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L. O. HOWARD, Entomologist and Chief of Bureau.

THE RED SPIDER ON COTTON.

BY

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Scientific Assistant.

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United States Department of Agriculture,

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L. O. HOWARD, Entomologist and Chief of Bureau.

THE RED SPIDER ON COTTON.[1]

(*Tetranychus bimaculatus* Harvey.)

By E. A. McGREGOR,

Scientific Assistant.

INTRODUCTORY.

The minute, reddish spinning mite commonly known as the red spider is rapidly assuming a position of importance among cotton pests. At Batesburg, S. C., in 1911, it first became noticeable on cotton about June 1, causing little more than passing notice at that time among the farmers, but by the 1st of July it had increased so enormously that the effect upon cotton in certain places was most alarming. Seasons of excessive drought greatly favor the multiplication of the mites until the resulting injuries are often so severe as to cause the death of many plants.

Red-spider infestation is frequently miscalled "rust" by farmers, since infested leaves soon turn deep red on their upper surface. Such leaves, however, if examined underneath, reveal the presence of the red spiders and the inconspicuous webs behind which they are feeding and laying their eggs.

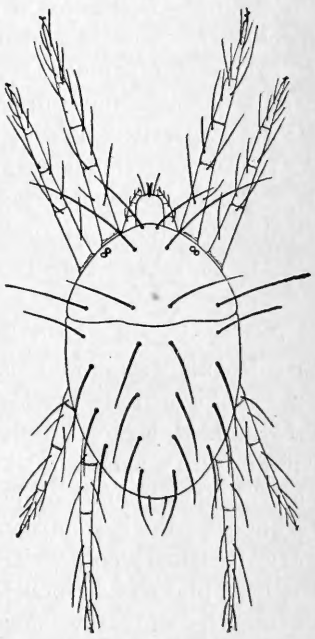


FIG. 1.—The red spider, *Tetranychus bimaculatus:* Adult female. Greatly enlarged. (From Banks.)

HISTORY AND DISTRIBUTION.

With the exception of an outbreak in Louisiana, reported by Prof. H. A. Morgan in 1893, severe occurrence of the cotton red spider had not been reported until 1903, at which time complaints of damage came

[1] This circular is based primarily upon work done at Batesburg, S. C., in 1911, under the direction of Mr. W. D. Hunter, but also includes the results of observations by Messrs. G. A. Runner and H. F. Wilson during the two preceding seasons.

from South Carolina and Georgia. In 1904 Mr. E. S. G. Titus,[1] then of this bureau, found severe infestation in fields about Batesburg, S. C., and the following year he reported severe injury in North Carolina, South Carolina, Georgia, and Alabama. Since then the additional records of Dr. F. H. Chittenden[2] and Messrs. G. P. Weldon, D. T. Fullaway, and others establish the presence of the common red spider in Maine, Massachusetts, New York, New Jersey, District of Columbia, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Ohio, western Colorado, Wyoming, Idaho, Washington, California, and the Hawaiian Islands.

The red spider was described by Harvey[3] in 1893 as *Tetranychus 2-maculatus*. Harvey considered it quite distinct from the European species *T. telarius* L. His types were from Orono, Me. In 1907 Prof. H. A. Morgan published observations on the cotton mite, and apparently accepted the determination of the species as *T. telarius*. In 1900 Mr. Nathan Banks described the cotton mite under a distinct name—*Tetranychus gloveri*—but from the study of additional specimens has now concluded that the name is synonymous with Harvey's *T. bimaculatus*. Specimens of red spiders on cotton from South Carolina have upon two recent occasions been determined by Prof. A. Berlese as the continental species—*Tetranychus telarius*. As there seems to be considerable doubt on this point, we shall follow Mr. Banks in considering the form with which we are dealing as *Tetranychus bimaculatus*.

DESCRIPTION.

The typical female (fig. 1) is 0.46 mm. long by 0.24 mm. wide, broad-oval, widest in front, and the legs are shorter than the body. Its color is usually brick-red. The typical male is 0.27 mm. long by 0.15 mm. wide, oval-wedge shape, narrowed behind, the legs about equaling the length of the body, and its color is usually reddish amber. Individuals of both sexes usually possess on either side of the body a dark spot, caused by the food contents. This spot may vary greatly in color, size, and outline. Similarly, depending upon the host plant and upon locality, the general color of the red spider is subject to great variation.

