observed for Macfree, NY613452, and Liberty (Table 1). This may be a potential future concern if black rot innoculum continues to increase. For comparison, Table 2 shows the disease-resistance ratings and commonly grown apple cultivars from a test in New York State (Cornell University) published in 1983.

Table 2. List of disease resistance of some apple varieties from New York test, 1983.

Cultivar	Resistance rating			
	Apple scab	Cedar apple rust	fire blight	Powdery mildew
Cortland	4	3	3	4
Delicious	3	1	2	2
Empire	4	2	2	3
Freedom	1	2	3	2
Golden Delicious	3	4	3	3
Idared	3	3	4	3
Jerseymac	4	1	3	-
Liberty	1	1	2	2
Macfree	1	3	2	-
Macoun	4	2	3	3
McIntosh	4	1	3	3
Mutsu	4	3	4	4
Northern Spy	3	3	2	3
Nova Easygro	1	1	2	3
Paulared	3	2	3	3
Prima	1	4	2	2
Priscilla	1	1	2	3
Sir Prize	1	3	4	2
Spartan	3	2	3	2

1 = very resistant. No control needed.
2 = resistant. Control needed only under high disease pressure.
3 = susceptible. Control usually needed where disease is prevalent.
4 = very susceptible. Control always needed where disease is present.

Acknowledgements: We thank Tony Rossi and others at the Horticultural Research Center for maintaining the block and applying insecticides. This activity is supported by the Massachusetts Cooperative Extension Service.

GRAY MOLD ON STRAWBERRIES

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Department of Plant Pathology

One of the most aggravating and economically damaging strawberry diseases is gray mold. It strikes after primary investments in plants have been made, and presents an ever-present, difficult to manage, disease problem. A conservative estimate gauges yield lost from fruit rots in general at about 10%. In the Northeast, the majority of this loss is caused by Botrytis cinerea, the gray mold fungus. Gray mold is a particular problem because, unlike most other berry rots, it often attacks living plants in the field as well as the harvested fruit.

The pathogen is well-adapted for survival. Botrytis occurs on a wide-range of hosts, and while an isolate from a different host may not be as virulent as a strawberry isolate, in most cases B. cinerea isolates can cause some degree of gray mold. Botrytis also has the ability to colonize dead or living tissue. The fungus will often establish itself on dead or aging plant tissue and move from that tissue to healthy areas. Petals and other parts of older flowers are likely to be colonized first. These infections may destroy the developing fruit immediately, or may remain latent until the fruit is well-ripened or harvested. As the fruit ripens, it becomes easier for the fungus to attack it, because endogenous enzymes in the fruit break down mechanical barriers to fungal infection. Substrates for fungal growth become more available, and biochemical defenses decrease as the fruit ripens, making a ripe strawberry an excellent habitat for Botrytis and other rotting fungi.

Botrytis cinerea inoculum is very common. In strawberry plantings in the Northeast, Botrytis usually overwinters in dead leaves and other decaying plant tissue, using survival structures called sclerotia. In spring, as the temperature warms, the sclerotia germinate and produce spores. These spores are carried about strawberry plantings by air currents, splashing moisture or insects. In the presence of free water on the plant, the spores germinate. Though the fungus is active over a wide range of temperatures, optimum conditions for a Botrytis epidemic occur when temperatures are approximately 60 to 70° F, and relative humidity exceeds 90%. If temperatures and humidity are optimal, an epidemic can occur in as little as 28 hours. One of the driving forces behind this rapid disease development is the prolific reproductive capacity of the fungus. Gray mold is an example of what is called a 'compound interest disease'. That is, each reproductive unit, in this case a condium or spore, can produce hundreds of new spores, which can each produce hundreds more spores, and so on as long as environmental conditions are favorable. Each generation progresses rapidly in warm, humid weather. With conidia multiplying at a high 'interest' rate, disease pressure becomes severe. Add to this the fact that initial inoculum is virtually always present, and gray mold becomes extremely difficult to manage. Figure 1 shows a diagram of the disease cycle for gray mold.

Most management efforts aimed at gray mold rely heavily on fungicides. To be effective, fungicides must be applied at proper times. Most effective programs attempt to prevent initial infections in the spring, and concentrate on protecting the plant, particularly the flowers and fruit, from infections when environmental conditions favor the disease. To be effective, a layer of fungicide must be kept on the plant surface. A minimum spray schedule involves 3 applications, one at 10% bloom, one at 50% bloom and one at the end of bloom. Where gray mold has historically been a problem, applications should start at white bud, then the 3 bloom applications should be made, and then applications should be made during fruit development at 5 to 10 day intervals. To maximize the protection it is wise to time spraying according to plant development and weather. Rapid plant growth leaves tissue unprotected until the next application, and heavy rain for more than 24 hours washes fungicides off and provides an excellent infection environment. Therefore, in addition to the prescribed applications, additional sprays should be made after 24 hours if rainy periods occur.

Such intensive fungicide spraying can and has led to resistance to some chemicals. Specifically, the systemmic fungicides, benomyl (Benlate®), thiophanate-methyl (Topsin M®) and vinclozolin (Ronilan®) can become ineffective if used alone or too heavily. The broad-spectrum contact fungicides, captan and thiram, are not likely to produce the same problems. As a consequence Benlate®, Topsin-M® or Ronilan® should be used in combination with a half-rate of captan. This reduces the risk of resistant Botrytis developing, while enabling growers to use one of three very effective chemicals. The rates for these chemicals are given in 'Managing Diseases and Insects on Small Fruits in New England', available from the Massachusetts Extension Service, Cottage A, University of Massachusetts, Amherst 01003.

There is another problem with the systemic fungicides in that they do not control Rhizoctonia, Phytophthora, Rhizopus and Mucor, fungi which also cause berry rots. In some cases, post-harvest rots caused by Rhizopus and Phytophthora have actually increased where Benlate or Ronilan were the only fungicides used.

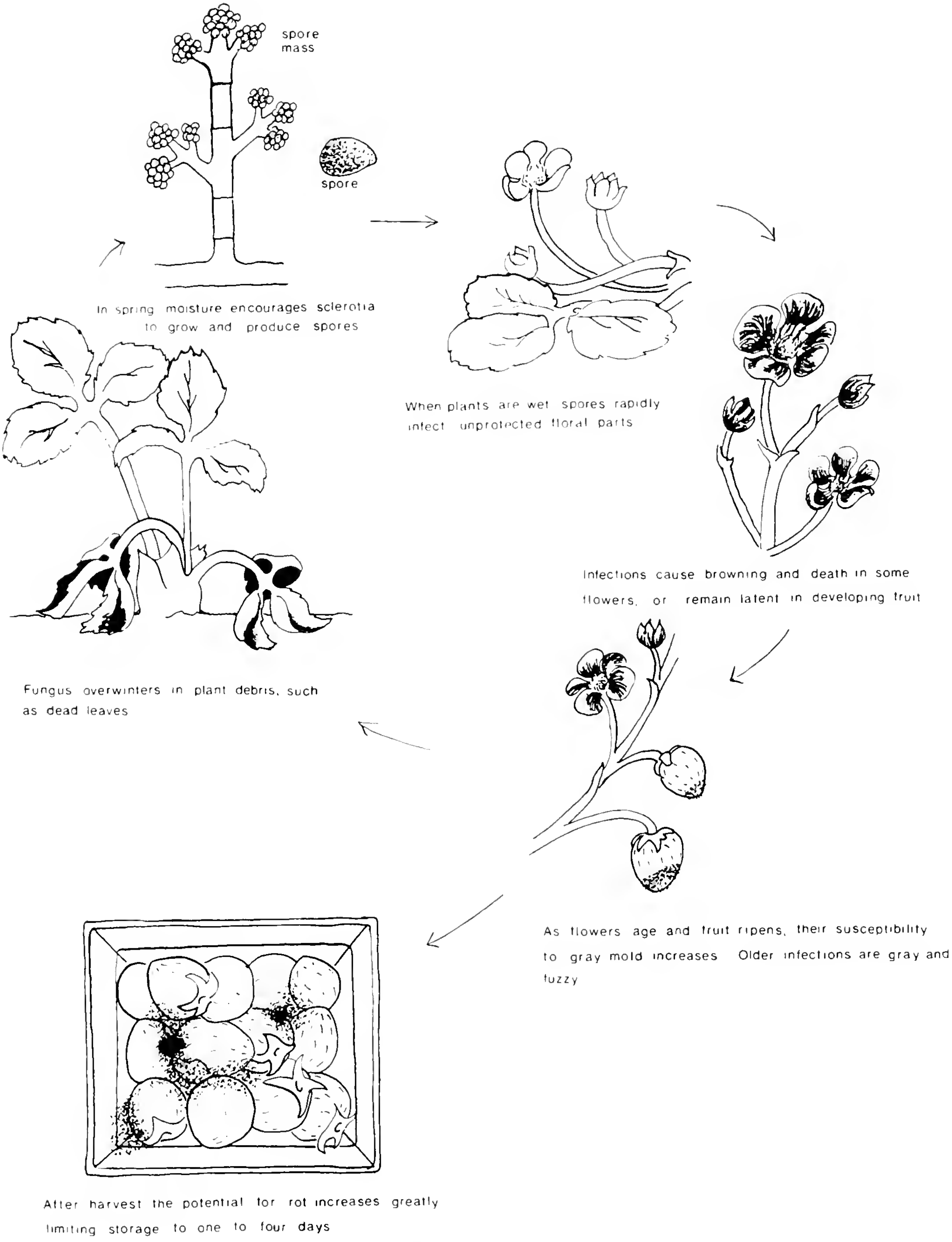
Cultural practices can reduce the amount of inoculum which contacts plants, and reduce the free moisture on plants necessary for infection. Mulching with straw or plastic keeps berries from contacting soil, hence reducing inoculum pressure and improves fungicide coverage. Narrower rows promote air circulation and drying, minimal weeds accomplishes similar goals. There is some evidence that adding micronutrients may decrease gray mold, though the interaction of nutrition and the disease has not received much study.

Some cultivars are more resistant to gray mold than others. In general, berries which are firmer are more resistant. A recent study at Cornell rated the following cultivars in decreasing order of susceptibility to berry rots: Honeoye, Guardian, Canoga, Tenira, Surecrop, Holiday, Veestar, Vibrant and Earlidawn. Of these, the first three cultivars were significantly more resistant than the others. Plant breeders are continuing to develop gray mold resistant cultivars.

Finally, an experimental approach to control has been tried using the biological control fungus Trichoderma. Preliminary results were not as consistent as control achieved by fungicides, but Trichoderma may yet be developed into an effective alternative to fungicide control. In the future, it may be possible to reduce or eliminate fungicides by using a combination of resistant cultivars, biological control agents and careful management of horticultural practices.

Obviously, these measures are aimed at reducing field incidence of gray mold. These practices will, as a consequence, reduce post-harvest disease incidence. Refrigeration is an option most small growers use to further reduce post-harvest gray mold. Beyond one or two days after harvest, strawberries become increasingly susceptible to rot, and the best strategy is to use or process them as soon as possible after harvest.

Acknowledgment: Special thanks to Paula Saucier for the illustration.



