ASSOCIATION OF PLANT HAIRS AND INSECT RESISTANCE
An Annotated Bibliography

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CONTENTS

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INTRODUCTION

The primary known component of the resistance in wheat to the cereal leaf beetle, *Oulema melanopus* (L.), is nonpreference for oviposition on plants with pubescent leaf surfaces. Therefore, during studies of resistance caused by pubescence, a bibliography was compiled of scientific publications reporting on the relationship between hairs and insect resistance.

Some plant hairs confer this resistance by interfering with such insect activities as feeding and oviposition; other plants have hairs or glandular trichomes that secrete material that is either toxic to the insect or impedes its mobility. Some plants, however, have hairs that make the plant susceptible to insect activity, and other more glabrous plants are insect resistant. Because each insect-host interaction is a unique relationship, it is difficult to generalize further about plant hairs and insect resistance. Insect reactions to pubescent plants reported in the publications in this bibliography are summarized below.

There are occasional discrepancies in the literature about plant hairs and insect behavior. Thus, the summary may be used as a general guide, but plant breeders and entomologists should make a thorough study of their insect-host situation to avoid the possible release of a cultivar vulnerable to another pest.

Host plant and insect(s)[1]	*Insect reaction*[2]	*Resistance mechanism or insect behavior affected*[3]
Alfalfa:		
Empoasca fabae (Harris), potato leafhopper	R	F O?
Beans:		
Aphis craccivora Koch, cowpea aphid	R	I
Aphis fabae Scopoli, bean aphid	R	I
Empoasca fabae, potato leafhopper	R	F O?
Empoasca flavescens (F.), tea-green fly[4]	R	F O?
Etiella zinckenella (Treitschke), lima bean pod borer	R?	--
Leguminivora glycinivorella (Mats.) Obraztov (= *Grapholitha glycinivorella* Matsumura), soybean pod borer[4]	S	O
Thrips tabaci Lindeman, onion thrips	S	P
Predaceous Syrphiidae	R	I
Chestnuts:		
Curculio elephas (Gyllenhal)	R	
Compositae:		
Melanoplus femurrubrum (De Geer), red-legged grasshopper	R	F
Corn:		
Diabrotica virgifera LeConte, western corn rootworm	R	F
Heliothis zea (Boddie), corn earworm	S	O
Cotton:		
Anthonomus grandis Boheman, boll weevil	R	O
Aphis gossypii Glover, cotton aphid, melon aphid	R S	F
Bemisia tabaci (Gennadius), cotton whitefly[4] or sweetpotato whitefly	S	P
Earias fabia (Cramer), cotton spotted bollworm[4]	S	O
Earias insulana (Boisduval), cotton spotted bollworm[4]	N	
Heliothis zea, bollworm	S	O
Cicadellidae (Jassidae)—*Empoasca* spp.; *Amrasca* spp.	R	F O?
Pectinophora gossypiella (Saunders), pink bollworm	N	
Pseudatomoscelis seriatus (Reuter), cotton fleahopper	S	
Spodoptera littoralis Boisduval, cotton leafworm	R	O F
Tetranychus spp., spider mites	R S	F
Thrips tabaci, onion thrips	N	
Trialeurodes abutilonea (Haldeman), bandedwing whitefly	S	
Cucurbitaceae:		
Bemisia tabaci, cotton whitefly[4] or sweetpotato whitefly	R?	
Grapes:		
Epitetranychus sp., red spider[4]	R?	

[1] Except where noted, common insect names are from *Common Names of Insects Approved by the Entomological Society of America*, December 1970.

[2] R = leaf hairs may cause insect resistance or partial resistance, or are a character associated with resistance. S = insect susceptibility associated with plant pubescence. N = no measurable differences. R? = probably resistant, literature not clear.

[3] F = feeding. I = insects are immobilized by hairs or trichome exudates. O = oviposition. P = leaf hairs provide protection, resulting in insect susceptibility. T = repellant or toxic material from trichomes. O? = probably oviposition, literature not clear. Blank spaces indicate that the literature does not specifically state the resistance or susceptibility mechanisms involved.

[4] Common name used in the publication(s) cited and not on the ESA List of Common Names (most of these names include only species that inhabit the United States, Canada, or their possessions or territories).

Host plant and insect(s)[1]	*Insect reaction*[2]	*Resistance mechanism or insect behavior affected*[3]
Lupins:		
Acyrthosiphon (= *Macrosiphum*) *pisum* (Harris), pea aphid	R	
Oats:		
Oscinella frit (L.), frit fly	R N	O
Passifloraceae:		
Heliconius erato (L.); *Heliconius melpomene* (L.), heliconiine butterfly larvae[4]	R	I
Rice:		
Chilo suppressalis (Walker), Asiatic rice borer	R	O
Solanaceae:		
Bemisia tabaci, cotton whitefly[4] or sweetpotato whitefly	R?	
Epitrix hirtipennis (Melsheimer), tobacco flea beetle	R	T
Heliothis virescens (F.), tobacco budworm	S R	O T
Macrosiphum euphorbiae (Thomas), potato aphid	R	T
Manduca sexta (L.), tobacco hornworm	R	T
Myzus persicae (Sulzer), green peach aphid	R	T
Tetranychus cinnabarinus (Boisduval), carmine spider mite	R	I O
Tetranychus urticae Koch, twospotted spider mite	R	I T
Trialeurodes vaporariorum (Westwood), greenhouse whitefly	R	I
Sorghum:		
Atherigona varia soccata Rondani, sorghum shoot fly[4]	R	F
Strawberries:		
Tetranychus urticae (Koch), twospotted spider mite	S	F O
Sugarcane:		
Aleurolobus barodensis (Maskell), sugarcane whitefly[4]	R	
Melanaspis glomerata (Green), sugarcane scale[4]	R	
Scirpophaga nivella (F.), top-borer[4]	R	F
Wheat:		
Mayetiola destructor (Say), Hessian fly	S	O
Oscinella frit, frit fly	R	
Oulema melanopus (L.), cereal leaf beetle	R	O F
Hylemya (= *Phorbia*) *genitalis* Schnabl, spring fly[4]	S	--

In general, the bibliography includes publications that appeared after Painter's (1951) book. However, a few that appeared before 1951 and that were not discussed by Painter are listed in this bibliography. In addition, those publications listed only by title at the end of Painter's book, are included herein. Painter's book is the second entry; it is categorized as "General." Other publications are listed alphabetically under the plant in the study.

The annotations do not necessarily reflect the main point of the article cited in the publication, but they do reflect the information about plant pubescence contained in each. Reports concerning the genetics of plant pubescence were not included unless both insect resistance and plant pubescence were discussed; however, many of the publications are concerned with the inheritance of plant hairs.

Because plant pubescence is associated with resistance and susceptibility to insects in at least 18 genera, the list will be of value to scientists working in host-plant resistance and in teaching.

