LYGUS BUG RESISTANT

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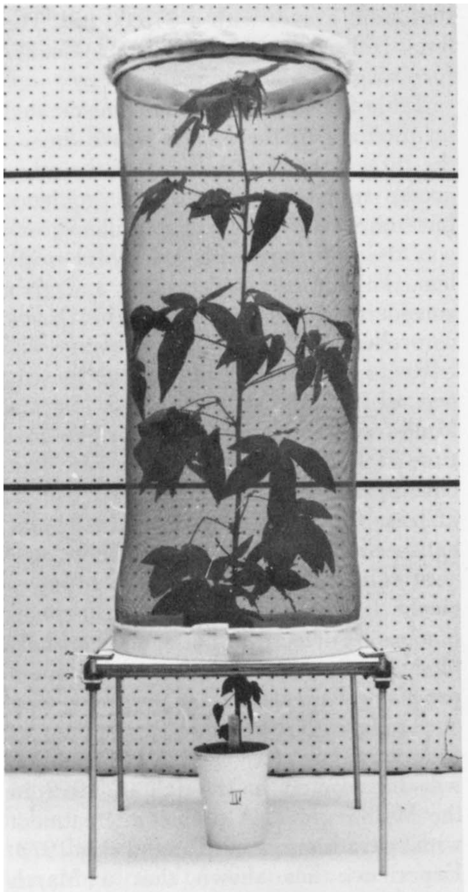