GRAY MOLD ON STRAWBERRY
BOTRYTIS CINEREA

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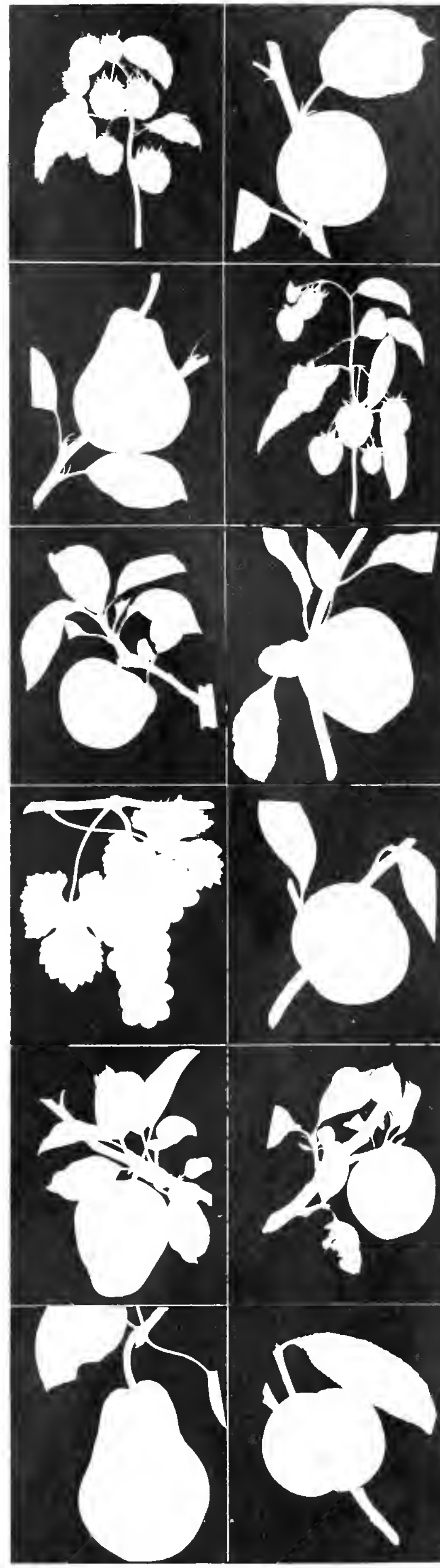

PREPARED BY
DEPARTMENT OF PLANT AND SOIL SCIENCES

COOPERATIVE EXTENSION SERVICE, UNIVERSITY OF MASSACHUSETTS, UNITED STATES DEPARTMENT OF AGRICULTURE AND COUNTY EXTENSION SERVICES COOPERATING.

EDITORS
W. J. LORD AND W. J. BRAMLAGE

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FACTORS INFLUENCING DPA RESIDUES ON APPLES

William J. Bramlage
Department of Plant and Soil Sciences

Most apple growers in New England use diphenylamine (DPA) as a postharvest dip or drench to control scald on apples. Although these treatments have been generally effective in controlling scald, results of a given treatment are not always the same. One reason for this is that fruit vary considerably in their susceptibility to scald, depending on variety, fruit maturity, fruit nutrition, and growing conditions.....especially the temperature that occurred during the days shortly before harvest.

Another reason for variable results is that a number of factors affect the amount of residue left on fruit by a treatment. (It is this residue that protects the fruit from scald during and following storage.) A recent study by Drs. Shih-Lo Lee, Asela Carag, and Hesh Kaplan of Decco Tiltbelt Division, Pennwalt Corporation, Monrovia, California (1) demonstrated some important factors influencing this residue.

Most of their studies were with Granny Smith apples, which are very sensitive to scald, and most employed No Scald DPA EC-283®, 31% a.i., as the test material. Their results can be summarized as follows:

1. Effect of DPA solution temperature. Cold apples were dipped in solutions at 41°, 55°, 70° and 95° F for 30 seconds, 1 minute, or 2 minutes. When dipped for 30 seconds, solution temperature had no effect on DPA residue, but when dipping time was 1 minute a solution temperature of 95° F. doubled the residue left by solutions at the lower temperatures. It should be noted that solutions of 41°, 55°, and 70° F. all left approximately the same residue regardless of solution temperature or treatment time.

2. Effect of fruit temperature. Cold apples were kept at 40°, 55°, or 72° F. for 10 to 12 hours to warm before dipping in a 70° F. solution for 1 minute. The coldest apples (40° F) retained the least residue, but there was no difference between those at 55° and 72° F.

3. Effect of dipping time. Apples were dipped for periods varying from 15 seconds to 4 minutes. A dip of only 15 seconds produced less residue than the other dipping periods, but all periods of 30 seconds or more produced the same residue.

4. Effect of DPA concentration. When apples were dipped in concentrations of DPA varying from 500 to 2500 ppm, the amount of residue increased with concentration. There was twice as much residue from 2500 ppm as from 500 ppm, but perhaps of greater interest is the finding that there was about one-third more residue from 2000 ppm than from 1000 ppm, since our recommendation usually calls for use of "1000 to 2000 ppm".

®Trade name

5. Effect of additives. Addition of calcium chloride at 24 lbs. per 100 gallons did not affect DPA residue, and neither did the addition of a surfactant.

6. Differences among varieties. The authors compared Granny Smith apples with Golden Delicious, Delicious, Jonathan, and Rome Beauty. When the fruit were all dipped under identical conditions, the residues were similar on all varieties except Delicious, which retained almost twice as much residue as did the other varieties.

7. Effect of DPA formulation. Three different commercial formulations of DPA were tested under identical conditions, and one of the formulations left twice as much residue as did the other 2 formulations.

Conclusions

These results indicate that apples should be treated for at least 30 seconds, but that prolonged periods provide no additional benefit unless the dipping solution is hot. They also show that cold apples will retain less residue than warm ones. However, the temperature of the dip solution is of little consequence unless a quite warm solution is used, which will greatly increase the amount of residue. They also illustrate that the same treatment can protect different varieties to different extents, and that different DPA formulations can produce different results. Within the solution itself, DPA concentration was highly important, but addition of $CaCl_2$ or surfactant had no effect on DPA residue. Addition of fungicides to the solution was not tested.

The results of this study should be of considerable interest to apple growers, who are frequently concerned about how treatment conditions affect scald control.

Literature Cited

1. Lee, S-L, A. Carag, and H.J. Kaplan. 1984. Factors influencing the uptake of diphenylamine by apples. HortScience 19(1):94-95

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POMOLOGICAL NOTES

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Response to chemical thinning. The primary effect of chemical thinning is a reduction in the number of smaller apples rather than a large increase in the size of the remaining fruits. Thinning does not change a potentially small apple into a large fruit but helps to insure that a potentially large apple will size properly.

HARVESTING, STORING AND RIPENING PEARS

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Pears are not a major crop in New England, yet many growers have modest plantings of them. Most of the crop is marketed locally by the grower, especially on roadside stands. We are not presently conducting research on pears at the University of Massachusetts, but we have periodically assessed the recommendations from other areas to keep growers updated on developments. Here is our present view of the requirements for marketing high quality pears.

Harvesting. Unlike most other fruits, pears cannot be tree-ripened or they will develop core breakdown and will often become "gritty". They must be picked green, and most importantly, they need to be picked at the correct stage of greenness. Unlike with apples, for pears firmness is a reasonably good index of maturity. It can be measured in the orchard with a penetrometer such as a Magness-Taylor pressure tester, but because of the hardness of pears, it must be done with the 5/16 inch penetrometer head, not the 7/16 inch head used on apples. The following firmness values have proven to be resonably indicative of optimum maturity of pears in Massachusetts: Bartlett, 20-17 pounds; Bosc, 15-12 pounds; Anjou, 15-13 pounds; Comice, 13-11 pounds; Gorham and Flemish, 14-12 pounds.

If pears are picked too immature, they tend to shrink in storage and to develop poorer quality when ripe. However, the greater danger is from picking them at too advanced a maturity, for this will greatly shorten their storage life and increase their susceptibility to core breakdown, rotting, and CO_2 injury. Perhaps the greatest problem with pears is that growers do not pay close enough attention to picking them at the correct time. It has been observed in England that a good key to pear maturity is to note the ripening pattern of early apple varieties. If they are ripening unusually early or unusually late, then pears are probably maturing in a similar pattern and their expected harvest season should be altered accordingly. Maturity can then be monitored more precisely with a pressure tester.

During packing, pears should be handled with care. Their hardness is misleading; bruises incurred during harvest often do not show up until the pears ripen. Any two-inch drop onto a hard surface will almost certainly produce a bruise.

Storage. If pears are to be stored, they should be cooled as quickly as possible. A core temperature of 40° F. should be achieved in no more than 2-3 days, and the core should be at storage temperature in no more than 10 days, or serious loss of storage life will result.

Pears benefit greatly from storage as close to their freezing point as possible. Their freezing point is between 27°F. and 29°F., and their recommended storage temperature is 30-31°F. Obviously, that temperature requires great care in storage operation, but the life of pears drops rapidly as storage temperature exceeds this recommendation. For example, storage life of Bartletts is 30% more at 30°F than at 32°F, and is 40% more at 30°F than at 34°F.

Pears have clear limits on how long they can be stored and still retain their ability to ripen properly after storage. In general, Bartletts seldom keep well in air beyond December or early January; Bosc beyond February, and Anjou beyond March. If stored longer than this in air, they will not ripen properly. Anjous present another requirement, in that they will not ripen properly unless they have been kept at a low temperature for close to 2 months.

Pears respond very well to CA for longer storage times. In some areas 1% O_2 is recommended. Pears can be very sensitive to CO_2, so less than 1% CO_2 in the storage atmosphere is often recommended, especially in combination with 1% O_2. CA studies with pears in New York led to the recommendation of 2.5% O_2 and less than 2.5% CO_2 for Bartlett and Bosc, so these conditions probably represent the best recommendation for pears grown in the Northeast.

Pears are very susceptible to shrivel. Since it is difficult to maintain high enough humidity in storage to avoid significant water loss and shrivel if pears are to be stored for long, perforated polyethylene liners or bags are often used with success. At the very least, it is desirable to place polyethylene sheets over the tops of bins before storing pears. With a relatively high humidity to control shrivel, unacceptable amounts of rots can develop on stored pears. Furthermore, pears (especially Anjou) may be susceptible to scald. Protection against rot can be provided by a preharvest drenching or dipping of the fruit with benomyl 50% WP at 8 ounces/100 gal. and if scald is a risk, 2700 ppm ethoxyquin can be added.

Ripening. For pears to achieve high quality, they must be properly ripened after storage. They will ripen at 60-65°F, but if the humidity is low they can shrivel quickly during this time. It is therefore necessary to either ripen them in a humid area or to cover them with a polyethylene sheet during ripening.

If pears have been stored too long, they will not ripen properly regardless of treatment. If it is intended to keep pears to the limit of their storage life, then you should periodically remove samples from storage and test their ripening time. If it takes less than 5 days for them to reach full ripeness, they are in danger of losing their ability to ripen and should be stored no longer. Maturity at harvest and storage temperature will markedly influence their maximum storage life.

Conclusion

Pears can be a very high quality commodity, but to produce this quality special care is required. They must be harvested at the proper stage of maturity, handled carefully, stored correctly and then ripened properly after storage if premium quality is to be achieved. Many consumers are wary of pears due to unfavorable experiences with them. When you are marketing your own pears locally, you have the opportunity to educate your customers to the potential quality of pears, and to greatly increase repeat sales.

APPLE FRUIT GROWTH

Franklin W. Southwick[1]

There is often some confusion about the growth of apples, particularly concerning the year-to-year variation in fruit shape and the growth during the harvest season. During and shortly after bloom apparently is a critical stage in fruit development because fruit size is primarily due to cell number, and cell division ceases about 3 weeks after full bloom. Thus, an apple with a greater number of cells at bloom, or shortly thereafter, has the potential to become larger in size by harvest than one with fewer cells.

Apple fruits increase in length and diameter after bloom. In 1914, J.R. Shaw in Massachusetts reported on the relationship between shape of Ben Davis and Baldwin apples and the temperature following bloom; the cooler the temperature, the more elongated the apple. He concluded that during the post-bloom period, temperature variations between the 6th and 16th day after full bloom fitted the observed variations in shape more closely than did temperature variations during any other period. As most growers know, distribution of seeds in fruit influences shape. Apples with a small number of seeds are frequently lopsided, with the less fleshy side being the one lacking seeds. The "king" fruit generally is larger than "side-bloom" fruit.