The references were compiled from the *Review of Applied Entomology* (R.A.E.), *Biological Abstracts*, *Plant Breeding Abstracts*, recent journals, and bibliographies of cited publications. Information from publications not in English was obtained largely from the abstract journals mentioned.

Credit is due Eileen Rathke, former research associate, Entomology Department, Michigan State University, for locating some of the publications cited in this bibliography.

GENERAL

(1) Levin, D. A. 1973. THE ROLE OF TRICHOMES IN PLANT DEFENSE. Quart. Rev. Biol. 48(1): 3-15.

Plant trichomes have been used for taxonomic purposes, but their adaptive significance has received little attention from the evolutionist and ecologist. Trichomes play a role in plant defense. This publication contains over 100 references concerning topics ranging from the description and ontogeny of trichomes to their role in plant defense of herbivorous invertebrates and vertebrates.

(2) Painter, R. H. 1951. INSECT RESISTANCE IN CROP PLANTS. Macmillan, New York. 520 pp. First paperback ed. 1968. The Univ. Press of Kansas, Lawrence and London. 520 pp.

Contains references to plant pubescence and insect behavior on: Alfalfa—pp. 24, 33, 362; beans—pp. 61, 297-298, 442; clover—pp. 24, 33, 297-298; corn—pp. 36, 219 (error on p. 36 of original edition: should read *fewer* corn eggworm eggs on glabrous leaves than on corn with hairy leaves); cotton—pp. 33, 86, 289-297, 305, 311; grapes—p. 38; and potatoes—pp. 278, 362, 375.

ALFALFA

(3) Taylor, N. L. 1956. PUBESCENCE INHERITANCE AND LEAFHOPPER RESISTANT RELATIONSHIPS IN ALFALFA. Agron. J. 48: 78-81.

Pubescent plants of *Medicago* sp. were more resistant to infestations of *Empoasca fabae* (Harris) than glabrous plants. Pubescence was inherited as a quantitative character.

BEANS

(4) Broersma, D. B., Bernard, R. L., and Luckmann, W. H. 1972. SOME EFFECTS OF SOYBEAN PUBESCENCE ON POPULATIONS OF THE POTATO LEAFHOPPER. J. Econ. Ent. 65: 78-82.

The orientation of plant hairs was more important to the resistance of *Empoasca fabae* than the number of hairs. Glabrous strains of *Glycine max* (L.) Merrill were damaged by leafhoppers more than other strains.

(5) DEFLUITER, H. J., and ANKERSMIT, G. W. 1948. [DATA ON THE INFESTATION OF BEAN BY "APHIS FABAE"] [In Dutch, English summary.] Tijdschr. Plantenziekten 54: 1-13. (R.A.E. 38: 93.)

Leaf hair density was greater on *Phaseolus vulgaris* L. growing in dry conditions than in wet conditions, but there were no significant differences in the mortality of the aphids in the two conditions. Cecidomyiid larvae and young larvae of *Coccinella septempunctata* L. (natural enemies of aphids) were also trapped on the hairs and died.

(6) HSU CHING-FUNG, KUO SHOU-KWEI, HAN YU-MEI, CHANG JUNG, and LI MEI CHUNG. 1965. [A PRELIMINARY STUDY ON THE RESISTANCE OF SOYBEAN VARIETIES TO THE SOYBEAN POD BORER ("LEGUMINIVORA GLYCINIVORELLA" (MATS.) OBRAZTSOV)] [In Chinese, English summary.] Acta Phytophyl. Sin. 4: 111-118. (R.A.E. 54: 221.)

A large number of *Leguminivora glycinivorella* (Matsumura) eggs were laid on the pods of hairy varieties of *Glycine max*; on nonhairy varieties, most eggs were deposited on the inner surface of the stipules.

(7) JAYARAJ, S. 1968. STUDIES ON THE PLANT CHARACTERS OF CASTOR ASSOCIATED WITH RESISTANCE TO "EMPOASCA FLAVESCENS" (F.) (HOMOPTERA: JASSIDAE) WITH REFERENCE TO SELECTION AND BREEDING OF VARIETIES. Indian J. Agr. Sci. 38: 1-16.

Jassid infestation was positively correlated at a highly significant level with plant characteristics of *Ricinus communis* L., one of them being the degree of waxy coating on the leaves.

(8) JOHNSON, B. 1953. THE INJURIOUS EFFECTS OF THE HOOKED EPIDERMAL HAIRS OF FRENCH BEANS ("PHASEOLUS VULGARIS" L.) ON APHIS CRACCIVORA" KOCH. Bul. Ent. Res. 44: 779-788.

Legs of the aphids became impaled on the hooked hairs. Mortality was lower on varieties with less dense pubescence.

(9) MILLER, L. W. 1947. POPULATION OF "THRIPS TABACI" LIND. ON BEAN VARIETIES. J. Austral. Inst. Agr. Sci. 13: 141-142.

Hairy bean leaves were associated with susceptibility to the onion thrips, *Thrips tabaci* Lindeman. The hairs may have produced a microclimate that favored breeding and that protected the nymphs from attack by the larger natural enemies.

(10) NISHIJIMA, Y. 1954. ON THE BORING OF HATCHING LARVAE AND THE LOCATION OF EGG DEPOSITION OF THE SOYBEAN POD BORER, "GRAPHOLITHA GLYCINIVORELLA" MATSUMURA. Mem. Fac. Agr. Hokkaido Univ. 2: 127-132.

Original paper and abstract not located. Reference cited by Nishijima (1960).

(11) ______. 1960. HOST PLANT PREFERENCE OF SOYBEAN POD BORER, "GRAPHOLITHA GLYCINIVORELLA" MATSUMURA, I. Oviposition site. Ent. Exp. Appl. 3: 38-47.

No significant differences occurred in microclimatic conditions (temperature and humidity) between hairy and glabrous fields of *Glycine max*. No relative differences in light intensity near hairy and glabrous plants were found.

(12) ______ and T. KUROSAWA. 1953. SOME FACTORS AFFECTING VARIETAL DIFFERENCES OF SOYBEAN TO THE ATTACK BY THE SOYBEAN POD BORER, "GRAPHOLITHA GLYCINIVORELLA" MATSUMURA. Res. Bul. Hokkaido Natl. Agr. Exp. Sta. 65: 42-51.

Original paper and abstract not located. Reference cited by Nishijima (1960).

(13) OKADA, I. 1948. STUDIES ON THE SOYBEAN POD BORER, "GRAPHOLITHA GLYCINIVORELLA" MATSUMURA. Kanchi Nogaku 2: 193-239.

Original paper and abstract not located. Reference cited by Nishijima (1960).

(14) PILYUGINA, O. A. 1932. ["ETIELLA ZINCKENELLA" (TREITSCHKE) IN THE LOWER VOLGA TERRITORY.] [In Russian.] Tr. Vses. Inst. Zern. Khoz. (Saratov), vol. 3 (From Chesnokov 1953, p. 13, complete reference listed under Wheat.)