The eggs are very minute, but in proportion to the mites they are large. They are perfectly round, and when first laid are as clear as water. Each female lays (in the months of June, July, and August) about 50 to 60 eggs, depositing about 6 per day for a period of about nine days. Less than 3 eggs or more than 9 are rarely deposited each

[1] Cir. 65, Bur. Ent., U. S. Dept. Agr., 1905.
[2] Cir. 104, Bur. Ent., U. S. Dept. Agr., 1905.
[3] Ann. Rept. Maine Agr. Exp. Sta. for 1892, Pt. IV, pp. 133–146.

day in summer weather. During the warmer months the eggs hatch in about four days after being laid.

The newly hatched red spider, called the larva, is almost round, has six legs, and is nearly colorless. It begins feeding at once, and (in summer time) after two days' activity it becomes quiet, darkens in color, casts its skin for the first time, and emerges as the primary nymph with an added pair of legs—making eight.

The primary nymph becomes larger in size and darker in color, but gives no indication of sex. Feeding continues actively and at the termination of another two-day period (in summer months) a second molting occurs which gives rise to the third stage—the secondary nymph.

With this last nympnal stage the first indication of sex appears. As with the preceding stages, two days usually suffice in summer for the completion of this period, at the end of which time the skin in shed for the third time and at last the perfectly developed adult mites appear. At the occurrence of each molt the skin splits in two, crosswise, and the creature crawls out of the two halves. The old cast skins are usually to be seen in abundance among the fibrils of the web.

THE ADULT MALES AND FEMALES COMPARED.

Concerning the relative abundance of females and males it may be said that there seems to be a predominance of females throughout the summer, but toward the approach of cold weather the occurrence of the sexes becomes more nearly equal. The period of life of the adult female varies from 17 days in midsummer to several months in winter. The male is shorter lived. As before stated, the female is decidedly larger than the male, more rounded behind, and of a much deeper color. She does not move about much, and when she does her motion is rather slow. On the other hand, when not mating, the male is frequently seen moving rapidly about. The body and legs are well beset with bristles, which are somewhat more conspicuous in the males than in the females. The eyes, consisting each of two orbs, one close behind the other, are situated near the front edge of the body directly over the second pair of legs.

MATING.

Almost immediately upon becoming adult, the red spiders mate and begin egg laying. The males seem to recognize unfertilized females with ease. The first eggs are frequently deposited on the same day upon which the transformation occurs from the last nymphal to the adult stage.

PARTHENOGENESIS.

Experiments conducted with unmated female red spiders clearly proved that they are normally capable of laying eggs, which in turn hatch and develop into mature individuals. No tests, however, have been successfully conducted to determine the sexual fertility of the latter.

GENERATIONS.

The season of 1911 at Batesburg, S. C., was one of unusual drought and heat and there were about 17 generations between March 11 and November 5. The time required for a single generation varied from 35 days in March and early April to 10 days throughout most of June, July, and August, and to 25 days in the greater portion of October and early November. The following table presents the duration of each stage of each of the 17 generations:

TABLE I.—*Development of generations of the cotton red spider.*

Generation.	Period covered by generation.	Incubation period.	Larval period.	Nymph (1) period.	Nymph (2) period.	Oviposition to adult.
		Days.	*Days.*	*Days.*	*Days.*	*Days.*
1	Mar. 11 to Apr. 14	13	9	6	7	35
2	Apr. 15 to Apr. 29	6	3	3	3	15
3	Apr. 30 to May 13	6	3	3	2	14
4	May 14 to May 25	5	3	2	2	12
5	May 26 to June 6	5	3	2	2	12
6	June 7 to June 17	4.5	2.5	2	2	11
7	June 18 to June 27	4	2	2	2	10
8	June 28 to July 7	4	2	2	2	10
9	July 8 to July 18	4	2.5	2.5	2	11
10	July 19 to July 28	4	2	2	2	10
11	July 29 to Aug. 7	4	2	2	2	10
12	Aug. 8 to Aug. 17	4	2	2	2	10
13	Aug. 18 to Aug. 29	5	2.5	2	2.5	12
14	Aug. 30 to Sept. 9	5	2	2	2	11
15	Sept. 10 to Sept. 24	5	3.5	3	3.5	15
16	Sept. 25 to Oct. 10	6	3	3	4	16
17	Oct. 11 to Nov. 4	9	6	5	5	25
	Average	5.5	3.1	2.7	2.8	14

RELATION OF WEATHER TO BREEDING ACTIVITIES.