From approximately 3 weeks following bloom to harvest fruit growth is by cell enlargement. Figure 1 shows typical growth curves for Early McIntosh and Golden Delicious apples plotted on the basis of fruit diameter and volume (assuming the fruit to be a perfect sphere). It can be noted that the growth rate is constant with no "final swell". In fact, when one plots the growth curve on the basis of diameter it appears that the rate of apple fruit growth tends to slow down as the fruit approaches maturity. This apparent slackening of growth rate is more pronounced for the later maturing Golden Delicious than for the earlier maturing Early McIntosh. If the data are calculated on the basis of volume increase, however, it is apparent that the growth rate actually accelerates in July and may not taper off appreciably for early apples and only slightly before harvest for late varieties. Thus, there is no periods of accelerated or decelerated growth as with the stone fruits. Fruit volume increases rapidly as fruit become larger because progressively more volume is required to add a given increment to the fruit diameter. This is shown in Table 1 where it can be seen, for example, that an increase in diameter of 0.1 inch on a 2.60 inch apple represents a volume increase of 18.51 cubic centimeters as compared to a 17.19 cubic centimeter increase in volume of a 1.50 inch apple that has grown another 0.25 inch in diameter. Also, a 0.25 inch increase on a 3.00 inch apple represents an increase in volume almost equivalent to the entire cubic contents of a 2.00 inch apple.

Since McIntosh may grow at the rate of 0.07 to 0.10 inch in diameter per week in September, the addition of 0.15 inch diameter on a 2.50 inch apple represents a 19.1 percent volume gain or a 17.2 percent increase in volume on a 2.75 apple within two weeks. In other words, the delay in harvest of 2 weeks can add materially to the volume of McIntosh picked and to individual fruit size.

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Under optimum conditions the rate of fruit growth is so consistent that apple fruit size at harvest can be predicted with reasonable accuracy as early as 35 days after full bloom. However, a period of moisture stress can drastically reduce fruit growth. The amount of growth lost from a soil moisture deficit or some other factor, causes a non-recoverable loss in fruit size. Trickle irrigation is becoming a cost effective practice to prevent loss in fruit size.

Table 1. The relationship of diameter increase to volume increase of apples (assumed to be perfect spheres).

Apple			Increase in cubic centimeters per diameter increase		When apples grow from	
Diameter		Volume				
Inches	Centimeters	cubic centimeters			diameter (inches)	% volume increase
0.5	1.27	1.07				
0.75	1.91	3.65	2.58			
1.00	2.54	8.58	4.93			
1.25	3.18	16.84	8.26			
1.50	3.81	28.97	12.13			
1.75	4.45	46.16	17.19			
2.00	5.08	68.67	22.61			
2.25	5.72	98.21	29.54			
2.50	6.35	134.12	35.91		2.50	
2.55	6.48	142.53	8.41		↓	19.1
2.60	6.60	150.59	8.06			
2.65	6.73	159.67	9.08		2.65	
2.70	6.86	169.10	9.43	18.51		
2.75	6.99	178.89	9.79		2.75	
2.80	7.11	188.27	9.38		↓	17.2
2.85	7.24	198.78	10.51			
2.90	7.37	209.69	10.91		2.90	
2.95	7.49	220.10	10.41			
3.00	7.62	231.76	11.66			
3.05	7.75	243.82	12.06			
3.10	7.87	255.32	11.50			
3.15	8.00	268.19	12.87			
3.20	8.13	281.64	13.45	63.43		
3.25	8.26	295.19	13.55			

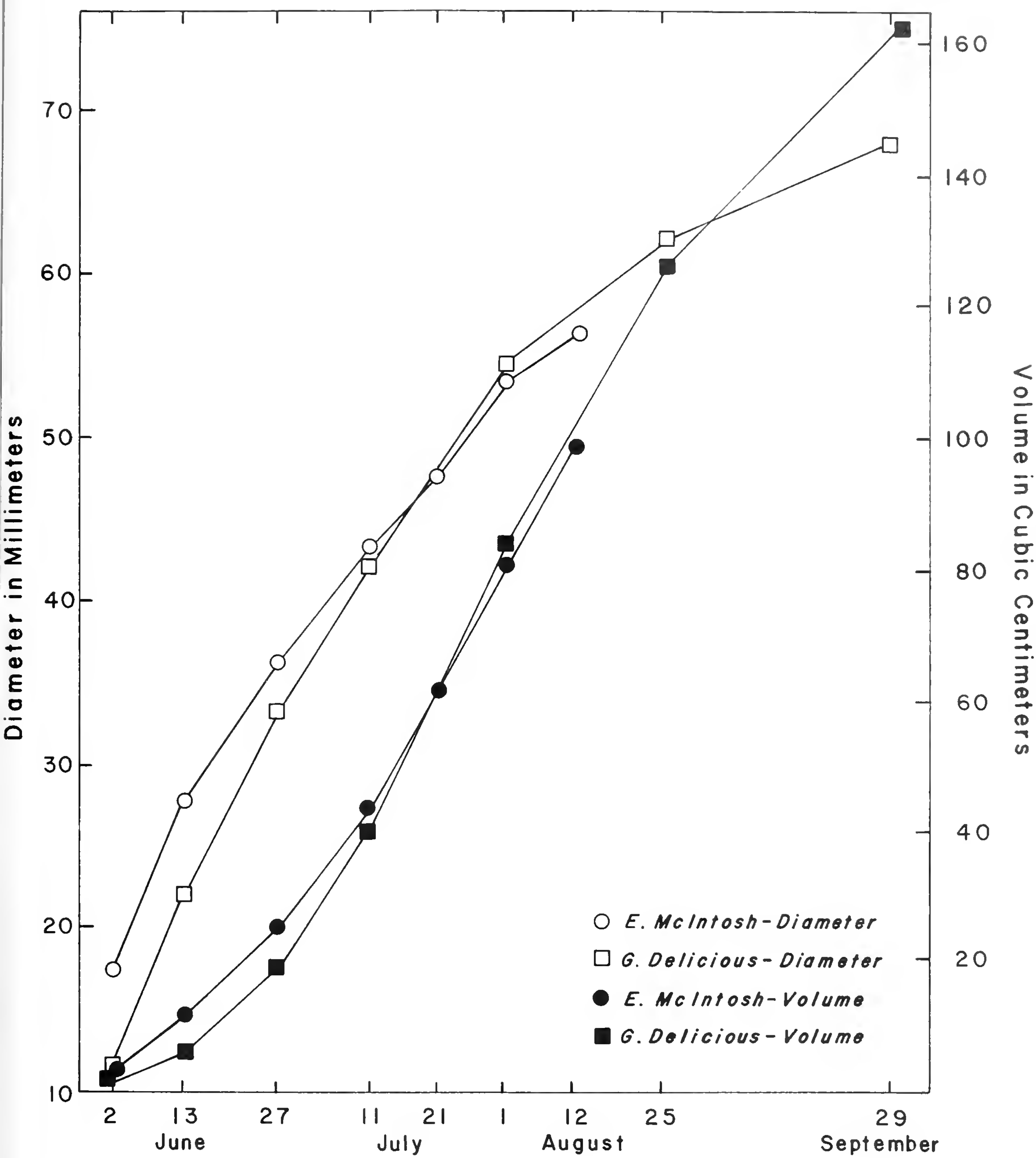

Figure 1. Fruit growth rate for Early McIntosh and Golden Delicious.

THE "MARSHALL" McINTOSH

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In recent years, thousands of Marshall McIntosh trees have been planted in New England. The demand has exceeded the supply because until recently the only source of this strain was a small nursery in Maine. We have described below the origin, growth habit and fruit of the Marshall McIntosh because of inquiries about the strain from other McIntosh-growing areas.

Marshall McIntosh is a non-spur strain that originated on a branch mutation of McIntosh in the orchard of the Marshall Farm, Inc., 340 Marshall Road, Fitchburg, Massachusetts 01420. The mutation was noticed in 1967 when the fruit developed red color 2 or 3 weeks earlier than those on the rest of the tree.

The Marshall brothers have found that the Marshall strain can be harvested earlier than other McIntosh strains, and can also be picked on the "normal" harvest dates without adverse consequences. They report that the fruit stores well in both air and CA storage, but believe more information is needed concerning the harvest and storage of the strain.

We at the University of Massachusetts as yet have little information about the Marshall strain. However, we think it has real potential for CA storage because of early coloring; that it will increase pack-out because of more red color; and that planting of the strain will make the harvest season more orderly because the number of days that McIntosh can be harvested will be extended.

Our limited data show that at the Horticultural Research Center, Belchertown, Massachusetts on September 6, 1978, 72% of the Marshall McIntosh fruit were Extra Fancy for color. On this date only 40% of the Cornell strain of McIntosh was Extra Fancy. On August 30, 1979, 75% of the Marshall were Extra Fancy in comparison to 43% of the Cornell fruit. Lastly, on September 4, 1980, 53% of the Marshall McIntosh were Extra Fancy and only 16% of the Cornell McIntosh fruit were of this grade for color. We also believe that the red color is more intense on Marshall than on other strains of McIntosh. Our data suggested that the maturations of Cornell and Marshall strains were similar as indicated by flesh firmness and sugar content of the fruit. Thus, limited observations suggested that Marshall McIntosh is an early coloring strain, not both an early coloring and early maturing strain.

In 1979 we established a planting in which Marshall McIntosh is being compared with 6 other strains of the variety. Hopefully, we shall be able to obtain more reliable and complete information on the maturation of these strains and on their keepability in air and CA storage.

In 1983, the trees for the first time bore sufficient fruit for some evaluations. On three dates...September 1, 7, and 14...fruit on trees of all seven McIntosh strains were visually evaluated for red color. It should be receallled that August and early September were very hot in 1983, and that red coloration was very slow. On both September 1 and 7, two-thirds of the Marshall McIntosh had at least 50% of their surface colored red. This was far superior to the coloring on any of the other strains. By mid-September, 84% of the Marshall were well colored, and only one other strain had close to that amount of color. Thus, even under growing conditions unfavorable to red color development, Marshall McIntosh developed color earlier than other strains.

On September 7 and 14, samples of fruit were picked from these trees and measured for firmness and for starch disappearance. At the first picking Marshall McIntosh were neither firmer nor softer than those of any other strain. At the second picking they were firmer than Macspur, Eastman, and Gatzke McIntosh, none of which was as red as Marshall. At neither picking did Marshall have either more or less starch than any other strain.

These results must be evaluated with great care as they represent fruit from young trees, with the fruit varying in size but tending to be unusually large. It will not be until the trees are bearing consistent and representative crops that reliable conclusions can be drawn, but the indications in 1983 were consistent with earlier observations: Marshall McIntosh appear to color early, but not to mature early.

Table 1. Influence of McIntosh strain on red color of fruit and fruit maturity, 1983.

Strain	Percentage of fruit with sufficient color for Extra Fancy grade[z]			Fruit Firmness (lbs)		Fruit Maturity (1-9)[y]	
	9/1	9/7	9/14	9/9	9/17	9/9	9/17
Morspur	17b	20b	57bc	15.5ab	14.5ab	1.9ab	2.5a
Marshall	64a	67a	84a	15.5ab	14.9a	1.9ab	2.8a
Imperial	15b	23bc	68ab	15.3ab	14.4abc	1.7ab	2.7a
Macspur	8bc	33b	56bc	14.7b	13.8cd	1.9a	2.6a
Eastman	1c	6c	25d	14.8b	13.6d	1.36b	2.8a
Gatzke	9bc	17c	53bc	15.3ab	1.40bcd	1.8ab	2.3a
Rogers	8bc	28b	39cd	16.0a	14.5abc	1.5ab	2.3a

[z]At least 50% of fruit surface with red color typical of the variety.

