Studies of Damage to Safflower by

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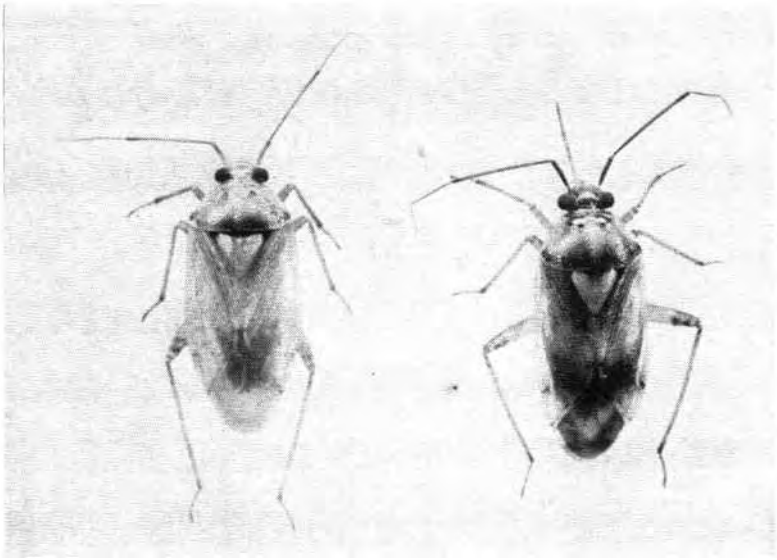


Lygus bug adults—female to left, male to right.

THIS DETAILED study of injury to safflower plants by thrips and lygus bugs was conducted to establish the economic thresholds of damage. Previous studies indicated that the western flower thrips *Frankliniella occidentalis* (Pergande), severely damages safflower buds; that the numbers of lygus bugs must be quite high to cause economic bud losses; and that safflower plants have extraordinary compensatory powers. The additional experiments reported here show more detailed information on numbers of thrips and lygus bugs required to cause material damage to safflower plants, the type of injury caused, and the recuperative ability of this plant.

Adult flower thrips.

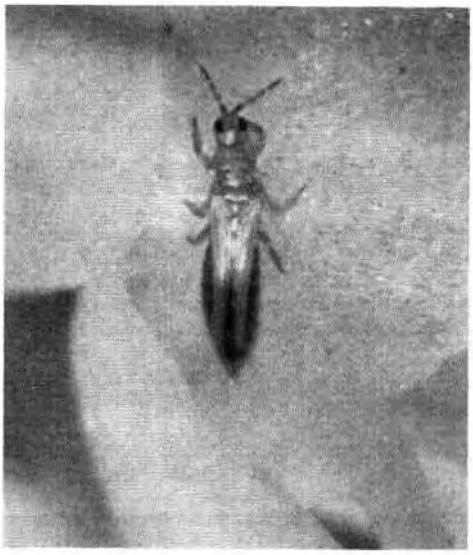


TABLE 1. EFFECTS OF FLOWER THRIPS ON SAFFLOWER BUDS ENCLOSED IN CAGES, DAVIS, 1963

No. of thrips introduced per bud	Max. no. of nymphs developed per bud	Averaged production values*			
		Seed heads	Diameter of seed heads	Seeds per seed head	Weight of seeds per seed head
		No.	Inches	No.	Gm.
0	0	2.0 b	0.89 c	22.7 c	1.08 c
5	30	2.0 b	0.92 c	22.3 c	1.03 c
10	75	1.8 ab	0.75 bc	18.7 bc	0.78 bc
20	150	1.5 a	0.54 a	8.9 a	0.33 a
40	300	1.2 a	0.58 ab	10.8 ab	0.45 ab

* Duration of test—34 days. Numbers which have a letter in common are not significantly different at the 5% level according to Duncan's multiple range test. (This criterion of difference is used also in tables 2 and 3.)

Small cloth cages (left) and large cages (right) for thrips and lygus injury studies on safflower.

Thrips injury

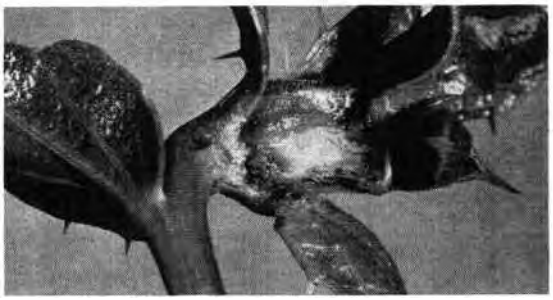
Adults of the western flower thrips, *Frankliniella occidentalis* (Pergande) (photo above), were introduced into small cloth field cages, each enclosing two safflower buds (photo left). Numbers of buds were kept constant, and thrips were placed into cages at the rates of 0, 5, 10, 20, and 40 thrips per bud, with 10 replications for each rate. The data given in table 1 show that the introduction of 5 or 10 thrips per bud did not cause a significant decrease in numbers of buds, seed