The structure and hair characters of the flower calyx in bean plants influenced oviposition behavior of the legume-pod moth, *Etiella zinckenella* (Tr.).

(15) SCHNEIDER, F. 1944. [ONE CAUSE OF THE RAPID MULTIPLICATION OF APHIDS ON BEANS.] [In German.] Forschr. Egrebn. Gartenb., pt. 5 repr. (R.A.E. 35: 147.)

Syrphid larvae did not control *Aphis fabae* Scopoli on *Phaseolus* because they usally were caught by the hooked leaf hairs and died.

(16) UCHIDA, T., and OKADA, I. 1937. [ON THE RELATION BETWEEN THE OVIPOSITION OF THE SOYBEAN POD BORER AND THE HAIRINESS OF THE SOYBEAN POD.] [In Japanese.] Oyo Dobutsugaku Zasshi 9: 100-104. (R.A.E. 25: 673.)

Observations in Manchuria showed that moths of *Leguminivora glycinivorella* preferred to oviposit on hairy pods and did not lay eggs on smooth pods of *Glycine max.*

(17) WOLFENBARGER, D. A. 1961. RESISTANCE OF BEANS ("PHASEOLUS, GLYCINE MAX, VIGNA SINENSIS, VICIA FABA, AND DOLICHOS LABLAB") TO THE MEXICAN BEAN BEETLE AND THE POTATO LEAFHOPPER. (Ph. D. thesis, Ohio State Univ.) Diss. Abstr. 22: 686.

A correlation coefficient of $r = -0.194$ (not significant at the 5 percent probability level) was found between the number of epidermal hairs and nymphal populations of *Empoasca fabae* on *Phaseolus vulgaris.*

(18) ______ and SLEESMAN, J. P. 1961. RESISTANCE IN COMMON BEAN LINES TO THE POTATO LEAFHOPPER. J. Econ. Ent. 54: 846-849.

The type of leaf hair and not the number may have been the important factor in *Empoasca fabae* resistance of *Phaseolus vulgaris.*

(19) ______ J. P. SLEESMAN. 1963. VARIATION IN SUSCEPTIBILITY OF SOYBEAN PUBESCENT TYPES, BROAD BEAN, AND RUNNER BEAN VARIETIES AND PLANT INTRODUCTIONS TO POTATO LEAFHOPPER. J. Econ. Ent. 56: 895-897.

Factors other than type of leaf pubescence were, at least in part, responsible for the resistance to hopperburn caused by *Empoasca fabae.*

CHESTNUTS

(20) POPOVA, I. 1960. [CHESTNUTS RESISTANT TO "CURCULIO ELEPHAS" (GYLLENHAL).] [In Bulgarian.] Rastit. Zasht. 8: 69-71. (R.A.E. 50: 60.)

The infestation of this weevil was in inverse ratio to the density of the spines on the pericarp of *Castanea* spp.

COMPOSITAE

(21) JANTZ, O. K. FOOD PLANTS OF "MELANOPLUS FEMURRUBRUM" (DE GEER) IN THE BLUESTEM GRASS REGION OF KANSAS. M.S. thesis, Kans. State Univ.,

Kuhnia eupatorioides L., a very hairy plant, was avoided by the grasshopper, *Melanoplus femurrubrum* (De Geer), in feeding preference tests.

CORN

(22) CALLAHAN, P. S. 1957. OVIPOSITION RESPONSE OF THE CORN EARWORM TO DIFFERENCES IN SURFACE TEXTURE. J. Kans. Ent. Soc. 30: 59-63.

Experiments with an apparatus designed to test the ability of a moth to cling to a surface showed that villous surfaces are best suited to moths of *Heliothis zea* (Boddie) for maintaining a foothold.

(23) HAGEN, A. F., and F. N. ANDERSON. 1967. NUTRIENT IMBALANCE AND LEAF PUBESCENCE IN CORN AS FACTORS INFLUENCING LEAF INJURY BY THE ADULT WESTERN CORN ROOTWORM. J. Econ. Ent. 60: 1071-1073.

Zinc-deficient *Zea mays* L. had the least number of hairs per leaf and the greatest amount of leaf injury. The close correlation between the amount of leaf pubescence and amount of leaf injury indicated that pubescence may act as a barrier to the feeding of the adults of *Diabrotica virgifera* LeConte.

COTTON

(24) ABUL-NASR, S. 1960. THE SUSCEPTIBILITY OF DIFFERENT VARIETIES OF COTTON PLANTS TO INFESTATION WITH INSECT AND MITE PESTS. Bul. Soc. Ent. Egypt 44: 143-156.

Two pubescent varieties of *Gossypium* were more susceptible to the cotton aphid, *Aphis gossypii* Glover, than standard cultivars. A pubescent line was more resistant to attack by a Lepidopteran, *Spodoptera littoralis* Boisduval (=*Prodenia litura* (F.)), and the *Tetranychus* complex. There were no significant differences in resistance to a Lepidopteran, *Earias insulana* (Boisduval), the pink bollworm, *Pectinophora gossypiella* (Saunders), or the onion thrips, *Thrips tabaci*.

(25) BATRA, G. R., and GUPTA, D. S. 1970. SCREENING OF VARIETIES OF COTTON FOR RESISTANCE TO THE JASSID. Cotton Grow. Rev. 47: 285-291.

Hair length on the lamina and thickness of palisade cells were the most important characters in resistance of *Gossypium* sp. to *Amrasca devastans* (Distant).

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(26) BUTLER, G. D., JR., and MURAMOTE, H. 1967. BANDED-WING WHITEFLY ABUNDANCE AND COTTON LEAF PUBESCENCE IN ARIZONA. J. Econ. Ent. 60: 1176-1177.

The relationship between greater abundance of *Trialeurodes abutilonea* (Haldeman) and leaf pubescence held only for a 'Dwarf A', *Gossypium barbadense* L., X 'Lankart', *G. hirsutum* L., genetic combination.

(27) EVANS, D. E. 1965. JASSID POPULATIONS ON THREE HAIRY VARIETIES OF SAKEL COTTON. Emp. Cotton Grow. Rev. 42: 211-217.

Three hairy varieties of *Gossypium barbadense* were resistant to *Empoasca libyca* (de Bergevin and Zanon) but not until late in the season. A white-fly, *Bemisia tabaci* (Gennadius), was more numerous on the hairy lines.

(28) HUNTER, R. C., LEIGH, T. F. LINCOLN, C. and others. 1965. EVALUATION OF COTTONS FOR RESISTANCE TO THE BOLL WEEVIL. Ark. Agr. Exp. Sta. Bul. 700, 38 pp.

Significant advances were made in resistance of *Gossypium hirsutum* to *Anthonomus grandis* Boheman with red plant color, increased pubescence, rapid fruit set, and Frego bract characters, but supplemental controls were needed for competitive levels of yield.