[y]Based on Starch-Iodine test: 1-immature; 9-overmature

POMOLOGICAL PARAGRAPH

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Measuring temperatures in cold storages. We have frequently urged storage operators to stop relying on a single thermometer placed near the door to measure storage temperatures. Totally unnecessary risks result from this method of monitoring storage temperature. A better method is to use remote sensing devices, such as thermocouples or thermistors, located at key positions within the storage.

A recent publication, prepared by J.A. Bartsch and G.D. Blanpied of Cornell University, gives step-by-step instructions for installing and using a thermocouple system for measuring storage temperatures. We urge any storage operator who is not presently using remote temperature measurement to obtain this publication and to use it as a guide for installing such a system. A small error in temperature control can cause a very large loss in fruit quality. A storage operator needs to have as precise a measure of storage temperatures as he can get. The publication, "Temperature Monitoring System for Cold Storage" is Extension Bulletin 430, and can be obtained by writing Helen Rogers, Department of Agricultural Engineering, Cornell University, Ithaca, New York 14853.

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POMOLOGICAL NOTES

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Plastic bags filled with dirt aid in tree training. According to the Great Lakes Fruit Growers News (April, 1983) Paul Friday of Coloma, Michigan is using small plastic bags with ½ to 1½ lbs. of dirt as tree training aids for young peach, apricot, and tart cherry trees. The dirt-filled plastic bags are fastened with 2 clothespins to the ends of branches requiring spreading. Mr. Friday believes that wide crotch angles on peach trees, as a result of limb positioning, has reduced the number of canker-infested crotches.

Producing your own fruit trees. Until recently fruit growers experienced difficulty in obtaining trees from nurseries. Because of this problem, many growers began to propagate their own trees. However, it is now evident that most of us are producing low quality trees which in the long-run will cost us more because of poor performance in the orchard than those purchased from a commercial nursery. Reasons for our lack of success in propagation include poor soil for a nursery, lateness of lining-out the rootstocks, and/or neglect of the nursery.

PREDICTING HARVEST SIZE OF McINTOSH APPLES

F.W. Southwick[1]

It is known that apple fruit size at harvest from healthy trees can be predicted with reasonable accuracy by measuring fruit size much earlier in the growing season. Therefore, measurements of fruit diameters in July or later can be used to accurately estimate average fruit size of McIntosh in early- mid- or late-September, assuming severe drought conditions do not develop during July or August. By taking some early size measurements a grower can determine whether or not he should consider doing some hand thinning to improve the overall size of the persisting fruit at harvest. The earlier hand thinning is done after completion of the June drop, the greater the improvement in size of the persisting fruit and the smaller the decrease in total yield.

Data in Table 1 can serve as a guide, showing the approximate harvest size of McIntosh on September 15 when fruit diameters were measured on July 15 and August 1. It is assumed that the McIntosh were sprayed with Alar-85 in mid-July at a concentration of 1000 ppm for pre-harvest drop control. To determine average fruit size, measure at least 25 fruits a random on several trees in each block. A suitable measuring device for measuring fruit diameters (Cranston Calpher) can be purchased from the McCormack Fruit Tree Co., Inc., 611-A Englewood, Yakima, Washington 98908.

Table 1. Prediction of fruit diameter (inches) of McIntosh apples on September 15, based on size on July 15 or August 1.

Fruit diameter July 15	Predicted fruit diameter on September 15	Fruit diameter August 1	Predicted fruit diameter on September 15
1.4	2.45	1.8	2.25
1.5	2.55	1.9	2.35
1.6	2.65	2.0	2.55
1.7	2.75	2.1	2.65
1.8	2.85	2.2	2.78
1.9	3.00	2.3	2.95
2.0	3.10	2.4	3.05
		2.5	3.15

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A SURVEY OF THE COST OF GROWING AND HARVESTING APPLES IN EASTERN NEW YORK IN 1983

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This is a survey and analysis of the cost of growing and harvesting apples for eight operations in Eastern New York. It includes operations from throughout the Hudson and Champlain Valley apple producing region. The objective of this study is to assist growers in identifying and analyzing that portion of their total expenditures which can be associated with the growing and harvesting portion of their business. The data contained within the study is thought to be representative of what better-than average growers are doing.

Method of Obtaining Data

Throughout the 1983 growing season, the growers in the survey were asked to keep a record of where labor was used. In early 1984 the eight operations were mailed survey forms to collect the labor information and other needed information. A short time later, each operation was visited to pick up the forms and collect any additional information that was required.

The operations included ranged in size from 41 acres of apples to 585 acres. The fruit produced by these growers account for approximately 8% of the apples produced in Eastern New York.

The sample of operations that is included in this study is neither a stratified nor random sample. The purpose of this study is to provide growers with a management tool with which to analyze their business. While the data contained in this report is useful in evaluating a growers operation from a management standpoint, it may not be representative of average costs in Eastern New York for other purposes.

Orchards Included in the Survey

For this study, acreage of bearing trees include all mature trees, even though they may not have produced a crop or the crop may have have been harvested. It also includes all young trees that produced enough fruit to make harvesting economically feasible, even though the volume of apples might not have been sufficient to cover the cost of growing the fruit. Using this method of determining a bearing acre can have a major impact on a growers average yield, since the number of bushels of apples harvested are divided by the total number of acres considered to be bearing. If a grower has

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a large acreage of young trees just coming into production, his average yield may be considerably less than a grower who is dealing only with mature trees. This may also increase both his growing and harvesting cost per bushel in the short run. However, if a grower is going to maintain a productive orchard over the long run, it is desirable and even necessary that he constantly plant young trees. If a new planting is expected to have a useful life of from 20-25 years, then approximately 4-5% of the total acreage should be replanted each year. Replanting about the same number of acres each year is desirable from several standpoints:

1. It insures that the productive base of the farm is constantly being renewed.

2. It makes it much easier to provide the labor and equipment needed for the operation as compared to planting larger acreages on an irregular basis.

3. The cash flow needs of business are more constant. It costs from \$6,000-\$10,000 per acre to plant and care for a young orchard until it begins to pay its own way. When replanting is done on a regular basis this cash flow drain is also more constant and more easily planned for.

This year, data was again collected to show the age breakdown of the trees on each operation. This is summarized in Table 1. It illustrates the importance that these growers have placed on establishing new orchards in recent years. However, it also illustrates that orchard replanting has been a very sporadic activity on several of the operations in the study, rather than a regular activity. Many of these operators have now recognized the need to plant approximately the same number of acres of young orchards each year.

This year we collected information on the number of acres pruned, average number of sprays per acre, number of acres receiving herbicides, average number of times each grower mowed his orchard and information on irrigation practices. This data is summarized in Table 1 also. Hopefully, it will provide growers with a better understanding of how their cost might compare to the figures contained within this publication.

Summer pruning includes all pruning activities done in the bearing orchards during the time from petal fall to harvest, including suckering. The number of sprays per acre include the average of all the sprays to an orchard for insect and disease control, growth regulations, thinning, and foliar fertilizers. The number of bearing acres receiving herbicides include those acres that received some type of herbicide treatment. Some of these may have been treated more than once.

All the costs associated with the production of the apple crop on acres of apples considered to be bearing acres are included in Table 2. In some cases, it was easy to identify those expenses associated with the growing phase of the operation, for others it was necessary to estimate what percent of the total expenditure was associated with growing the crop. An example of the latter is the management salary. On none of these operations was one person in charge of only growing the apples. Therefore, it was necessary to estimate what portion of the manager's salary should be charged to the growing phase of the operation. Also, it was necessary to separate the costs of caring for the young non-bearing acres and the costs associated with the bearing acres.

The return on investment for orchards, building and equipment recognizes the cost of having capital tied up in the business. If a grower is relying on borrowed capital to finance the ownership of the orchards, buildings and equipment, this cost of capital is an easily identified cost. It is the interest he must pay his lender. However, this cost exists, even if a grower is using his own money. The dollars invested in the business have an earnings potential of their own. These dollars could be invested in the bank or elsewhere and produce some income. This earnings potential must be recognized as an opportunity cost of capital, when a grower invests his money in his own business. His business must earn a profit, over and above the basic earning potential of his capital, to be profitable in a real sense. In this publication the return on investment or opportunity cost of capital is calculated at the rate of 12% of the value of orchard, buildings and equipment.

The value of the orchards, buildings and equipment was obtained by asking each grower to estimate the market value of bearing orchards, buildings used in the growing phase of the business and equipment used to grow the apple crop. The return on investment for the orchards and buildings is included in the orchard overhead group. The return on investment for the equipment is included under equipment on Table 2.

The real estate tax represents the taxes actually paid on the bearing orchards and the taxes on the buildings used to store growing equipment and materials. In most cases it was necessary to break these out from a total tax bill.

Rentals includes the payment made for orchards or buildings not owned by the grower. Five of the participating growers rent some orchards and/or buildings.

The category "other" under orchard overhead in Table 2 includes insurance, short term interest, and any miscellaneous cost associated with the growing phase of the business. The short term interest includes only the interest on loans made to produce the crop, typically they might include loans for pruning, materials, etc. It does not include interest on loans for the purchase of equipment, buildings, orchards, etc. This type of interest would be covered under the return on investment.

The labor costs in Table 2 includes the gross wages paid the employee plus the employer's share of social security, workmen's compensation, unemployment insurance and the cash cost of any fringe benefits.

Harvesting Cost

Table 3 illustrates the costs associated with the harvest operation. Many of these costs, unlike those in the growing costs, vary directly with the amount of fruit harvested. Therefore, they are shown on a per bushel basis, rather than a per acre basis.

The picking and other labor categories includes the gross wages paid for harvesting apples plus any bonus and/or incentives. They also include the employer's share of social security, workmen's compensation, unemployment insurance and any other benefits paid other than housing and transportation. The harvesting costs include the cost of harvesting all fruit, including drops.

Summary

The average 1983 growing cost was $1,231.61 per bearing acre. This was up 12% from $1,100.97 in 1982. Most of this increase can be attributed to the weather experienced throughout the 1983 growing season. The major increase occurred in the labor and materials categories. The mild winter we experienced allowed growers to prune more trees which increased the amount of labor cost associated with pruning and brush removal. The cold, wet spring made it necessary for a number of growers to apply more fungicides. The very hot and dry period of July, August, and early September caused a number of growers to increase their use of insecticides and miticides. This same weather pattern also meant that many growers had to irrigate more than in past years.

The average per bushel growing cost was $2.67 in 1983 as compared to $2.10 in 1982. This increase of 27% was due in part to the increase in the per acre costs but more importantly to a decrease of 64 bushels in the average yield per acre. This yield decrease can also be attributed at least in part to the weather.

The harvesting cost for 1983 was $1.50, approximately the same as the $1.48 in 1982. The combined growing and harvesting cost for 1983 was $4.17 as compared to $3.58 in 1982 and $4.25 in 1981. The major reason for the changes in the per bushel costs over the past three years has been the fluctuation in the average yield.

Fruit Quality

It should be remembered that these figures are an attempt to measure the cost of growing and harvesting apples. One major factor, which impacts the profitability of an operation, which has not been discussed, is fruit quality. This is a factor which growers cannot afford to overlook when they are evaluating their yields and costs. It is very possible for a grower with higher production per acre and lower costs to be less profitable than his neighbor. This is because the increase in production and reduction in costs may come at the expense of quality.

In using the figures contained in this article to analyze his business, a grower must keep the concern for fruit quality foremost in mind. A growers ability to produce high quality fruit at a reasonable cost will determine his success.