The influence of the weather on breeding activity is very noticeable. Hot, dry conditions greatly favor and hasten development, while cool, wet weather correspondingly retards it. A female laying normally about 6 or 7 eggs per day will often upon the occurrence of a very hot day, suddenly increase the number to 15 or even more eggs per day, or upon a chilly day may drop as suddenly to 1 or 2 eggs. It is easy then to understand the remarkable rate at which this pest increases during times of unusual drought.

OBSERVATIONS ON HABITS.

In establishing herself upon cotton the female selects a concave area between the under veins of the leaf and begins at once to deposit eggs. These may be attached to the fibrils of the web slightly above the surface, or, as seems most often the case, they are placed directly

upon the leaf. The eggs are usually clustered rather closely and rarely occupy an area greater in size than that of a dime. Feeding continues interruptedly throughout the period of egg laying and the affected area of the leaf becomes thickly dotted with the blackish-green puncture marks. Meanwhile a wine-red spot has appeared on the upper surface of the leaf directly over the young colony, which spreads as the colony increases and may finally color the entire leaf. As the eggs hatch the larvæ remain close to the place of their birth. The mites seem of a decidedly social disposition. In a young colony there is usually little web formed, but where the spiders are very abundant the web may become quite conspicuous. It doubtless affords some protection from adverse weather conditions, and upon several occasions hostile insects have been observed ensnared and dead among the fibers. New females, after mating, either select an attractive spot on the leaf, or migrate upward to a more tempting leaf, or in some cases may even travel to another plant.

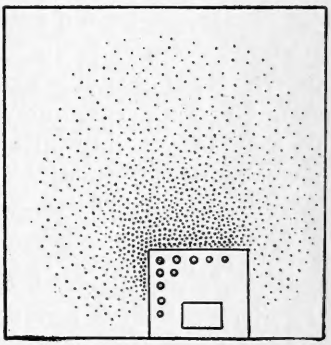


FIG. 2.—Diagram showing how violets growing in dooryard give rise to red spider infestation in adjoining field. The infestation is most severe near the yard. This diagram is typical of many cases found during 1911. (Original.)

THE VIOLET AS HOST.

When cotton dies or becomes untempting in the late fall an exodus of red spiders from the cotton fields occurs in the effort to find more suitable food plants. At this time cotton mites may be easily found on a number of native and cultivated plants, prominent among which are cowpeas, tomato, Jamestown weed, ironweed, and cultivated violets. Most of these plants die after the frosts, but the violet remains somewhat green throughout the winter, and it is upon this plant, probably, that the vast majority of mites overwinter. Out of many cases of cotton infestation investigated the vast majority have indicated most clearly that the original source of the pest was doubtless this innocent pet of the housewife, the English violet. (See fig. 2.)

OTHER HOSTS.

In all, the red spider has been found in 1911 upon over 50 species of plants, including weeds, ornamental plants, and garden and field crops. Upon most of these the pest was only occasionally seen, but it was found commonly throughout the active season upon the following plants: Beans, cowpeas, dahlia, ironweed, Jerusalem-oak weed, Jamestown weed, okra, tomato, wild blackberry, and wild geranium.

HIBERNATION VERSUS WINTERING.

Some observers have thought that the red spider commonly hibernates in trash or in the soil in cotton fields, but the past season's investigations have produced absolutely no evidence to support this idea. During the early spring, before the active season for the red spider commenced, trash was several times taken from fields in which the infestation had previously been severe and examined with great care. A few minute dormant acarids and other forms were thus obtained, but no red spiders could be found in such material. Similarly, during December, 1911, ample quantities of trash, etc., from recently infested fields were carefully examined, but always without finding any trace of the red spider. That this pest remains more or less active throughout the winter there can be no doubt. Mr. G. A. Runner found active adults at Batesburg, S. C., on December 21, 1909. Mr. H. F. Wilson observed red spiders feeding in early February at the same locality. The writer found all stages on violets on March 11, and adults as late as December 19, on the same host at Batesburg. The finding of the active red spiders during the coldest weather is certainly an additional indication that hibernation does not take place in South Carolina.

DISPERSION.