(29) KAMEL, S. A. 1965. RELATIONSHIP BETWEEN LEAF HAIRINESS AND RESISTANCE TO COTTON LEAF WORM. Emp. Cotton Grow. Rev. 42: 41-48.

Resistance to *Spodoptera littoralis* was associated with leaf hair density on both surfaces of *Gossypium* spp. leaves, especially on the lower surface.

(30) ——— and ELKASSABY, F. Y. 1965. RELATIVE RESISTANCE OF COTTON VARIETIES IN EGYPT TO SPIDER MITES, LEAFHOPPERS, AND APHIDS. J. Econ. Ent. 58: 209-212.

The hairy *Gossypium barbadense* variety 'Bahtim-101' was found to be highly resistant to spider mites, *Tetranychus* spp., jassids, and the cotton aphid, *Aphis gossypii*. The literature is contradictory with respect to the relationship between hairiness and resistance to cotton aphids.

(31) KNIGHT, R. L. 1952. THE GENETICS OF JASSID RESISTANCE IN COTTON. 1. THE GENES H_1 AND H_2. J. Genet. 51: 47-66.

The cicadellid resistance of two perennial types of *Gossypium barbadense* was caused by a basic, partially dominant, hairiness gene designated H_1 that was accompanied by several minor hairiness genes. H_2, a hair density gene, was responsible for the dense tomentum of *G. tomentosum* Nuttal.

(32) ———. 1954. THE GENETICS OF JASSID RESISTANCE IN COTTON. IV. TRANSFERENCE OF HAIRINESS FROM "GOSSYPIUM HERBACEUM" TO "G. BARBADENSE." J. Genet. 52: 199-207.

A major hairiness gene was transferred from *Gossypium herbaceum* L., (Wagad 8), to Sakel (*G. barbadense*), and the gene appeared identical with H_1, the usual key gene in hairiness control in New World cottons.

(33) ———. 1955. THE GENETICS OF JASSID RESISTANCE IN COTTON. V. TRANSFERENCE OF HAIRINESS FROM "GOSSYPIUM ARBOREUM" TO "G. BARBADENSE." J. Genet. 53: 150-153.

A major hairiness gene was transferred from tetraploid *G. arboreum* L. (Multani) to Sakel, and the gene appeared allelic to and closely similar to H_1.

(34) ——— and J. SADD. 1954. THE GENETICS OF JASSID RESISTANCE IN COTTON. II. 'PUBESCENT T 611.' J. Genet. 51: 582-585.

The gene controlling hairiness in the Upland variety 'Pubescent T 611' was transferred to Sakel and shown to be identical with the *G. tomentosum* gene H_2.

(35) ——— and J. SADD. 1954. THE GENETICS OF JASSID RESISTANCE IN COTTON. III. THE KAPAS PURAO, KAWANDA PUNCTATUM, AND PHILLIPPINES FERGUSON GROUP. J. Genet. 52: 186-198.

Three types of genes in *Gossypium* were involved in the genetic control of pubescence to give jassid resistance on the abaxial surface.

(36) LLUKEFAHR, M. J., COWAN, C. B., PFRIMMER, T. R. and NOBLE, L. W. 1966. RESISTANCE OF EXPERIMENTAL COTTON STRAIN 1514 TO THE BOLLWORM AND COTTON FLEAHOPPER. J. Econ. Ent. 59: 393-395.

Resistance of a glabrous and nectary-free experimental *Gossypium* sp. (strain 1514) to insect attack was evaluated. Lower populations of *Heliothis zea*, and *Pseudatomoscelis* (= *Psallus*) *seriatus* (Reuter), were found on this cotton than on commercial varieties.

(37) ——— and COWAN, JR., C. B., BARIOLA, L. A. and HOUGHTALING, J. E. 1968. COTTON STRAINS RESISTANT TO THE COTTON FLEAHOPPER. J. Econ. Ent. 61: 661-664.

The glabrous character in strains of *Gossypium hirsutum* suppressed populations of *Pseudatomoscelis seriatus* below economically damaging levels and was as effective as some recommended insecticides.

(38) ——— COWAN, C. B. and HOUGHTALING, J. E. 1970. FIELD EVALUATIONS OF IMPROVED COTTON STRAINS RESISTANT TO THE COTTON FLEAHOPPER. J. Econ. Ent. 63: 1101-1103.

Pubescent strains of *Gossypium hirsutum* (homozygous for genes H_2H_2) had significantly more mirids (*Pseudatomoscelis seriatus* (Reuter)) than those with the normal complement of trichomes (homozygous for genes H_1H_1).

(39) ——— HOUGHTALING, J. E. and GRAHAM, H. M. 1971. SUPPRESSION OF "HELIOTHIS" POPULATIONS WITH GLABROUS COTTON STRAINS. J. Econ. Ent. 64: 486-488.

Use of glabrous strains of *Gossypium* spp. with the resultant decrease in *Heliothis* oviposition could delay the need for insecticides, and the strains might permit other biological factors to be utilized more effectively.

(40) MAY, A. W. S. 1951. JASSID RESISTANCE OF THE COTTON PLANT. Queensland J. Agr. Sci. 8: 43-68.

Resistant lines of *Gossypium* sp. had a dense cover of long stellate hairs along the entire length of the midrib. Only plants with long, dense pubescence over all of the midrib should be used in breeding programs for resistance to *Empoasca maculata* Evans.

(41) MEHTA, R. C., and SAXENA, K. N. 1970. OVIPOSITIONAL RESPONSES OF THE COTTON SPOTTED BOLLWORM, "EARIAS FABIA" (LEPIDOPTERA: NOCTUIDAE), IN RELATION TO ITS ESTABLISHMENT ON VARIOUS PLANTS. Ent. Exp. Appl. 13: 10-20.

Among the plant parts tested, *Abelmoschus esculentus* Moench., fruit, and *Gossypium hirsutum* leaves appeared the most suitable for oviposition by *Earias fabia* (Cramer) because of their great hair density and the presence of certain chemicals.

(42) MERKLE, M. E., and MEYER, J. R. 1963. STUDIES OF RESISTANCE OF COTTON STRAINS TO THE BOLL WEEVIL. J. Econ. Ent. 56: 860-862.

The Pilose-Okra leaf strain of *Gossypium* sp. (with single dominant genes for pilose) had a low percentage of squares punctured under conditions of low weevil population pressure; when infestations of *Anthonomus grandis* increased on other plots, a rapid increase also occurred on these plants.

(43) MOUND, L. A. 1965. EFFECT OF LEAF HAIR ON COTTON WHITEFLY POPULATIONS IN THE SUDAN GEZIRA. Emp. Cotton Grow. Rev. 42: 33-40.

Gossypium barbadense lines with hairy leaves provided shelter for adult *Bemisia tabaci*. These whiteflies left glabrous-leaved varieties more readily than they left pubescent cultivars.