Table l. Eight operations, 1983

	Total	Average	Range
Total acres of apples	1,936	242	41-585
Acres of bearing apples	1,558	195	21-473
Percent of non-bearing		20	7-49
Tree age (% of total acreage)			
1-5 years		24	6-59
6-10 years		23	2-38
11-15 years		9	2-20
16-20 years		14	0-25
21-30 years		11	1-20
over 30 years		19	0-39
Apples harvested (bu.)	717,615	89,702	10,385-162,115
Picked fruit	640,598	80,075	10,151-154,175
Drops	77,017	9,627	234-28,561
Total estimated crop	724,615	90,577	10,885-162,115
Percent of crop harvested		99	95-100
Yield per acre (bu. harvested)		461	343-685
Percentage of crop harvested as drops		11	2-23
Number of bearing acres pruned			
Dormant	1,268	159	NA
Summer	783	98	NA
Percentage of bearing acres pruned			
Dormant		81	31-100
Summer		50	0-100
Average number of sprays per acre		13.5	10-17
Number of bearing acres receiving herbicides		161	20-473
Average number of times mowed		3.8	3-5
Number of acres irrigated	347	43	0-180
Average number of times acres irrigated		1.23	NA

Table 2. Growing cost (dollars per bearing acre) eight operations, 1983

		Average	Range
Orchard overhead			
Real estate tax		$23.37	$15.08 - 28.30
Return on investment		214.82	83.52 - 545.14
Rental		18.31	0.00 - 98.34
Other		50.59	8.00 - 113.81
	Total	$307.09	$206.85 - 662.67
Management			
Salary		$86.41	$34.15 - 187.07
Accounting/secretarial		22.73	5.13 - 87.17
Office expense		4.73	2.37 - 11.76
	Total	$113.87	$55.99 - 276.61
Labor			
Pruning & brush removal		$147.10	$77.02 - 233.00
Spraying		38.14	12.55 - 56.48
Orchard floor management		30.07	15.30 - 55.07
Irrigation		8.29	0.00 - 49.71
Other		50.06	9.44 - 146.15
	Total	$273.66	$166.31 - 366.00
Equipment			
Depreciation		$50.33	$31.34 - 112.10
Return on investment		60.40	37.61 - 134.52
Fuel		47.79	16.28 - 68.81
Repairs & maintenance		75.32	34.21 - 105.71
Other		7.60	0.00 - 13.00
	Total	$241.44	$157.08 - 409.81
Materials			
Fungicides		$75.93	$49.99 - 115.38
Insecticides		54.32	30.25 - 90.32
Miticides		53.13	36.49 - 77.38
Spray oil		6.71	0.00 - 17.61
Growth regulators		29.53	17.10 - 44.80
Herbicides		8.88	2.18 - 16.89
Lime and fertilizer		28.57	7.56 - 49.21
Other		38.48	13.42 - 68.86
	Total	$295.55	$209.67 - 441.32
Total growing cost per bearing acre		$1,231.61	$977.43 -1,836.38
Yield per acre (bu.)		461	343 - 685
Cost per bushel		$2.67	$1.72 - 3.96

Table 3. Harvesting costs (dollars per bushel) , eight operations, 1983.

	Average	Range		
Equipment				
Depreciation	.03	.02	-	.06
Return on investment	.04	.03	-	.08
Fuel	.03	.01	-	.05
Repairs and maintenance	.04	*	-	.10
Other	.02	*	-	.06
Total	.16	.07	-	.33
Containers				
Depreciation	.09	.05	-	.12
Return on investment	.10	.06	-	.14
Repair and maintenance	.03	*	-	.11
Total	.22	.13	-	.30
Housing for pickers				
Depreciation	.02	*	-	.05
Return on investment	.06	.01	-	.12
Repairs and maintenance	.03	*	-	.10
Insurance	*	*		*
Fuel and electrical	.02	.01	-	.05
Real estate tax	.01	.00	-	.01
Supplies	.01	*	-	.01
Total	.15	.07	-	.30
Picking Labor	.59	.48	-	.87
Picker transportation	.09	.03	-	.13
Other labor				
Supervision	.13	.05	-	.23
Fruit handling	.11	.07	-	.17
Accounting/secretarial	.02	*	-	.05
Total	.26	.14	-	.40
Other harvesting costs	.03	.00	-	.08
Total harvesting cost per bushel	1.50	1.12	-	1.98

* Less than .01 per bushel

DAILY ACTIVITY OF APPLE BLOTCH LEAFMINER ADULTS[1]

T.A. Green and R.J. Prokopy
Department of Entomology

Over the past 8 years, the Apple Blotch Leafminer (ABLM), Phyllonorycter crataegella, has become a serious pest in commercial apple orchards east of the Hudson River. High populations of this organophosphate resistant insect have been associated with reduced fruit size, premature fruit ripening, and reduced fruit set the following year in some cultivars.

In a previous issue of FRUIT NOTES (Spring, 1983) we reported on the development of a visual monitoring trap for ABLM adults. Concurrent with that work, we conducted a study of the behavior of ABLM moths in and around commercial apple orchards. Our study has thus far been restricted to the second and third adult flights, occurring in early July and late August, respectively.

To determine the location and activity of ABLM adults, we performed 1 minute observations of various tree structures including the upper leaf surface, lower leaf surface, fruit, trunk, and ground cover, at 1 hour intervals. We recorded the numbers of ABLM observed at each location. In like fashion, we observed the tree canopy for flight activity.

Our results are presented in Figure 1. We found the primary location of stationary ABLM throughout the day to be the lower leaf surface. We observed a number of mating pairs, again predominantly on the lower leaf surface, and exclusively before 11:00 AM. We also observed several ovipositing females, all on the lower leaf surface, and all in the late afternoon and evening.

We found flight activity to be concentrated during two periods of the day, from sunrise to 3-4 hours after sunrise, and from 3-4 hours before sunset to sunset. The number of flights observed per minute during the AM flight period was approximately 2.5 times that of the PM flight period. During the AM flight, landings on the upper leaf surface outnumbered lower leaf surface landings by a 2 to 1 margin. This ratio was reversed in the evening.

To further investigate the differences observed between the two flight periods, we captured flying ABLM and determined their sex. We employed three capture methods:

[1] We wish to express our appreciation to research assistants Geoffrey Hubell and Martin Rose, and to the following families for use of their orchards: Jack DeLuca, Ed Roberts, Dave Shearer, Harvey and Marvin Peck, Ray Davis, and Cameron Sewell (in New Hampshire).

visual traps; net sweeps; and captures of moths by an aspirator immediately after landing. These results are presented in Figure 2. All three methods indicated that the AM flights were virtually all made by males, whereas the PM flights were made predominantly by female moths.

We found the same general pattern of activity to occur on non-host trees adjacent to orchards, but far fewer ABLM and no ovipositions were observed there.

In summary, then, our study indicates that at least during the second and third generations, male ABLM moths fly from first light to approximately 9-10 AM, probably searching for females to mate. Virtually all mating occurs during this time. This strategy may be designed to minimize wind disruption of sex pheromone trails emitted by females, by taking advantage of the lower wind speeds usually associated with this time of day.

From mid-morning to approximately 5 PM, ABLM adults are largely inactive and are located in relatively concealed and shaded areas, possibly to avoid desiccation and predation. In the evening, females are in flight, probably foraging for ovipostion sites.

On the basis of our results, we recommend that insecticide applications for adult ABLM be timed to coincide with the evening flight period. This will maximize both the effectiveness of any fumigant action and contact of females with fresh insecticide. This season we plan to investigate the effect of temperature on oviposition rates, and to extend our observations to the overwintering generation of adults.

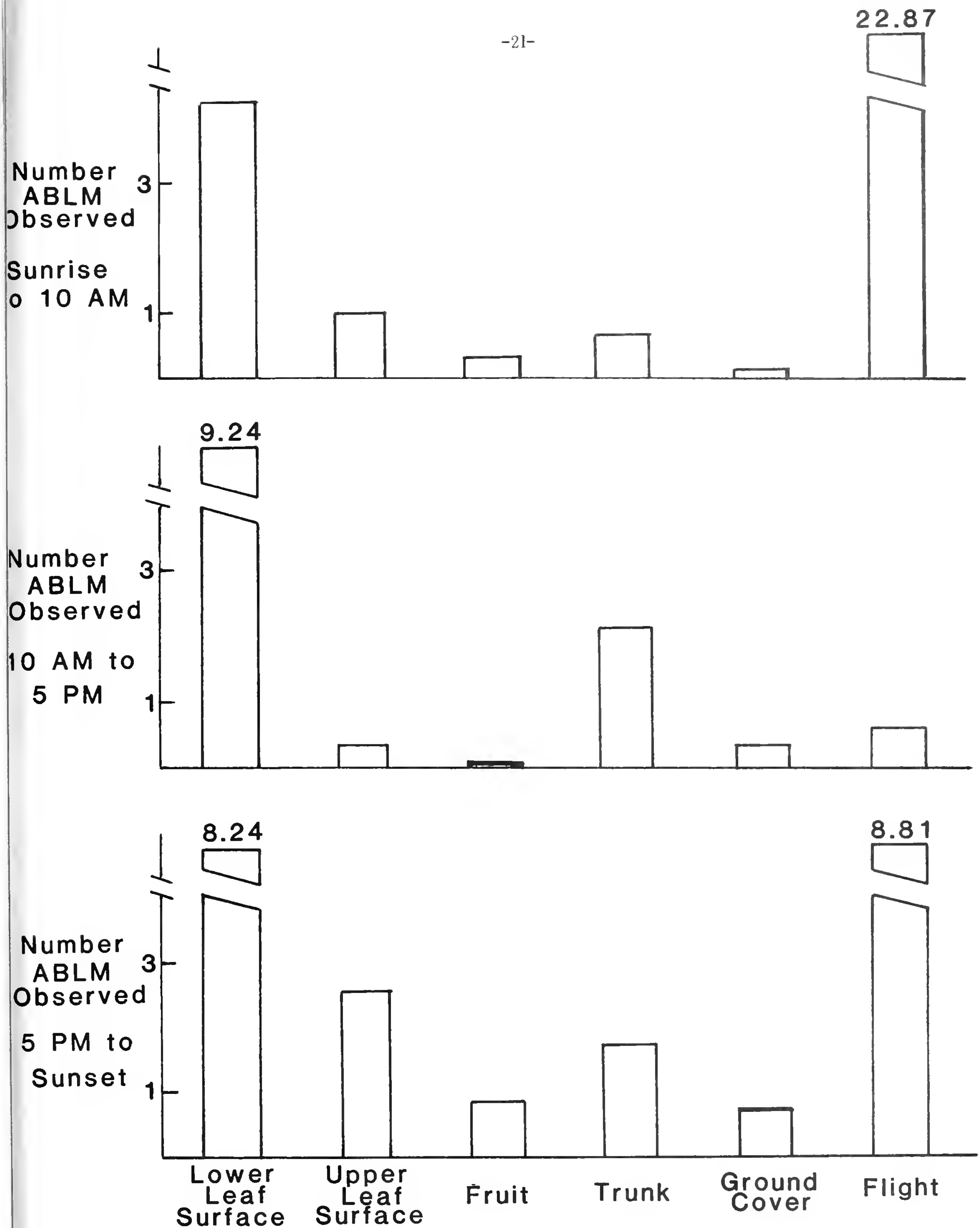

Figure 1. Number of ABLM adults observed per minute at various locations during three different time periods.