How do red spiders become established upon cotton? They have no wings and their legs are very minute. Close observations reveal that on the ground they normally travel at the rate of 1 inch per 15 seconds, which, if maintained, would total 480 feet in 24 hours. Red spiders are doubtless occasionally transferred by dogs, chickens, other domestic animals, insects, and birds. Strong winds may serve occasionally to transfer them from plant to plant. It is the writer's firm belief, however, that the chief means of dispersion is the red spider's own efforts. When once established in a field they may be further distributed by farm hands and by stock while cultivation is being carried on. They also spread from plant to plant along the interlacing branches, but traps specially prepared with "tangle-foot" and placed in the field have proven that individuals commonly crawl from plant to plant by way of the stalk and the ground.

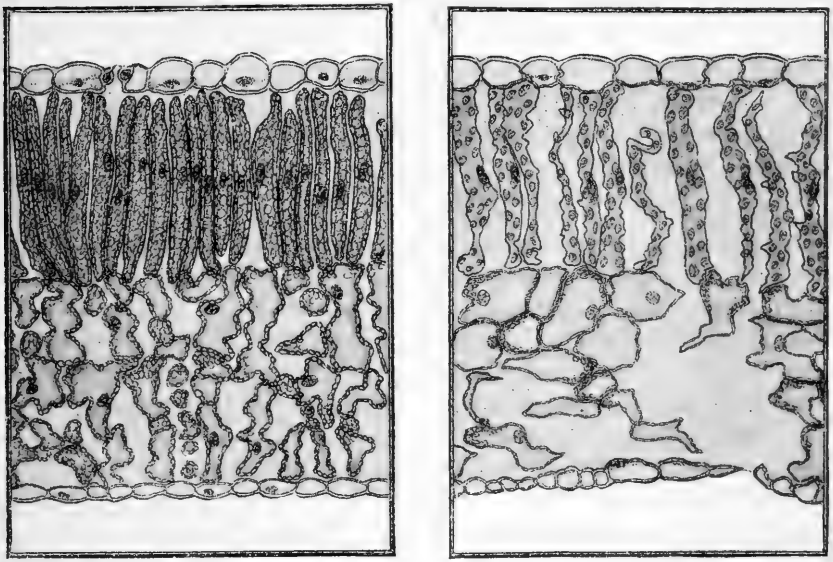
Since the red spider apparently uses no instinct or intelligence in finding cotton plants, it follows that the pest must hit upon the cotton stalks entirely by chance. The result of this haphazard manner of migration must necessarily result often in the penetration of the spiders far into the center of fields, thus giving rise to the mistaken impression that they had hibernated at these points.

Furthermore, as the likelihood of the discovery of cotton by the spider is doubtless in proportion to the thickness of the "stand," it

should follow that the thick broadcasting of a narrow border strip along the edge of a field adjoining a source of infestation would serve as a trap crop to intercept the majority of migrating spiders. This strip should be plowed in as soon as there seems to be danger of a general movement to the main field. (For a practical test of this idea, see under Prevention, p. 10.)

NATURE OF DAMAGE.

Cotton seedlings 2 inches high were found infested on May 1, but not until June 1 did the work of the pest become noticeable. The



a *b*

FIG. 3.—*a*, Cross section of normal cotton leaf; *b*, cross section of cotton leaf injured by the red spider. The puncture is near lower right-hand corner. Highly magnified. (Original.)

presence of the pest on cotton is first revealed by the appearance on the upper surface of the leaf of a blood-red spot. As leaves become badly infested they redden over the entire surface, become distorted, and drop. The lower leaves are first attacked, but infestation spreads upward until often only the bare stalk and one or two terminal leaves remain. Such plants almost invariably die. The injury to the leaf and the discoloration which follows the feeding of the mites are easily understood by referring to figure 3, which represents (*a*) the appearance of healthy cotton leaf-tissues and (*b*) the condition of the tissue after feeding by the pest. As previously intimated, the worst spots of infestation are usually to be found in close proximity

to yards with borders of violets. Large fields are probably never completely damaged, but small fields frequently become wholly affected. The crop of one 5-acre field near Leesville, S. C., was probably reduced at least 50 per cent by this pest. Local spots with from 25 to 100 per cent damage are frequently to be seen.

NATURAL CONTROLLING AGENCIES.