(44) MUTTUTHAMBY, S., ASLAM, M. and KHAN, M. A. 1969. INHERITANCE OF LEAF HAIRINESS IN "GOSSYPIUM HIRSUTUM" L. COTTON AND ITS RELATIONSHIP WITH JASSID RESISTANCE. Euphytica 18: 435-439.

Two pairs of genes appeared as part of the genetic control of pubescence of leaves in the crosses of *Gossypium hirsutum* studied.

(45) OLIVER, B. F., MAXWELL, F. G. and JENKINS, J. N. 1970. A COMPARISON OF THE DAMAGE DONE BY THE BOLLWORM TO GLANDED AND GLANDLESS COTTONS. J. Econ. Ent. 63: 1328-1329.

In view of previous indications of reduced oviposition on *Gossypium* spp. with glabrous leaves, it was suggested that the glandless version of a smooth-leaved variety would be less susceptible to *Heliothis zea* than the more commonly grown hirsute glanded cottons.

(46) POLLARD, D. G., and SAUNDERS, J. H. 1956. RELATIONS OF SOME COTTON PESTS TO JASSID RESISTANT SAKEL. Emp. Cotton Grow. Rev. 33: 197-202.

Jassid-resistant (hairy-leaved) lines of *Gossypium barbadense* were susceptible to *Aphis gossypii*, *Bemisia tabaci*, and *Tetranychus* sp. The importance of developing a jassid-resistant variety not more susceptible to other insects was stressed.

(47) SIKKA, S. M., SAHNI, V. M. and BUTANI, D. K. 1966. STUDIES ON JASSID RESISTANCE IN RELATION TO HAIRINESS OF COTTON LEAVES. Euphytica 15: 383-388.

Of three characteristics of hairiness studied, length of hair appeared to be of prime importance, followed by density of hair on the lamina. Pubescence on the midrib did not seem an important role in imparting resistance of *Gossypium hirsutum* to *Amrasca devastans* (Distant).

(48) STEPHENS, S. G. 1957. SOURCES OF RESISTANCE OF COTTON STRAINS TO THE BOLL WEEVIL AND THEIR POSSIBLE UTILIZATION. J. Econ. Ent. 50: 415-418.

Red plant color, plant hairiness, and absence of stem glands in *Gossypium* spp. were involved in resistance to *Anthonomus grandis*.

(49) ———. 1959. LABORATORY STUDIES OF FEEDING AND OVIPOSITION PREFERENCES OF "ANTHONOMUS GRANDIS" BOH. J. Econ. Ent. 52: 390-396.

Hairiness of the flower buds of *Gossypium* discouraged feeding of *Anthonomus grandis* when an alternative choice of glabrous buds was available.

(50) ——— and LEE, H. S. 1961. FURTHER STUDIES ON THE FEEDING AND OVIPOSITION PREFERENCES OF THE BOLL WEEVIL ("ANTHONOMUS GRANDIS"). J. Econ. Ent. 54: 1085-1090.

The boll weevil resistance associated with hairiness in *Gossypium* was separated into two categories: 1. Mechanical resistance—the bracteoles of hairy plants are "sealed" during the early stages of development, thus temporarily protecting the enclosed flower buds from damage. 2. Presumed antibiotic effects—larvae of *Anthonomus grandis* were found to develop less rapidly in hairy than in nonhairy buds.

(51) TIDKE, P. M., and SANE, P. V. 1962. JASSID RESISTANCE AND MORPHOLOGY OF COTTON LEAF. Indian Cotton Grow. Rev. 16: 324-327.

Lamina thickness was the character that had the highest correlation with jassid resistance of *Gossypium hirsutum* and *G. barbadense*. Other characters which influenced resistance were angle of insertion of leaf hair, length of hair, number of hairs per unit length of leaf veins, and hairs on the lamina.

(52) WANNAMAKER, W. K. 1957. THE EFFECT OF PLANT HAIRINESS OF COTTON STRAINS ON BOLL WEEVIL ATTACK. J. Econ. Ent. 50: 418-423.

Differences in the positions and characteristics of plant hairs in *Gossypium* spp. were discussed in relation to their possible importance in resistance to *Anthonomus grandis*. Resistance may be conditioned by hair length, density, and position.

(53) WESSLING, W. H. 1958. RESISTANCE TO BOLL WEEVIL IN MIXED POPULATIONS OF RESISTANT AND SUSCEPTIBLE COTTON PLANTS. J. Econ. Ent. 51: 502-506.

The reliability of resistance to attack by *Anthonomus grandis*, conferred by the mutant gene, H_2, was tested under different environmental conditions. The mutant *Gossypium* strain, Pilose, showed a significantly lower proportion of egg-laying punctures throughout the investigation.

(54) ———. 1958. GENOTYPIC REACTIONS TO BOLL WEEVIL ATTACK IN UPLAND COTTON. J. Econ. Ent. 51: 508-512.

Mutant lines of Upland cotton carrying any two of four mutant genes, H_1^-, H_2, gl, and R_1, were tested together with lines that have the same genetic background but that differ by opposite alleles to the genes under test. All mutant *Gossypium* lines tested showed varying degrees of resistance to attack by *Anthonomus grandis*.

CUCURBITACEAE

(55) EL KHIDIR, E. 1965. BIONOMICS ON THE COTTON WHITEFLY ("BEMISIA TABACI" GENN.) IN THE SUDAN, AND THE EFFECTS OF IRRIGATION ON POPULATION DENSITY OF WHITEFLIES. Sudan Agr. 1: 8-22. (R.A.E. 57: 231.)

Hairy leaves cucurbits and *Solanum melongena* L. caused irregularities of pupal margins of *Bemisia tabaci* and affected the number and distribution of the dorsal spines.

GRAPES

(56) PRINTZ, YA. I. 1937. [PESTS AND DISEASES OF GRAPES.] [In Russian.] Sel'. Khozgiz. (From Chesnokov 1953, p. 13. Complete reference listed under Wheat.)

The extent of downiness on leaves of *Vitis* spp. influenced the degree of infestation by the red spider (*Epitetranychus* sp.).

LUPINS

(57) WOGEREK, W., and DUNAJSKA, L. 1964. [THE MORPHOLOGY AND ANATOMY OF LUPIN VARIETIES RESISTANT AND NONRESISTANT TO THE PEA APHID "MACROSIPHUM PISUM."] [In Polish.] Biul. Inst. Ochr. Rośl. 27: 1-15. (R.A.E. 54: 511.)

Length and density of leaf hairs of *Lupinus* spp. were examined. There were few hairs on the highly susceptible variety. The resistant lines had dense pubescence, but it did not prevent access to the leaf surface by *Acyrthosiphon* (=*Macrosiphum*) *pisum* (Harris).

OATS

(58) ANDERSON, H. 1956. UNDERSÖKNINGAR RÖRANDE VANLIGA FRITFLUGAN. "OSCINELLA FRIT" (L.). Sver. Utsadesforen Tidskr. 66: 249-280. (From Peregrine and Catling. 1967.)