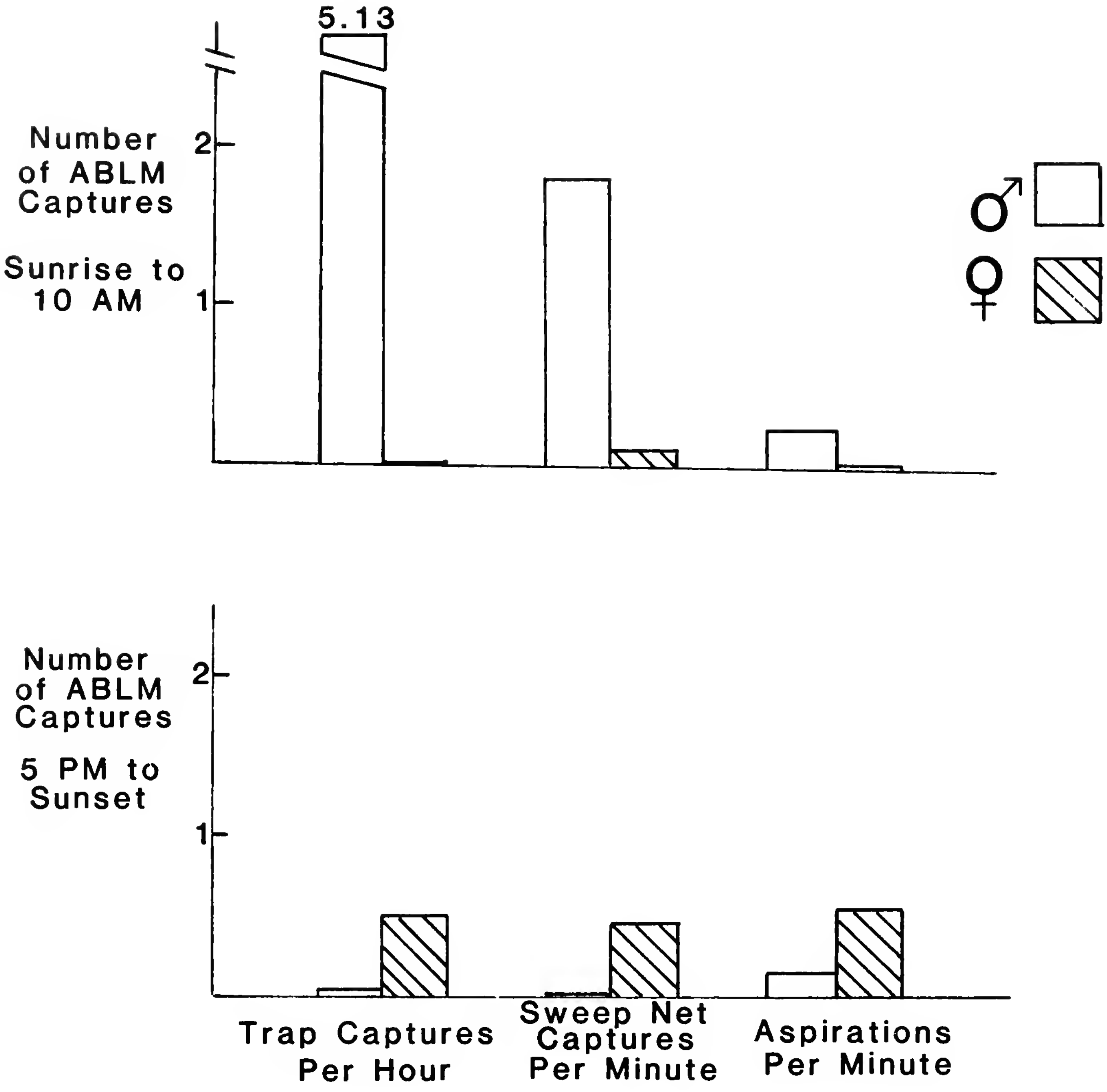

Figure 2. Number of ABLM adults captured by three different methods during morning and evening flight periods.

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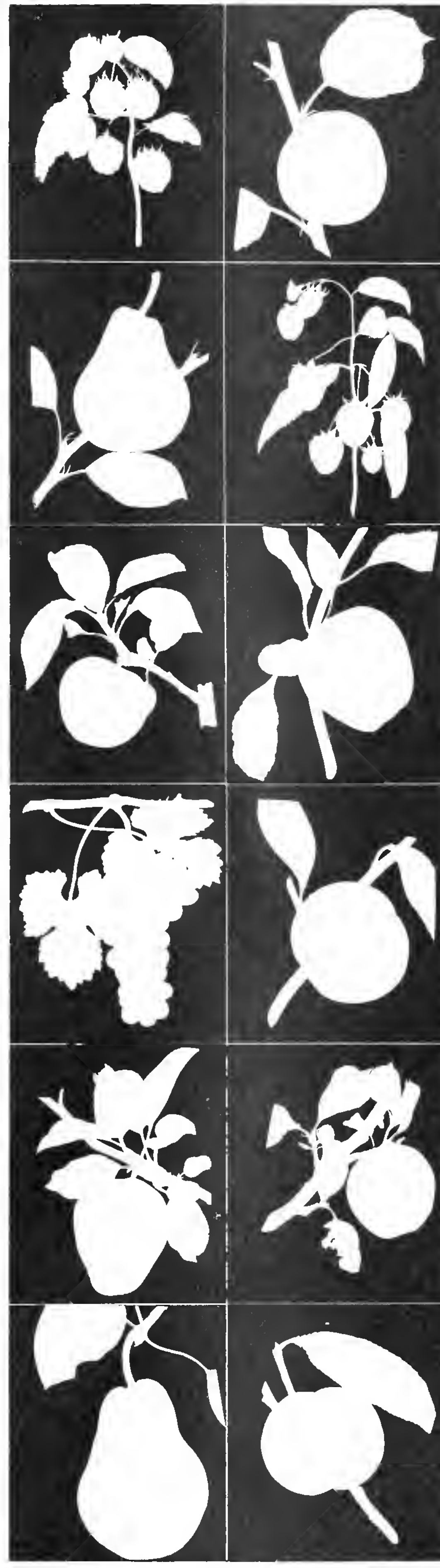

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FRUIT NOTES SUBSCRIPTION

The Fall Issue of FRUIT NOTES is the 4th and last issue for the year. Now is the time to renew your subscription for 1985. The question has been asked about multi-year subscriptions. This would be desirable but the Editor of FRUIT NOTES retires in 1985 and the fate of this publication after this date is unknown.

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BIGGER APPLES, LESS CALCIUM, MORE PROBLEMS

William J. Bramlage
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It has frequently been observed that large apples do not store as well as small apples within a given variety. When storage problems occur, they tend to be much more prevalent on the largest apples within a box.

This relationship of storage disorders with fruit size is largely a reflection of the fact that within a sample of fruit, calcium (Ca) concentrations are lower within the larger fruit. For example, Dr. Mack Drake recently analyzed some random samples of different sizes of packed McIntosh apples. The results (Table 1) showed a marked reduction of fruit Ca as size increased. We have seen many times that differences in Ca concentration of this magnitude can lead to quite different amounts of breakdown, rot, bitter pit, and even scald on McIntosh after storage.

Table 1. Calcium concentration in McIntosh apples of different sizes, 1983.

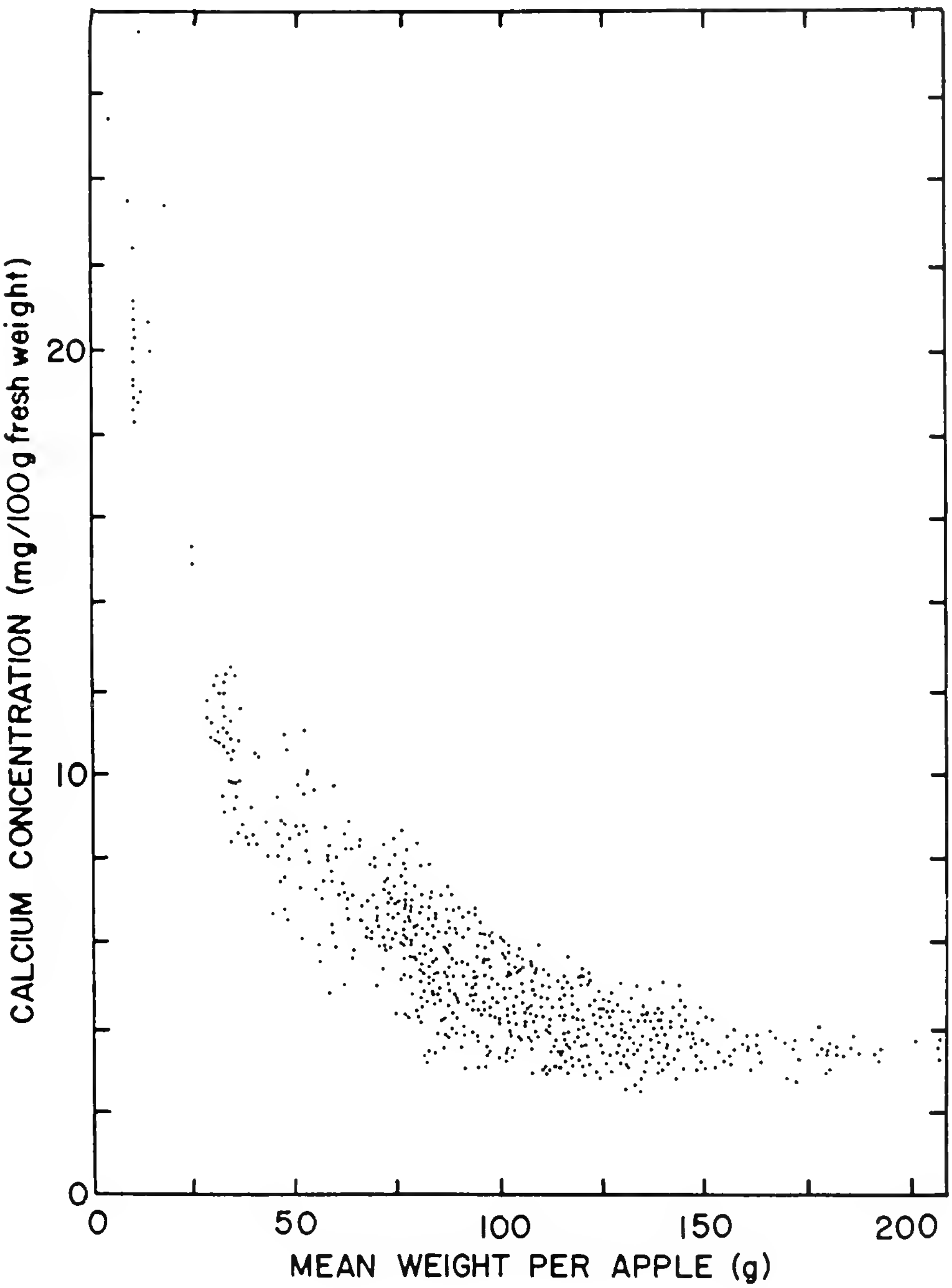
Box count	Fruit circumference (inches)	Average fruit weight (g)	Ca concentration^z (ppm dry wt.)
160	2.5 - 2.6	100	129
140	2.7 - 2.8	122	119
120	2.9 - 3.0	154	111
96	3.1 - 3.2	186	90

^{z}Ca concentration in outer cortex tissue on calyx half of the fruit.

The relationship between fruit size and fruit Ca concentration in apples has been studied extensively by Michael A. Perring at the East Malling Research Station, Kent, England. In bulk samples, he has found that the relationship is very dramatic (Figure 1). The main reason for larger fruit having lower Ca concentrations is that the amount of Ca transported by the tree into developing apples is very small, and as apples enlarge their cells get larger and the concentration of Ca in them becomes diluted by water and other cellular constituents. Large apples have larger cells, hence their Ca is more diluted.

Another reason for the fruit size: Ca relationship is that relatively large fruit generally come from low-yielding trees, or areas of trees. With light cropping more vegetation is produced, and what Ca is available in the tree is preferentially transported to the vegetation; in general, the more vegetation there is per apple, the less Ca is available for the fruit.