Red spider occurrence was most severe throughout July and was still at its height on August 1. Within three weeks of the latter date, however, the pest had become so greatly diminished that it was hardly noticeable and was doing practically no damage. This phenomenon indeed happened suddenly, and the agencies which worked to produce it are unquestionably of great economic value. The toughening of the leaves at that time may have caused many mites to desert cotton for other plants, but another factor of much more importance was the appearance in abundance of several species of insect enemies.

CLIMATIC INFLUENCES.

As before mentioned, climatic conditions exert a marked influence upon the welfare of the pest. During times of little rainfall and high temperature reproduction goes on by leaps and bounds; on the other hand, long, heavy rains work havoc to the red spider population. In spite of the fact that the red spiders inhabit the underside of the leaves, many are washed off by rains and many more are destroyed by the upward bombardment of sand particles, which may always be seen coating the lower leaves after storms. From observations made both early in the season and at the beginning of winter it is doubtless true that the young stages are killed by freezing weather. This naturally prevents any considerable winter increase, and in addition many adults probably perish.

INSECT ENEMIES.

Hot weather, although favoring red-spider development, also encourages the increase of insect enemies, of which several have been observed. Were it not for these inconspicuous friends of the farmer the depredation to his crops by the red spider would unquestionably be far more severe. The following are a few of the more important beneficial species observed this season at Batesburg, S. C.

Triphleps insidiosus Say (fig. 4), a small anthrocorid bug, was seen from the beginning of August, and both in the nymphal and adult stages was probably the most effective enemy of the spider. Coming upon a red spider like a flash, the adult thrusts its sharp proboscis through the pest's back and proceeds quietly to siphon out

the body contents. The first victim observed was "drained" in about five minutes, but each succeeding meal was of shorter duration as the appetite became satisfied. The actions of the nymph (fig. 5) are similar, but the individuals observed were seen only to destroy eggs of the spider. In this operation the proboscis was not inserted far into the ovum, and two minutes sufficed for draining an egg.

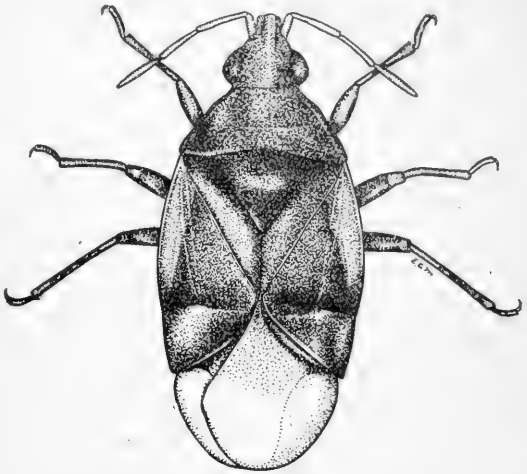


FIG. 4.—*Triphleps insidiosus*, an important enemy of the red spider. Much enlarged. (Original.)

A species of Chrysopa or lace-winged fly was seen abundantly throughout most of the summer, the larva of which is doubtless very active in reducing the pest.

Two species of thrips, *Euthrips fuscus* Hinds and *E. occidentalis* Pergande, have been determined this season from cotton. They are commonly found throughout the season about red spider colonies, and may be very instrumental in spider destruction. *Scolothrips sexmaculata* Pergande has been recorded as an enemy of the red spider by Pergande and by Duffy.

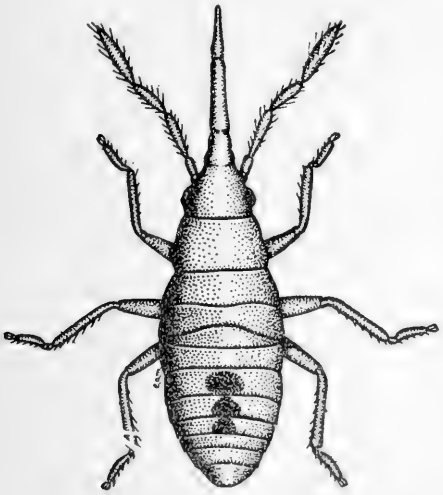


FIG. 5.—*Triphleps insidiosus:* Nymph. Greatly enlarged. (Original.)