Hirsute shoot bases in *Avena* were associated with the resistance of *Oscinella frit* (L.).

(59) PEREGRINE, W. T. H., and CATLING, W. S. 1967. STUDIES ON RESISTANCE IN OATS TO THE FRIT FLY. Plant Pathol. 16: 170-175.

None of the forms of resistance to *Oscinella frit* (L.) in *Avena* found and investigated in this study merited incorporation into a breeding program.

PASSIFLORACEAE

(60) GILBERT, L. E. 1971. BUTTERFLY-PLANT COEVOLUTION: HAS "PASSIFLORA ADENOPODA" WON THE SELECTIONAL RACE WITH HELICONIINE BUTTERFLIES? Science 172: 585-586.

Hooklike trichomes of *Passiflora adenopoda* D.C. (=*acerifolia* Cham. et Schlecht.) provide a specific, absolute defense against butterfly larvae of *Heliconius erato* (L.) and *Heliconius melpomene* (L.). *See also* Natl. Geog. School Bul. No. 20., Feb. 14, 1972.

RICE

(61) PATANAKAMJORN, S., and PATHAK, M. D. 1967. VARIETAL RESISTANCE OF RICE TO THE ASIATIC RICE BORER, "CHILO SUPPRESSALIS" (LEPIDOPTERA: CRAMBIDAE), AND ITS ASSOCIATION WITH VARIOUS PLANT CHARACTERS. Ann. Ent. Soc. Amer. 60: 287-292.

In general, varieties of *Oryza sativa* L. less susceptible to infestation by *Chilo suppressalis* (Walker) were those with hairy upper lamina, tight leafsheath wrapping, small stem with a ridged surface, and thicker hypodermal layers.

(62) PATHAK, M. D., ANDRES, F., GALACGAC, N. and RAROS, R. 1971. RESISTANCE OF RICE VARIETIES TO STRIPED RICE BORERS. Int. Rice Res. Inst. (Los Baños) Tech. Bul. 11. 69 pp.

The resistance of 'TKM 6' to *Chilo suppressalis* was not lowered when hairs on the leaf blades of *Oryza sativa* L. were rubbed off with a wet cloth. This suggested that for 'TKM 6', the pubescent lamina was not a major influence on ovipositional preference.

SOLANACEAE

(63) ABERNATHY, C. O., and THURSTON, R. 1969. PLANT AGE IN RELATION TO THE RESISTANCE OF "NICOTIANA" TO THE GREEN PEACH APHID. J. Econ. Ent. 62: 1356-1359.

Because of the lack of toxicity of seedling and young plants, older *Nicotiana* plants should be used in screening tests for this type of resistance to the green peach aphid, *Myzus persicae* (Sulzer). Toxic exudates from certain trichomes of these plants increased in amount as the plants matured.

(64) AINA, O. J., RODRIGUEZ, J. G. and KNAVEL, D. E. 1972. CHARACTERIZING RESISTANCE TO "TETRANYCHUS URTICAE" KOCH IN TOMATO. J. Econ. Ent. 65: 641-643.

There was direct acaricidal action attributable to leaf hair exudate of *Lycopersicon.* This was verified by topical application of the exudate to mites.

(65) EL KHIDIR, E. 1965. TITLE AND COMMENTS UNDER CUCURBITACEAE.

(66) GENTILE, A. G., and STONER, A. K. 1968. RESISTANCE IN "LYCOPERSICON" AND "SOLANUM" SPECIES TO THE POTATO APHID. J. Econ. Ent. 61: 1152-1154.

Solanum pennellii Correll and segregates of five accessions of *Lycopersicon peruvianum* (L.) Mill. were resistant to *Macrosiphum euphorbiae* (Thomas) in the greenhouse. The entanglement of the aphids in the glandular hairs prevented colonization on *S. pennellii*, but physiological incompatibility appeared to be the reason that aphids failed to colonize the segregates of *L. peruvianum*, which have a sparse vesture of glandular hairs.

(67) ______. 1968. RESISTANCE IN "LYCOPERSICON" SPP. TO THE TOBACCO FLEA BEETLE. J. Econ. Ent. 61: 1347-1349.

Young leaves of *Lycopersicon* spp. were divested of exudate from glandular hairs by washing with 75 percent ethanol. These leaves and unwashed senescent leaves on older plants did not repel the tobacco flea beetle, *Epitrix hirtipennis* (Melsheimer).

(68) GENTILE, A. G., WEBB, R. E. and STONER, A. K. 1969. "LYCOPERSICON" AND "SOLANUM" SPP. RESISTANT TO THE CARMINE AND THE TWO-SPOTTED SPIDER MITE. J. Econ. Ent. 62: 834-836.

Tetranychus cinnabarinus (Boisduval) and *Tetranychus urticae* became entangled in the sticky exudate of the glandular hairs of *S. pennellii* and *L. hirsutum* Humb. & Bonpl. and *L. hirsutum f. glabratum* C. H. Mull.

(69) ______. 1968. RESISTANCE IN "LYCOPERSICON" AND "SOLANUM" TO GREENHOUSE WHITEFLIES. J. Econ. Ent. 61: 1355-1357.

The sticky exudate from glandular hairs of *S. pennellii* and *L. hirsutum* trapped adults of *Trialeurodes vaporariorum* (Westwood).

(70) GIBSON, R. W. 1971. GLANDULAR HAIRS PROVIDING RESISTANCE TO APHIDS IN CERTAIN WILD POTATO SPECIES. Ann. Appl. Biol. 68: 113-119.

Glandular hairs occur abundantly on *Solanum polyadenium* Grenm., *S. tarijense* Hawkes, and *S. berthaultii* Hawkes. The exudate impedes *Myzus persicae* and *Macrosiphum euphorbiae* movement and the aphids starve to death.

(71) GREENE, G. L., and THURSTON, R. 1971. OVIPOSITIONAL PREFERENCE OF "HELITHIS VIRESCENS" FOR NICOTIANA SPECIES. J. Econ. Ent. 64: 641-643.

In general, *Nicotiana* plants with an average of 250 or more eggs of *Heliothis virescens* had leaves with many protruding trichomes, and they were very villous.

(72) JOHNSON, B. 1956. THE INFLUENCE ON APHIDS OF THE GLANDULAR HAIRS ON TOMATO PLANTS. Plant Pathol. 5: 130-132.

Aphis craccivora and *Myzus persicae* did not generally become established on *Lycopersicon* because of some physiological incompatibility rather than to the physical effect of the glandular hairs. Some other species of aphids are capable of living on tomato plants.

(73) PARR, J. C., and THURSTON, R. 1968. TOXICITY OF "NICOTIANA" AND "PETUNIA" SPECIES TO LARVAE OF THE TOBACCO HORNWORM. J. Econ. Ent. 61: 1525-1531.