The pattern shown in Figure 1 can be expected when examining bulk samples of apples. However, when you measure individual apples the pattern is not as distinct (Perring and Jackson). A large apple does not always have a low Ca concentration, and a small apple does not always have a high Ca concentration,



even when the fruit all come from the same tree on the same date. Obviously, there are factors that affect the movement of Ca into individual apples, since apples of a given size and variety can vary considerably in the total amount of Ca they contain (Perring and Jackson).

Perhaps the most dramatic variation from this pattern is found with very small apples. Perring has observed that very small apples (which should have high Ca) sometimes are heavily afflicted with bitter pit. We have also observed that very small McIntosh and Delicious are sometimes severely broken down. We have also noted that these small apples with breakdown often contain no, or almost no, plump seeds, and in a recent study we found that in Delicious, fruit Ca concentration decreased as seed number decreased, even when the fruit were all the same size. We have also noted that McIntosh with few or no seeds tend to mature earlier than ones with many seeds, as as is well known, more mature fruit tend to deteriorate faster than less mature fruit. Thus, seed number may be one cause of the variation in Ca concentration among fruit of a given size. Poor pollination may contribute to low fruit Ca.

The absolute relationship between apple size and Ca concentration changes somewhat from year to year (Perring and Jackson) and also varies considerably from variety to variety (Perring), even when bulk samples are analyzed. For example, Perring found that for a given size of fruit, Mutsu contained a higher Ca concentration than did Cox, although in both varieties the general pattern of Figure 1 was displayed.

These findings demonstrate that while there is not an absolute fruit size: fruit Ca relationship, there certainly is a strong and highly important general relationship. When growing conditions are such that average fruit size is increased for a variety, average fruit Ca can be expected to be lowered, and with this lowering of fruit Ca concentration there is increased potential for fruit disorders during and after storage.

This situation creates a paradox for apple growers. Production of larger fruit can increase yield substantially, thereby increasing potential income substantially. However, this greater fruit size creates a greater Ca problem, and needs to be accompanied by remedial actions to prevent reduced storage life of the fruit that have been produced. Production of larger fruit increases then need for foliar applications of Ca and/or for postharvest Ca treatments to the fruit.

It is the opinion of many investigators that the "calcium problem" of apples that exists world-wide today is one that has been created by intensive production methods that have increased average fruit size and yield. It is unlikely that the need for high productivity will diminish with time, and so it is also unlikely that the need for Ca treatments will diminish with time.

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PHOTOGRAPHS OF NUTRIENT DEFICIENCIES AND TOXICITIES AND HEAT STRESS

William J. Lord
Department of Plant and Soil Sciences

In the past, we occasionally published in FRUIT NOTES photographs of nutrient deficiencies. Last year when we had numerous problems - severe scab outbreak in some orchards, hail, russetted apples, small fruit, an extremely wet spring, a dry summer, slow color development on fruit of some varieties, etc. - it became apparent that confusion existed concerning nutrient deficiency symptoms. Deficiency symptoms recognition that caused problems were mainly boron (B), potassium (K) and magnesium (Mg). Therefore, for your information we have again published photographs and brief descriptions of some nutrient deficiencies of apples and pears.

Calcium (Ca). Bitter pit and cork spot are visual evidence of low Ca in apples and are more prevalent on some varieties and years than others. Bitter pit is common on Cortland, Baldwin and Northern Spy whereas cork spot is much less prevalent but can be found on Delicious and Golden Delicious in New England.

The Delicious on the left in Figure 1 shows bitter pit and the one on the right

Figure 1. Symptoms of calcium deficiency on Delicious fruit.

has cork spot. Bitter pit is most frequently associated with the calyx end of the apple and its severity may increase in storage. Cork spot is not localized and will appear anywhere on the apple. The spots are more pronounced than bitter pit, being much deeper and wider. In some cases the cork spot resembles the inner cone of a miniature volcano, with the depressed skin area containing green or dark red pigment. Cork spot does not increase in severity in storage.

Magnesium (Mg) Deficiency. Mg deficiency of apple and pear trees has been more prevalent in orchards the last 2 years probably due to excessive rainfall early in the growing season. These visual observations were supported by leaf analysis which indicates that Mg is exceptionally low in some instances.

Mg symptoms are characterized necrotic (brown) areas between the veins (Figures 2, 3). The older basal leaves on shoots and spurs are usually affected first and as the

Figure 2. Magnesium deficiency symptoms on apple leaves.

season progresses the injury symptoms appear on the younger leaves. The deficiency symptoms frequently become apparent in late July and early August. By late summer, the shoots on which leaves show Mg deficiency may be defoliated except for a few leaves near their terminals. Mg deficiency increases fruit drop at harvest.

Figure 3. Magneisum deficiency symptoms on pear leaves.

Figure 4. Heat stress symptoms on pear foliage.

Heat stress symptoms on pear foliage (Figure 4) are sometimes confused with Mg deficiency. Symptoms of heat stress (scorch) appear suddenly after a period of intense heat. The scorch generally can be found on spur and terminal leaves of several or more branches throughout the trees, the leaves being partially brown or black. There is no progression of symptoms from the older to the most recently-formed leaves on terminal shoots as with Mg deficiency. Frequently, the majority of injured leaves drop as the growing season progresses. The Bosc variety may be more susceptible to heat stress than other pear varieties commonly grown in New England.

Potassium (K). Figure 5 shows leaf margin burn caused by K deficiency. This symptom can be easily confused with the leaf margin burn from calcium chloride sprays and sometimes confused with Mg deficiency. However, unlike leaf burn from calcium chloride sprays, the scorch of leaf margins due to K deficiency progresses from the older leaves to the younger leaves of current season shoots as the season advances. The scorch may turn gray in color. Fraying and tattering of the leaves may occur due to loss of the dead areas along their margins. When the deficiency is severe leaf drop commencing with the older leaves of current season's terminal growth, is evident in the latter part of the growing season. Nevertheless, leaf analysis is sometimes necessary to confirm the problem is K and not calcium chloride burn.

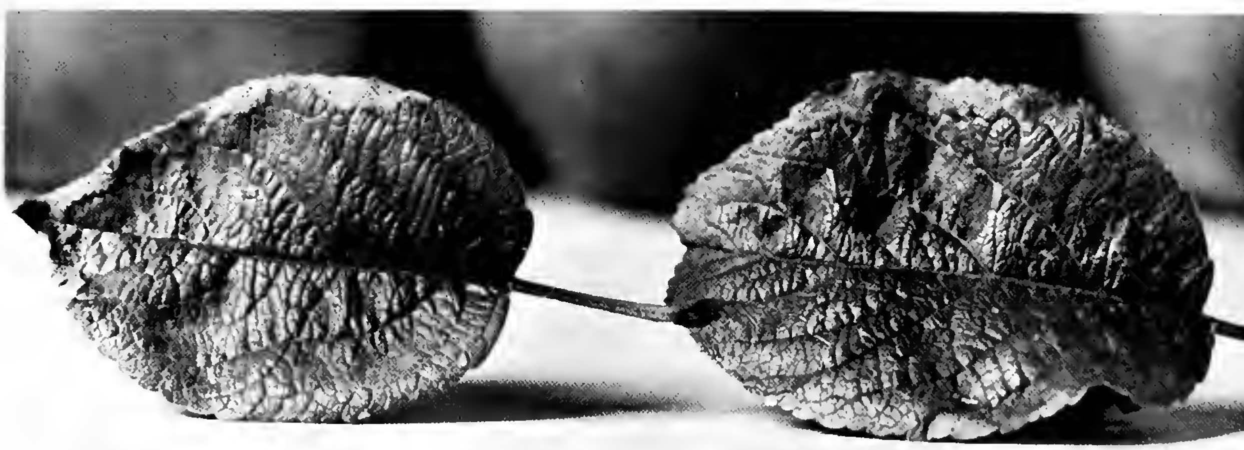

Figure 5. Potassium deficiency symptoms on apple leaves.

Total K absorbed and the total dry matter produced is similar for fruiting and non-fruiting trees but in heavy-cropping trees is translocated into the fruits. Thus, the demand of a large crop for K is great and both the tree and fruit may be deficient in this element. Leaf injury because of K deficiency can cause pre-harvest drop and reduce fruit size. In contrast, light cropping trees are probably much higher in K than is needed because of "luxury" uptake.

K deficiency symptoms are apt to be more frequent in dry years because drought conditions reduces uptake of elements.

Boron Toxicity (B). Toxicity symptoms of this element are observed in a few orchards each year. Symptoms occur on bearing trees sprayed with a foliar application of B, on trees fertilized with B the year of planting, or bearing trees that received excessive rates of B containing fertilizer. Figure 6 shows typical foliar symptoms of B toxicity. The symptoms are characterized by loss of chlorophyll (green coloration) from along the midrib and larger lateral veins. The symptoms are first apparent at the base of the leaf blade. In severe cases, loss of chlorophyll is more extensive than shown in the picture.

Boron Deficiency (B). Occasionally B deficiency is so acute in pear trees that the fruits become malformed and cracked (Figure 7). B deficiency on apple trees is less common than B toxicity. It is very easy to prevent, thus it is embarassing to have the disorder. It certainly hurts financially because all the fruit where deficiency exist should be sold only for cider.

The most common symptom of B deficiency is found internal in fruit being characterized by brown, round or irregular shaped lesions of about $\frac{1}{4}$ inch diameter (Figure 8). The dead cell masses become dry, hard and corky before harvest. Fruit affected with the disorder will have a pebbled surface (particularly noticeable on Cortland), open calyx, and abnormally dark color as they mature. However, frequently the first recognition of the problem is excessive preharvest drop.

Figure 6. Boron toxicity symptoms on apple leaves.

Figure 7. Symptoms of boron deficiency in pear fruit.

Manganese Deficiency (Mn). This element is found deficient in several orchards each summer. As shown in Figure 9, apple leaves having Mn deficiency have interveinal fading of chlorophyll with the veins remaining green. In the past we have analyzed McIntosh apple leaves from trees showing Mn deficiency and found the leaf of this element to be 9 to 14 ppm. Mn levels of this magnitude are critically low in comparison to the desired standard of 50-100 ppm set by other states for apple trees.

Manganese Toxicity (Mn) is implicated with the problem of "apple measles" shown in Figure 10. The twig from Delicious at the top of the photograph shows severe symptoms of measles while the twig below has normal bark. Measles can severely injure or kill young Delicious trees. An over-application of a dormant-oil spray can induce symptoms similar to that shown in Figure 10.

Figure 9. Symptoms of manganese toxicity on apple leaves.

Figure 10. Bark on three year-old wood from Delicious trees showing measles (top of photograph) as compared to normal bark (bottom of photograph).

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POMOLOGICAL PARAGRAPH

William J. Lord
Department of Plant and Soil Sciences

New Apple Rootstock Will Soon Be Available. Mark a new size-controlling rootstock, one of a series of rootstocks developed by Dr. Robert Carlson, Michigan State University, Professor emeritus of Horticulture, will soon be commercially available. Trees on Mark (formerly designated MAC-9) are reported to be well-anchored, precocious and between M9 and M26 in size. Thus, Mark under Michigan conditions, shows great promise as a size-controlling rootstock that enhances early fruit production and requires no support because of poor anchorage or brittle roots.

We have Starkspur Supreme Delicious on Mark at our Horticultural Research Station in Belchertown but the trees are only 4 years old. Nevertheless, the trees on Mark presently appear to be well anchored, precocious and somewhat larger than those on M26. In contrast, unsupported Starkspur Supreme Delicious trees on M9 or EMLA27 are leaning badly or have broke at the scion-rootstock union.

It is reported that limited quantities of trees on Mark will be available for purchase during the winter of 1986-87. By this time Mark will have been more thoroughly tested because it has been included in the North Central Region Cooperative Rootstock Trial established in 1980-81 at 25 locations in the United States and 2 in Canada.