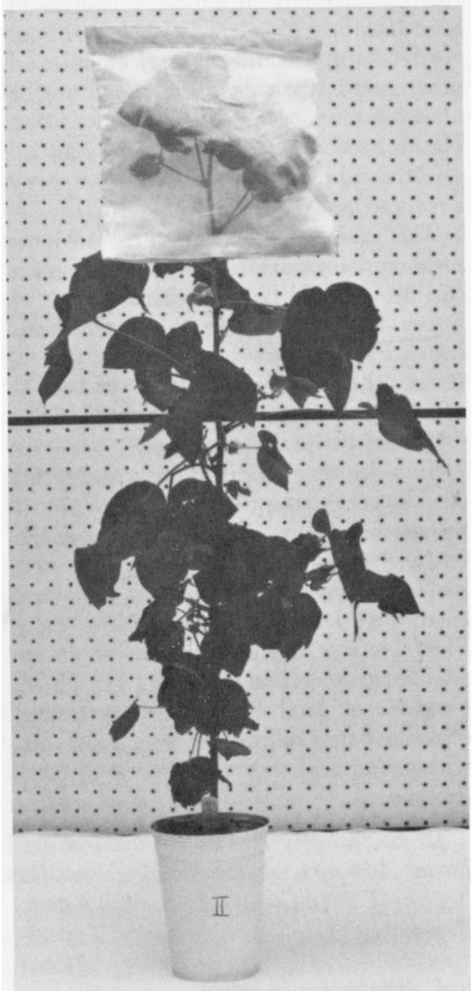

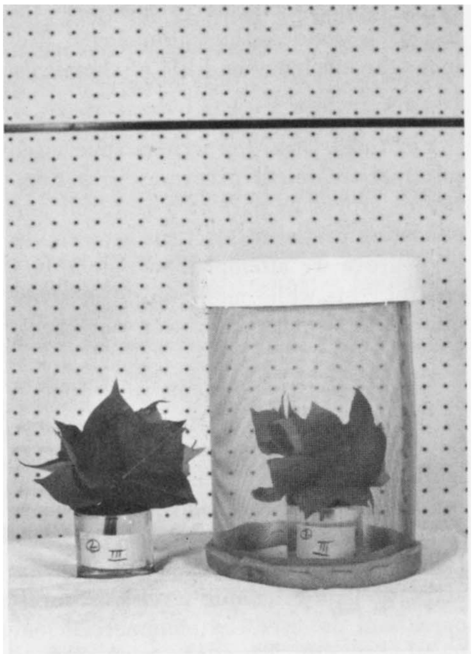

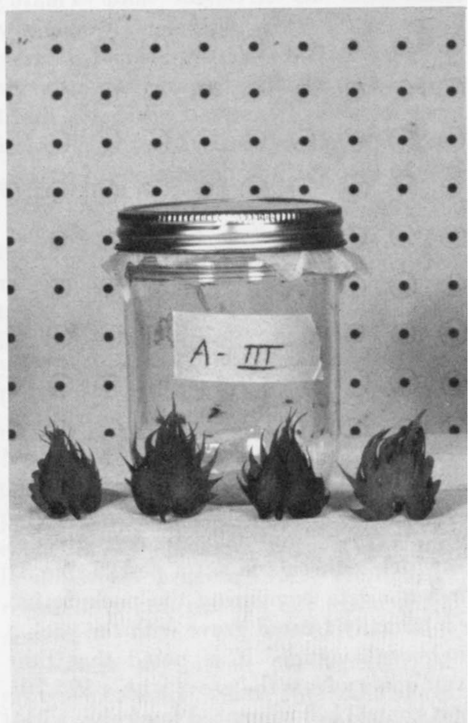

Photos show methods used to determine cotton variety impact on lygus bugs: top left, whole plant; lower left, terminal sleeve; top right, leaf bouquet cages used to determine egg laying preferences; lower right, detached squares and fruit jar cage used to determine cotton variety impact on bug growth.

LYGUS BUGS are serious pests of cultivated crops throughout the world. In California, they are especially destructive to alfalfa, beans, cotton, safflower, strawberries, and sugarbeets. In cotton, feeding of *Lygus hesperus* Knight often damages the floral parts, causing incomplete pollination or shedding of floral buds (squares). Depressed yields, reduced lint quality, and lateness of maturity can result from such injury.

Control of lygus bugs in cotton has traditionally depended on chemical pesticides, which have often led in turn to insecticide-resistant populations of bugs and to secondary outbreaks of lepidopterous pests and spider mites. Since alfalfa is a preferred lygus bug host, specialists have recently advocated strip-harvesting or interplanting of alfalfa in cotton fields, to reduce plant bug damage. Growers, however, have not generally accepted this technique, because it requires special care in irrigation and harvesting.

Planting resistant varieties has become an increasingly important aspect of insect management. The practical value of this approach has recently been demonstrated in California where alfalfa varieties resistant to the spotted alfalfa aphid have been grown. In most of these plantings, the need for chemical treatment for this insect was significantly reduced. The use of resistant varieties has two particular advantages: the effect of a resistant plant on an insect is generally specific for the insect, and the effect persists generation after generation, year after year. These specific and persistent effects contrast sharply with the indiscriminate, decreasing effectiveness of most insecticides. Other benefits include: (1) no residues toxic to man, livestock, wildlife, and beneficial insects; (2) low cost to the farmer; and (3) compatability with other control measures.

TABLE 1. MEAN NUMBER* OF LYGUS NYMPHS HATCHING FROM EIGHT COTTON GENOTYPES USING FOUR METHODS OF ELICITING EGG LAYING. SHAFTER, CA—1972.

FREE-CHOICE		NO-CHOICE					
		Whole plants		Leaf bouquets		Plant terminals	
Entry	$\bar{x}$	Entry	$\bar{x}$	Entry	$\bar{x}$	Entry	$\bar{x}$
247-1-6	5.21a	247-1-6	6.19a	247-1-6	16.71a	247-1-6	5.49a
NM1517V	5.31a	N0097	9.41ab	Stoneville 7A frego	28.58ab	Stoneville 7A frego	10.27ab
Acala SJ-1	9.40b	X771/Y5g	21.27c	Deltapine 14 frego	28.59ab	Super okra leaf	11.11ab
N0097	14.36bc	NM1517V	13.35b	Super okra leaf	29.65ab	Deltapine 14 frego	15.97b
X771/Y5g	10.00ab	Acala SJ-1	16.44b	Acala SJ-1	42.18b	Acala SJ-1	19.47b

* Means followed by the same letter(s) are not significantly different, $P = 0.05$ (Duncan's Multiple Range test).

In 1970, researchers of University of California (Davis) and U. S. Department of Agriculture at the U. S. Cotton Research Station in Shafter, initiated studies to identify and characterize resistance in cotton to lygus bugs. This research, supported in part by a grant from the Rockefeller Foundation, has involved screening over 175 experimental lines, varieties, and species of cotton, *Gossypium* spp., for resistance to lygus bugs. These cottons represent a genetically diverse group of commercial, obsolete, and uncultivated genotypes from around the world.