Forty-four species of *Nicotiana* and two species of *Petunia* were tested. Although some of the toxicity may be caused by the alkaloids inside the leaf which are ingested during feeding, much of the resistance to *Manduca sexta* (L.) (=(Johannson)) is believed caused by contact with alkaloids in the trichome secretions.

(74) REDDY, G., THURSTON, R. and DONOUGH, H. W. 1970. TRICHOME EXUDATES AS A MECHANISM FOR TRANSPORTING SOIL-APPLIED DISULFOTON TO LEAF SURFACES IN "NICOTIANA" SPECIES. J. Econ. Ent. 63: 2005-2006.

Data suggested that systemic insecticides might be translocated by this system to the surface of plants, thereby neutralizing the presumed harmlessness of soil treatments to predaceous insects.

(75) STONER, A. K. 1970. SELECTING TOMATOES RESISTANT TO SPIDER MITES. J. Amer. Soc. Hort. Sci. 95: 78-80.

Rapidly viewing plants of *Lycopersicon* spp. with the naked eye and saving those with the greatest concentration of glandular hairs was as effective a method of detecting those with resistance to *Tetranychus cinnabarinus* as randomly counting glandular hairs with the aid of a microscope.

(76) ——— FRANK, J. A. and GENTILE, A. G. 1968. THE RELATIONSHIP OF GLANDULAR HAIRS ON TOMATOES TO SPIDER MITE RESISTANCE. Amer. Soc. Hort. Sci. Proc. 93: 532-538.

The resistance of tomato varieties to *Tetrancychus cinnabarinus*, as measured by oviposition tests, was found to be associated with the number of glandular hairs on the leaves of *Lycopersicon* spp.

(77) THURSTON, R. 1970. TOXICITY OF TRICHOME EXUDATES OF "NICOTIANA" AND "PETUNIA" SPECIES TO TOBACCO HORNWORM LARVAE. J. Econ. Ent. 63: 272-274.

Removing the trichome exudates of *Nicotiana* by various washing methods reduced the toxicity of tobacco leaves to larvae of *Manduca sexta*.

(78) ——— SMITH, W. T. and COOPER, B. P. 1966. ALKALOID SECRETION OF TRICHOMES OF "NICOTIANA" SPECIES AND RESISTANCE TO APHIDS. Ent. Exp. Appl. 9: 428-432.

Nicotine, anabasine, and probably nornicotine were identified in the trichome secretions of various *Nicotiana* spp.

(79) ——— PARR, J. C. and SMITH, W. T. 1966. THE PHYLOGENY OF "NICOTIANA" AND RESISTANCE TO INSECTS. Fourth Int. Tobacco Sci. Congr. Proc., The Natl. Tobacco Board of Greece, Athens, pp. 424-430.

Adults and nymphs of *Myzus persicae* were killed by contact with such alkaloids as nicotine and anabasine, which are secreted by certain plant trichomes of *Nicotiana*. Small larvae of *Manduca sexta* were also killed by topical applications of these secretions.

(80) ——— and WEBSTER, J. A. 1962. TOXICITY OF "NICOTIANA GOSSEI" DOMIN TO "MYZUS PERSICAE" (SULZER). Ent. Exp. Appl. 5: 233-238.

Materials exuded from the leaf hairs of *Nicotiana* spp. were toxic to *Myzus persicae*, *Rhopalosiphum padi* (L.), and *Acyrthosiphon pisum* (Harris). The symptoms of such poisoning resemble those of nicotine poisoning.

SORGHUM

(81) BLUM, A. 1968. ANATOMICAL PHENOMENA IN SEEDLINGS OF SORGHUM VARIETIES RESISTANT TO SORGHUM SHOOT FLY ("ATHERIGONA VARIA SOCCATA"). Crop Sci. 8: 388-390.

The resistant cultivars of *Sorghum* possessed a much greater density of silica bodies (dumbbell-shaped, intercostal, and silicified prickle hairs) in the abaxial epidermis at the base of the first, second, and third leaf sheaths.

STRAWBERRIES

(82) KISHABA, A. N., VOTH, V. HOWLAND, A. F. and others. 1972. TWOSPOTTED SPIDER MITE RESISTANCE IN CALIFORNIA STRAWBERRIES. J. Econ. Ent. 65: 117-119.

Highly susceptible clones of *Fragaria* spp. appeared to be more pubescent than those that were less susceptible to *Tetranychus urticae*.

SUGARCANE

(83) AGARWAL, R. A. 1969. MORPHOLOGICAL CHARACTERISTICS OF SUGARCANE AND INSECT RESISTANCE. Ent. Exp. Appl. 12: 767-776.

Clones of *Saccharum* sp. with a low number of stomata and spines on their leaves and a small number of stomata on the stalks were susceptible to the whitefly (*Aleurolobus barodensis* (Maskell)) and the scale insect (*Melanaspis glomerata* (Green)).

(84) VERMA, S. C., and MATHUR, P. S. 1950. THE EPIDERMAL CHARACTERS OF SUGARCANE LEAF IN RELATION TO INSECT PESTS. Indian J. Agr. Sci. 20: 387-389.

Varieties of *Saccharum* sp. with high spine density along the lower surface of the leaf midribs were less susceptible to attack by larvae of *Scirpophaga nivella* (F.) than varieties with less spine density.

WHEAT

(85) CHESNOKOV, P. G. 1934. [FRIT FLY RESISTANCE IN WHEAT], IN VAVILOV, N. I. [SELECTED WRITINGS OF N. I. VAVILOV. THE ORIGIN, VARIATION, IMMUNITY AND BREEDING OF CULTIVATED PLANTS.] (Translated from Russian by C. K. Starr.) Chronica Botanica 13: 149.

Triticum timopheevii (Zhuk.), distinguished by the high degree of hairiness of its leaves and leaf sheaths, was highly resistant to *Oscinella frit* in heavy fly infestations in the Maikopsk Region of North Caucasus.

(86) ______. 1953. [METHODS OF INVESTIGATING PLANT RESISTANCE TO PESTS.] (Translated from Russian.) Published for the Natl. Sci. Found., Washington, D.C. by the Israel Program for Sci. Translations, Jerusalem, p. 13.

Varieties of *Triticum* with a smooth, hairless leaf-blade surface are unfavorable for oviposition by *Mayetiola destructor* (Say).

(87) GALLUN, R. L., ROBERTS, J. J., FINNEY, R. E. and PATTERSON, F. L. 1973. LEAF PUBESCENCE OF FIELD GROWN WHEAT: A DETERRENT TO OVIPOSITION BY THE CEREAL LEAF BEETLE. J. Environ. Qual. 2: 333-334.

Leaf pubescence, a deterrent to oviposition by *Oulema melanopus* (L.), is being bred into wheats in an attempt to replace insecticides as a means of controlling damage by this insect. On the basis of number of eggs per 30.5 meters of drill row, each of three pubescent Purdue lines reduced the number of eggs laid and the number of damaged leaves at least 94 percent compared with a less pubescent cultivar, 'Arthur'.