The Consumer's View of Fresh Pears

William J. Bramlage

Department of Plant and Soil Sciences

A ripe pear can be a true delicacy, yet consumption of pears ranks far below that of fruits such as oranges, apples, and bananas. Why don't we eat more pears? A very interesting picture emerges from a study conducted in England, entitled "The Pear Situation 1976" and published by The Apple and Pear Development Council. As a part of this study housewives who were regular buyers of fruit were interviewed, including ones who purchased pears frequently, irregularly, or not at all.

Why buy pears? Consumers purchased fruit for the following purposes: as a dessert; as a snack; for inclusion in lunch boxes or picnic baskets; and for casual eating, such as while watching TV. The main reasons for not ordinarily purchasing pears were that the consumers either did not like them or because they considered pears unsuitable for certain of these purposes, especially for inclusion in lunch boxes and for casual eating.

Pears were considered unsuitable for lunch boxes primarily because they were thought to be too fragile, while the main objection to them for casual eating was that you cannot casually eat a ripe pear! Unlike apples or bananas, pears usually require a plate, a knife, and a napkin when eaten. This point was emphasized by mothers with young children, who felt that the most satisfactory way to serve pears to a child was to peel, slice, and core the fruit.

Selection. In the store the consumers were searching for a basis on which to predict the quality of pears. The most obvious possibilities are the appearance and the variety name. However, variety names are not conspicuously promoted and even when they are few consumers have sufficient knowledge to relate quality with variety. Therefore, appearance is the all-important factor in choice of pears. Yet, consumers had little understanding of what to expect from a pear's appearance. As a result, purchase of pears was very risky. Many of those interviewed were unwilling to subject themselves to criticism from the rest of the family, so they tended to avoid this risk and make a "safe" purchase of other fruit.

What is so unpredictable about pears? First, their tendency to be hard when the consumer wants them to be soft. A substantial portion of those interviewed had little idea that pears could be ripened in the home, much less knowledge of how to ripen them. Second, there was little perception of exactly when a pear should be eaten. Therefore, when pears were purchased it was only in small quantities and if the purchase proved disappointing the buyer usually skinned pears for some time afterward.

Acceptability. Consumers were generally well aware of the health-giving properties of apples and oranges, but they questioned the nutritional value of pears. Housewives were particularly anxious to provide their children with good, wholesome, fresh fruit and were unclear of the nutritional role of pears.

There was also an image that pears tend to be more expensive than apples, for example, and that pears therefore were a luxury item. This image plus the uncertainty of quality were strong deterrents to regular purchases of pears.

Quite interestingly, there was strong indication that favorable disposition to pears was often acquired early in life. Many of the consumers who were enthusiastic about pears were strongly encouraged to eat them as children. Children were particularly strong motivators of fruit purchase, so it seemed reasonable to conclude that pear buying would be stimulated by giving mothers a good reason for buying them for their children.

The Ideal Pear. The housewives interviewed found it much easier to describe what they did not like about pears than what they did like. The most prominent dislikes were dryness and hardness, commonly thought to go together. Other prominent dislikes were grittiness, tendency for bruises to appear during ripening, and browning in the core.

The majority of those interviewed were seeking a pear that had an attractive smooth skin, was juicy, and had a smooth internal texture. (It should be noted, though, that some consumers prefer hard pears, and that in the U.S. there is reputed to be a growing preference for hard green peas among young consumers.) There was a preference for clear skinned, green to yellow pears with a true "pear shape", and opposition to ones with a brown ground color, which was associated with tough pears having a leathery skin.

Conclusions. Although this study was conducted in England and is about 10 years old, it is likely that the perceptions revealed by the interviews are widespread and still relevant. The study strongly suggests that pear sales and consumption could be improved considerably by better promotion and information, and especially by providing the consumer with more consistent quality, and with information about how to handle pears once they have been purchased.

POMOLOGICAL PARAGRAPH

William J. Lord

Department of Plant and Soil Sciences

Harvest Indices. Changes in firmness of flesh, surface color, seed color, size of fruit, ground color, ease of separation from spur, days from full bloom, the Starch-Iodine test, calendar date and ethylene production are indices of maturity that a grower may follow to determine when to harvest his apples. Ethylene level in the fruits clearly is the best measure to assess maturity, ripening and storability but our experiences with a portable instrument to measure this gas has been less than satisfactory. Among the indices that are of little or no value are seed color, fruit size and fruit color. The seeds may change color from light green to brown weeks before other indices indicate picking maturity. Surface color is of no value with red strains because their entire surface may redden when still very immature.

Recently, there has been renewed interest in using the Starch-Iodine Test for evaluating apple maturity. As apples mature and ripen, the starch in the immature fruit changes to sugar. This decreasing level of starch can be measured by treating the fruit with an iodine solution. Contact your Regional Fruit Specialist for further information concerning the Starch-Iodine tests.

Picking at the proper stage of maturity is particularly important if the fruit is to be stored. But this is confounded by color required for sale, type of storage and length of storage. Therefore, there is no such thing as optimum maturity stage for all fruit. Fruit for long-term storage should be harvested and stored before they gain the capacity to produce large quantities of ethylene. However, those intended for shorter storage can and should be allowed to remain on the trees longer to gain extra quality and sales appeal.

DO FUNGICIDE RESIDUES AFFECT APPLE MAGGOT FLY EGGLAYING?

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In previous issues of FRUIT NOTES, we described some of our studies on the effects of various substances on apple maggot fly egglaying. For example, we found that a substance (pheromone) released by female flies following egglaying deters other females from attempting to lay an egg in that fruit (Vol. 42, No. 1). We also found that sodium chloride (table salt) Vol. 45, No. 5) and acid rain (Vol. 48, No. 4) deter egglaying, while calcium chloride has no such effect (Vol. 45, No. 5).

Recently, we decided to test some of the fungicides commonly applied to apples to control mid- to late-season diseases for possible effects of their residues on apple maggot fly egglaying. We felt that an egglaying deterrence from fungicides applied during the months of peak apple maggot fly activity might affect grower choice of fungicides for use against diseases.

We tested at field rates 9 organic fungicides currently recommended for apples and 1 fungicide (Bordeaux mixture) no longer applied to apples. Unfortunately, our laboratory trials showed no effects of any of the organic fungicides on apple maggot fly egglaying. Only the inorganic fungicide Bordeaux mixture significantly deterred fly egglaying (Table 1). Before the introduction of organic fungicides, Bordeaux mixture was widely used as an orchard fungicide. However, it is phytotoxic and is not compatible with many other pesticides, and thus is no longer recommended for orchard use.

It is also interesting to note that even the fungicides which left visibly heavy residues on test fruit (such as sulfur) or had a disagreeable odor (such as fenarimol) did not deter fly egglaying. We are reminded that insects may react in ways which differ dramatically from what we might expect.

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Table 1. Percent of arriving females attempting egglaying into hawthorn fruits treated with fungicide or spring water control.

Experiment	Rate of formulated material (lb/100 gal)	Egglaying attempts (%)
1)		
Control	-	39.2
Captan (50WP)	2.0	49.1
2)		
Control	-	58.2
Maneb (80WP)	1.5	62.5
Dodine (65WP)	0.375	54.2
3)		
Control	-	42.8
Benomyl (50WP)	0.375	43.8
Sulfur (actual)	5.0	56.6
4)		
Control	-	67.5
Thiram (65WP)	2.0	67.3
5)		
Control	-	65.4
Metiram (80WP)	2.0	49.1
Dikar (80WP)	2.0	60.0
6)		
Control	-	49.2
Ferbam (76WP)	1.5	70.0
Fenarimol (12.5EC)	3 oz.	50.9
7)		
Control	-	66.7
Bordeaux mixture (copper sulfate-lime)	3-11	12.1*

*Significantly less than egglaying into control fruits.

Effects of Rootstock and Stempiece/Rootstock Combinations on Growth, Leaf Mineral Concentrations, Yield and Fruit Quality of 'Empire' Apple Trees[1]

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A study of 8-year duration was recently completed in which we studied the vegetative growth, leaf mineral concentrations, fruiting and fruit quality responses of 'Empire' apple trees on M26, M9, M27, M9/MM106, M9/MM111, M27/MM106 and M27/MM111. The stempieces were 8 inches (20 cm) in length. Our summary and conclusions from this study are below.

Growth. It was difficult to train, without temporary support, trees on M26, 9/106, 9/111, 27/106 and 27/111 because of leader leaning. Leader leaning appeared associated with the growth characteristic of 'Empire' rather than an excessive crop load. Since this problem also has been encountered with other varieties on M26 or interstems, we concluded that it may be frequently necessary to provide support for the central leader until the trees have obtained the height and volume desired.

Interstem trees on MM111 produced more root suckers than those with MM106 as the understock. Trees on M27 produced no root suckers. The root suckering was not particularly troublesome on the interstem trees probably because all but 2 inches of the stempiece was planted below ground and maintained by periodic removal or addition of top soil. Costante et al. in Vermont showed that interstem trees planted with most of the stempiece beneath ground had less root suckers and problems associated with burrknots on the stempieces.

Height and spread of trees on M26, 9/106, 9/111, 27/106 and 27/111 were similar, and they were larger than those on M9 and M27. The data disagreed with the suggestion by nurserymen that a M27 stempiece on either MM106 or MM111 will produce a tree approximately the size of the same cultivar on M9 rootstock.

M27 appears too dwarfing to be of value under less than extremely favorable growing conditions and a high level of management. However, Tukey in Pennsylvania predicts off bright future for this rootstock as the industry shifts to virus-tested rootstocks which induce high vigor.

Leaf mineral concentrations. The rootstock and stempiece/rootstock combinations influenced leaf phosphorous, magnesium, boron, manganese, and aluminum in 'Empire' scion foliage but the differences were small except for manganese levels in trees on M27. Manganese level in leaves from trees on M27 was much higher than those for trees on the other rootstock and stempiece/rootstock combinations.

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[1]This study was funded in part by grants from the International Dwarf Fruit Tree Association.

Effects of rootstock on nutrient uptake and movement may vary among locations due to orchard conditions, tree age, variety and crop load. Nevertheless, appropriate preventative measures may be necessary before planting trees on M27 rootstocks where manganese has been associated with internal bark necrosis on Delicious apple trees.

Fruitfulness and fruit size. No rootstock or stempiece/rootstock combination consistently influenced bloom or fruit set although it is well known that M9 rootstock can induce early precocity and limited data show that rootstocks can influence fruit set. The trees fruited in their 3rd growing season but yields were low until the 6th growing season. After 8 growing seasons it was found that trees on M26, 9/106 and 27/106 were more productive than those on 9/111, M9 and M27. However, when fruitfulness was related to trunk girth, production efficiency did not differ among the trees on the various rootstock and stempiece/rootstock combinations. There was no consistent influence of rootstock or stempiece/rootstock combinations on fruit size of 'Empire' in this study.

Individual trees within the rootstock and stempiece/rootstocks combinations became somewhat biennial. Heavy cropping during the 7th or 8th growing seasons combined with the tendency of 'Empire' to produce small fruit, indicated the need to chemically thin this variety to enhance fruit size and to prevent biennial bearing.

Fruit maturity. Fruit from trees on 27/111 ripened later than those from trees on the other rootstock and stempiece/rootstock combinations. However, the delay in ripening was small and probably of no commercial importance.

Data cited above indicated that M27 and M9 were equally suitable as stempieces. No interstem combination showed an advantage over the lower-priced singly-worked trees on M26 although MM111 is reported to be adapted to a greater variety of soils than M26. We concluded that interstem trees will require a higher level of management that is usually given trees on more vigorous size-controlling rootstocks in northeastern United States.

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