Lady-beetle larvæ and adults of several species were commonly seen on infested leaves. These were usually either *Coccinella 9-notata* Hbst. or *Hippodamia convergens* Guér., but a small black species, (*Scymnus*) *Stethorus punctum* Lec., was occasionally observed. The larger beetles were probably more intent upon cotton aphides, but the last-mentioned species, although late in appearing and not very numerous, seems to be more restricted to the cotton mite than are other species.

REMEDIAL MEASURES.

PREVENTION.

Control on violets.—First among preventive measures against the red spider is that of its control on violets. In most cases, as before stated, infested cotton fields upon examination are found to have near them infested violet borders. In early June of the past season, in one particular instance, violets adjoining fields of past severe annual infestation were thoroughly sprayed. It is of great interest to record that subsequent infestation in these fields was practically negligible. These and similar observations certainly emphasize the important part that the violet plays in the seasonal history of the red spider.

Clean culture.—Borders of weeds and underbrush about fields should be burned or grubbed out. Margining a field close to a spot which was heavily infested the previous season there was found to occur a thick border of wild geranium, dock, and other weeds which at that time contained many red spiders. These weeds were destroyed by burning over them a heavy application of straw. No spiders appeared in the adjoining cotton throughout the season.

Broadcasted cotton.—An opportunity was accidentally provided of testing the value of thickly broadcasting cotton at the boundary of a field as a trap crop for red spiders. This cotton, intended as a cover crop, intervened between the cotton field proper and a large, heavily infested border of violets—a former abundant source of migration. The broadcasted cotton became infested and was later plowed in. The adjoining field remained free from mites. The success of this experiment would strongly indicate that the cotton trap crop is one of the most practical cultural expedients to be used in controlling this pest.

Spacing.—Experiments at Batesburg, S. C., have shown that the red spider commonly travels between plants upon the ground. This shows the futility of spacing as a remedial measure.

Time of planting.—The advantages of early or of late planting are not sufficiently clear to justify serious consideration. It would seem reasonable, however, to suppose that early planting would enable the plants to attain greater size and vigor by the time of the appearance of the spiders and that this would perhaps assist the plants in withstanding the weakening effects of the pest.

Rotation.—In an effort to test the rotational value of other crops, cowpeas, corn, beets, and peanuts were planted in or near infested areas. In addition, grains, beans, peas, onions, tomatoes, squash, watermelon, okra, turnip, lettuce, and other vegetables in infested locations have been observed frequently. Excepting the grains and peanuts, the red spider has been seen commonly upon all of these.

On the other hand, should an immune crop be found and employed, it is extremely probable that the pest would reinvade the fields upon the return to cotton culture with as great ease and quickness as it has done during any previous season, providing the sources of infestation were yet at hand. Rotation, then, does not promise to contribute toward the solution of the problem.

Effects of fertilizers.—A rather elaborate series of tests with fertilizers was instituted in an attempt to determine whether the various applications assisted cotton to withstand the injurious effects of infestation. Since almost no infestation appeared in these test plats it was impossible to deduce positive conclusions. It was very noticeable, however, that plants receiving heavy applications withstood the very severe drought conditions which prevailed in South Carolina in 1911 conspicuously better than did plants which were not so treated. It seems reasonable to suppose, therefore, that plants which have been fortified by a liberal quantity of fertilizer will be assisted, upon occurrence of severe infestation, in resisting its effects.

REPRESSION.

We have just discussed cultural measures which may help to prevent infestation. We will now consider what may be done to combat the pest when it has already gained entrance to a field.

Pulling infested plants.—The experiment was made in one field of pulling up and destroying the first few plants which showed infestation. In this particular case the operation was repeated three times. Care was taken to find every plant showing the characteristic red spots, and these were carried from the field and burned. The result was most satisfactory, and the pest was completely eradicated.

If infestation has spread until a considerable patch has become involved it might be advisable, in the case of a large field, to plow up the affected portion in order to save the balance of the field. Such a drastic measure, however, should only be resorted to in extreme cases, and the planter concerned must be the judge of its desirability.