(88) ______ RUPPEL, R. and EVERSON, E. H. 1966. RESISTANCE OF SMALL GRAINS TO THE CEREAL LEAF BEETLE. J. Econ. Ent. 59: 827-829.

Wheats with highly pubescent leaves were largely avoided for oviposition. A 14-chromosome wheat, *Triticum persicum fuliginosum* Vavilov, with highly pubescent leaves, had great resistance to *Oulema melanopus* (L.).

(89) MILLER, B. S., ROBINSON, R. J., JOHNSON, J. A. and others. 1960. STUDIES ON THE RELATION BETWEEN SILICA IN WHEAT PLANTS AND RESISTANCE TO HESSIAN FLY ATTACK. J. Econ. Ent. 53: 995-999.

Certain varieties of *Triticum* had silicified hairs on the surface of the sheath, and most of these varieties were susceptible to attack by *Mayetiola destructor*.

(90) RINGLUND, K. 1970. TYPES OF RESISTANCE TO INSECTS IN SMALL GRAINS. Europe. Mediterranean Plant Protect. Organ. Pub. Ser. A54: 37-43. *See* Ringlund and Everson, 1968.

(91) ______ and EVERSON, E. H. 1968. LEAF PUBESCENCE IN COMMON WHEAT, "TRITICUM AESTIVUM" L., AND RESISTANCE TO THE CEREAL LEAF BEETLE, "OULEMA MELANOPUS" (L.). Crop Sci. 8: 705-710.

Leaf surface pubescence in *Triticum aestivum* L., was quantitatively inherited; the gene action estimated on the square root scale was mainly additive.

(92) SAKHAROV, N. L. 1923. [NATURE OF RESISTANCE OF SOME FORMS OF WHEAT IN RELATION TO ATTACK BY THE SPRING FLY ("ADIA GENITALIS" SCHNABL.).] [In Russian.] Zh. Opyt. Agron. Yugovost. 2 (1). *In* Vavilov, N. I. [Selected Writings of N. I. Vavilov. The Origin, Variation, Immunity and Breeding of Cultivated Plants.] (Translated from Russian by C. K. Starr.) Chronica Botanica 13: 149.

Hairiness of wheat (*Triticum* sp.) leaves favored the attack of the spring fly, *Hylemya* (= *Phorbia*) *genitalis* Schnabl.

(93) SCHILLINGER, J. A. 1966. LARVAL GROWTH AS A METHOD OF SCREENING "TRITICUM" SP. FOR RESISTANCE TO THE CEREAL LEAF BEETLE. J. Econ. Ent. 59: 1163-1166.

All highly resistant accessions of *Triticum dicoccum* Schrank were pubescent, but this pubescence varied in density and size of hairs. Pubescent leaf surface, per se, was not the sole factor in resistance to *Oulema melanopus*; very susceptible pubescent accessions of *Triticum dicoccum* also were found.

(94) ______. 1969. THREE LABORATORY TECHNIQUES FOR SCREENING SMALL GRAINS FOR RESISTANCE TO THE CEREAL LEAF BEETLE. J. Econ. Ent. 62: 360-363.

Larval survival of *Oulema melanopus* on resistant *Triticum* lines after 3 days was significantly reduced, and larval weights were significantly lower on very resistant wheat. Seedlings of the pubescent wheat line, CI 8519, were least preferred for oviposition.

(95) ______ and GALLUN, R. L. 1968. LEAF PUBESCENCE OF WHEAT AS A DETERRENT TO THE CEREAL LEAF BEETLE, "OULEMA MELANOPUS." Ann. Ent. Soc. Amer. 61: 900-903.

Densely pubescent wheat (*Triticum* sp.) was almost entirely avoided for oviposition by *Oulema melanopus*. The number of eggs laid on plants was significantly less for each increase in level of pubescence.

(96) SMITH, D. H., JR., NINAN, T., RATHKE, E. and CRESS, C. E. 1971. WEIGHT GAIN OF CEREAL LEAF BEETLE LARVAE ON NORMAL AND INDUCED LEAF PUBESCENCE. Crop Sci. 11: 639-641.

Triticum aestivum L. germinated and grown in closed petri dishes had leaves with more pubescence than wheat grown under natural conditions. Larval weight gain of *Oulema melanopus* was significantly lower on these plants compared with the control plants.

(97) VAVILOV, N. I. 1951. RESISTANCE IN WHEAT TO "LEMA MELANOPA". *In* Vavilov, N. I. Selected Writings of N. I. Vavilov. The Origin, Variation, Immunity and Breeding of Cultivated Plants. (Translated from Russian by C. K. Starr.) Chronica Botanica 13: 147.

Hairy lines of *Triticum* were attacked less by *Oulema melanopus* than smooth-leaved forms according to V. A. Megalov.

(98) WEBSTER, J. A., and SMITH, JR., D. H. 1971. SEEDLINGS USED TO EVALUATE RESISTANCE TO THE CEREAL LEAF BEETLE. J. Econ. Ent. 64: 925-928.

Small grain seedlings were tested in the laboratory for resistance to *Oulema melanopus* by exposing plants to prediapause adults. Very pubescent wheat lines had little seedling mortality; less pubescent *Triticum* lines and smooth-leaved *Avena* and *Hordeum* lines were damaged extensively.

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(99) ——— Smith, Jr., D. H., and Lee, C. 1972. REDUCTION IN YIELD OF SPRING WHEAT CAUSED BY CEREAL LEAF BEETLES. J. Econ. Ent. 65: 832-835.

Yield loss (percentage basis) caused by *Oulema melanopus* indicated the superiority of pubescent *Triticum* lines for resistance to this insect.

(100) ——— Gage, S. H. and Smith, Jr., D. H. 1973. SUPPRESSION OF THE CEREAL LEAF BEETLE WITH RESISTANT WHEAT. Environ. Ent. 2: 1089-1091.

Oulema melanopus egg input and summer adult emergence per unit area were considerably lower in field plots of *Triticum aestivum* with densely pubescent leaf surfaces, than in plots where *T. aestivum* plants had much less leaf surface pubescence.

(101) Wellso, S. G. 1973. CEREAL LEAF BEETLE LARVAL FEEDING, ORIENTATION, DEVELOPMENT, AND SURVIVAL ON FOUR SMALL GRAIN CULTIVARS IN THE LABORATORY. Ann. Ent. Soc. Amer. 66: 1201-1208.

Survival of *Oulema melanopus* from first-instar larva to the adult stage was considerably lower on CI 8519 wheat (*Triticum aestivum* L.), than on 'Genesee' wheat (*T. aestivum*), 'Clintland 64' oats (Avena sativa L.), or 'Hudson' barley (*Hordeum vulgare* L. Emend. Lam.). The length and density of trichomes of CI 8519 were much greater than those of the other three hosts. Larval survival appeared to be related to physical factors rather than nutritional deficiencies.

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