Lygus host plants

Cotton is not a preferred host of the lygus bug in California. This insect typically overwinters on native vegetation, weeds, and alfalfa. Migration from these hosts to adjacent cultivated crops such as safflower may occur in the spring. Bug populations normally increase as the season progresses, but a significant migration to cotton occurs only when the previous hosts are unavailable. Once on cotton, however, females usually lay eggs. Nymphs hatching from these eggs are largely restricted to the cotton plant where they feed and grow to maturity, often causing damage.

To be resistant to lygus bugs, a cotton genotype might lack the specific chemical or mechanical stimuli which allow females to recognize the plants as suitable for egg laying. Or the genotype might adversely affect the insect's growth, by a lack of proper nutrients, for example. The first type of resistance, unsuitability for egg laying, leads to nonpreference by the insect. Nonpreference for egg laying could reduce the impact of bug migration into cotton plantings from other hosts by minimizing the rate of population increase.

Several methods were used to determine varietal effects on lygus bug egg laying. In free-choice laying tests, female bugs were enclosed with cotton plants of different varieties in a cylindrical wire mesh cage. In no-choice tests, females were confined with wire mesh cages on plants or bouquets of excised leaves of a single variety, or held on plant terminals with organdy sleeve cages. Eggs were allowed to hatch, and nymphs were counted to estimate egg laying.

One experimental line 247-1-6, whose parent has been reported resistant to bollworm, *Heliothis zea* (Boddie) and tobacco budworm, *H. virescens* (F.) by workers in Texas and Mississippi, had significantly fewer eggs than the Acala-SJ-1 check in all tests (table 1). The overall level of egg laying, computed collectively for all four methods, was approximately 60% less on 247-1-6 than on SJ-1. The relatively poor agronomic qualities of 247-1-6, however, require that it be considered only as a possible source of resistance for breeding purposes. Nevertheless, the results of this study suggest that its oviposition-depressing characteristics could have a considerable impact on lygus bug suppression when moved into a more productive background.

TABLE 2. AVERAGE ADULT WEIGHT OF LYGUS BUGS REARED ON EXCISED SQUARES OF NINE COTTON GENOTYPES. SHAFTER, CA – 1972.

Entry	$\bar{x}$ (mg)
Pima S-3	2.83*
N0095	4.36
Acala SJ-1	5.27
247-1-6	5.77
Texas 27xM8-1-21	6.86*
Super okra leaf	7.67*
Deltapine 14 frego	7.78*
T 859	8.22*
Stoneville 7A	8.27*

* Means are significantly different from that of Acala SJ-1, $P = 0.05$ (Student t test).

In another type of plant resistance, a cotton genotype might lack *Lygus* feeding stimulants, contain toxic substances, lack specific nutrients, or contain an imbalance of nutrients required for normal growth and development of this insect. Like nonpreference for egg laying, this resistance mechanism could also be important in reducing the population of lygus bugs in cotton.

Varietal effect on growth of lygus bugs was studied in the laboratory by rearing young bugs to adulthood on clipped squares of various genotypes. The results shown in table 2 indicated that lygus bugs reared on Pima S-3, a commercial long staple cotton, had lower adult weights than bugs reared on Acala SJ-1. Five genotypes were more susceptible than the Acala standard: Texas 27 × M8-1-21, Super okra leaf, Deltapine 14 frego, T859, and Stoneville 7A. Subsequent studies, using improved rearing methods, have suggested that the reduction in weight may be associated with a decreased rate of nymphal growth on the long-staple cotton. This mode of resistance could be related to the relative lack of plant bug damage observed in an obsolete variety of Pima cotton by workers in Arizona as early as 1939.

These preliminary findings suggest that certain cotton genotypes exert depressive effects on the egg laying behavior and growth of lygus bugs. In assessing their usefulness in reducing *Lygus* damage, however, the yield, vigor and quality responses of the genotypes must be considered. A line which sustains relatively severe injury at low lygus bug levels would be inferior to one which sustains less damage in spite of a greater bug population. Consequently, at least two aspects of the lygus-cotton relationship must be evaluated in determining the value of a particular mode of resistance: (1) the effect of the plant on the insect's behavior and growth; and (2) the effect of the insect on the plant's growth, fruiting patterns, and yield. Both relationships will be intensively investigated in future lygus bug resistance studies at Shafter.

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