Insecticides.—In all, 26 spray combinations were thoroughly tested under conditions entirely natural. The field used for this purpose was about 1 acre in extent, and infestation had become both very general and very severe. A strip through the middle of the field, crossing each sprayed plat, was left unsprayed to serve as a check. Since no substance was discovered which could safely be used to destroy all eggs in one application, it was found necessary to spray twice with an interval of six or seven days, so as to destroy the hatching larvæ. The killing ability of all these sprays was computed, and the percentages range from 100 to 0. Each of the following six combinations (see Table II) was found to be very satisfactory. These are presented to indicate the manner of preparation, together with the

cost of 100 gallons of each. If one of these were to be used in preference to all others it should undoubtedly be potassium sulphid. This insecticide commends itself from every standpoint—cheapness, simplicity of preparation, continued readiness for use, ability to kill quickly, and safety of foliage. Altogether it seems to be an ideal red-spider spray. It was found that 100 gallons, when applied as a misty spray, about sufficed to treat an acre of average-sized cotton.

TABLE II.—*Some satisfactory sprays for the red spider.*

Spray No.	Formula and items.		Total cost.	Per cent killed.
I	Potassium sulphid, 3 pounds, at 25 cents		$0.75	100
	Water, 100 gallons.			
II	Flowers of sulphur, 15 pounds, at 4 cents	$0.60		
	Fresh lime, 20 pounds, at 4 cents } boiled	.80		
	Water, 100 gallons		1.40	100
III	Miscible oil, 5 gallons, at $1		5.00	100
	Water to make 100 gallons (1 to 20).			
IV	Potassium permanganate, 16½ pounds, at 50 cents		8.25	100
	Water to make 100 gallons (2 per cent solution).			
V	Miscible oil, 2½ gallons, at $1	$2.50		
	Black-leaf tobacco extract, 40%, ½ gallon, at $1.25 per pound	2.00		
			4.50	99
VI	Flowers of sulphur, 28 pounds, at 4 cents	$1.12		
	Soft soap, 14 ounces, at 40 cents per pound	.35		
	Water to make 100 gallons.		1.50	98

SUMMARY.

The female red spider, appearing to the naked eye like a dot of reddish ink from the point of a fine pen, lays about 50 or 60 round, colorless eggs, which hatch in summertime in about four days.

The colorless, newborn spider has six legs, feeds at once, and molts in two days to the primary nymph.

This first nymphal stage (and all later stages) possesses eight legs, and has become larger in size and darker in color. In two more days (in summer) it, in turn, molts to the secondary nymph.

The second nymphal stage lasts two days, at the end of which time, after molting, the fully formed adult emerges. Mating occurs at once and egg laying commences immediately afterwards.

Thus, one generation requires in summer weather in South Carolina about 10 or 11 days. There are probably about 15 generations in an average year in that locality.

The red-spider colonies live on the underside of the cotton leaves, and their constant feeding causes blood-red spots to appear on the tops of the leaves. The effect upon the cotton plant is that the leaves drop, one by one, until usually the plant dies.

The pest increases and spreads most rapidly in hot, dry weather until (toward the end of July) several acres of a field may become badly damaged.

Several insects have been discovered which destroy many mites, and are thus of great benefit to the planter.

At the end of the cotton-growing season most of the red spiders migrate afoot in search of greener plants, the majority of those which survive settling ultimately upon the cultivated violet.

RECOMMENDATIONS.

(*1*) *Clean culture.*—Burn or grub out all weeds and underbrush about cotton fields and practice fall plowing so far as possible.

(*2*) *Control on violets.*—Spray or destroy suspected violet plants in order to remove the sources of red spider infestation.

(*3*) *Broadcasted trap borders.*—Thickly sow cotton along margins of fields at points where infestation has appeared on former occasions, and plow these in about June 1, so as to intercept and destroy the invading mites.

(*4*) *Pulling first infested stalks.*—Maintain a careful watch of fields so that the first attacked plants may be detected, removed, and burned, thus preventing further spread.

(*5*) *Spraying.*—Apply one of the insecticides recommended above to the infested portion of a field before occurrence becomes too general to prohibit its use. Two applications should be made; the first to destroy the living mites, and the second, a week later, to kill the recently hatched individuals which were eggs at the time of the first spraying.

Finally, the opinion will be ventured that the red spider is not a difficult pest to combat. Unlike many other pests, it has no wings and spreads mainly by means of its tiny legs. Migration does not extend far from its winter quarters. This makes every man's problem virtually his own. In other words, if his infestation has always come from a certain spot upon his premises, proper attention to this spot will yield him results in spite of the negligence of his neighbors.

Approved:

JAMES WILSON,

Secretary of Agriculture.

WASHINGTON, D. C., *February 14, 1912.*

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