Thrips and Lygus Bugs

Trials with western flower thrips confined on growing safflower buds for 34 days demonstrated that the buds are able to tolerate numbers of nymphal thrips averaging as high as 75 per bud (when cages were initially injected with 10 adults per bud) without any significant drop in seed production. However, infestations that had started with 20 or 40 adults per bud did significantly decrease the number of good seed heads produced, the number of seeds per head, and the total yield. Trials with lygus bugs, Lygus hesperus Knight, indicated that the threshold of economic damage to the safflower crop was exceeded when the ratio of bugs to buds exceeded 1-to-8. Significant decreases in yield criteria were obtained when the bug-to-bud ratios were adjusted to 1-to-4 or higher. A new stripe, or thin-hulled, variety appeared to be more susceptible to injury by lygus bugs than the variety U. S. 10.

head diameters, numbers of seeds per head, or seed yield. However, 10 adults, resulting in a maximum of 75 nymphs per bud toward the end of the test, did cause reductions approaching economic significance. A very significant reduction in each of these values occurred when 20 or 40 thrips per bud were introduced—resulting in as many as 150 and 300 nymphs per bud, respectively.

Field cage and survey work has demonstrated that the only practical method of determining the severity of thrips damage to safflower was by a prebloom count of damaged buds. The upright, bronzed, and blasted buds due to thrips feeding (photo below) were easily discernible, and could be counted from a random selection of a standard number of buds per plot. The average percentage of bud blasting obtained indicated that the economic threshold of about 75 nymphs per bud occurred when 25% to 30% of the buds were blasted.



Bud damage to safflower from lygus bugs, above, and safflower bud damage from thrips, to left.

Lygus bug damage

Buds of the safflower variety U.S. 10 were covered with 3 × 6 inch cloth cages in early spring (May), and the desired number of buds were kept constant thereafter by manually destroying all new buds as they developed. Male lygus bugs of the species *Lygus hesperus* Knight (see photo on opposite page), were introduced into cages and replaced as needed to keep the numbers constant for a period of 26 days. The data in table 2 show that two lygus bugs per bud destroyed 100% of the buds and no heads or seeds developed. One lygus bug per bud resulted in 90% bud loss and practically no seed development. One lygus bug per two buds blasted 80% of the buds and very significantly reduced the diameter of the remaining seed heads, the number of seeds, and the seed yield. One lygus bug per four buds caused a 75% head loss and a significant reduction of seed yield; but this ratio did not result in a significant decrease in head diameter or seed numbers. The 1-to-4 ratio was just below the threshold of economic damage. There were noticeable reductions of all measurable head and seed criteria, but only the loss of seed weight was serious. A ratio of

Defoliated safflower plant, left below, and normal plant, right.

TABLE 2. EFFECTS OF LYGUS BUGS ON SAFFLOWER BUDS ENCLOSED IN SMALL CAGES, DAVIS, 1963

Ratios of lygus bugs to plant buds	Averaged production values*			
	Reduction in number of seed heads	Diameter of seed heads	Seeds per seed head	Weight of seeds per seed head
	%	Inches	No.	Gm.
2/1	100.0	0.00 a	0.0 a	0.00 a
1/1	90.0	0.06 ab	0.3 ab	0.01 a
1/2	80.0	0.25 b	7.1 b	0.22 ab
1/4	75.0	0.49 c	15.3 c	0.46 bc
1/8	26.0	0.67 c	15.6 c	0.51 cd
0/2 (ck.)	0.0	0.71 c	21.2 c	0.75 d

* Exposure to lygus bugs was continued for 26 days, at which time the seed heads were beginning to mature. Viability of the small amount of seed obtained in the higher yields varied from 85.1 to 100%, with the check averaging 91.6%. No meaningful differences in germination were noted.

1-to-8 reduced the numbers of buds by only 26%, and caused no other significant loss. None of the bug-to-bud ratios decreased the size or viability of seeds. Data from another experiment on one of the new, thin-hulled stripe varieties of safflower showed that it may be more sensitive to the feeding of lygus bugs and suffer a greater seed loss.

All of the experimental evidence obtained to date show that dense populations of lygus bugs must be present to cause important bud blasting (table 2) and economic loss of seed. Serious seed losses occur only when 60 or more lygus bugs per sweep are present (equivalent to 1 lygus per 4 buds). Treatment with insecticides does not appear to be worth while until 25 to 30 lygus bugs per sweep can be taken (a ratio of 1 lygus per 8 buds).

Plant compensation

An investigation was also made to determine what correlation, if any, exists between seed yield and bud loss due to insect feeding. An evaluation was made of the effect of reducing the number of buds, seed heads, or the amount of foliage on the production of seeds (numbers, size, viability, and yield).

The data from the prebloom disbudding, deheading, and defoliation experiment (table 3) showed that 50% disbudding caused very little decrease in seed head development. Removal of 100% of the buds (leaving only the large seed heads) significantly reduced the number of seed heads finally produced. However, this was accompanied by a significant increase in the diameters of seed heads, the weight and number of seeds per head, and in the size of seeds—resulting in no reduction in the final yield of seed. The variety U.S. 10 thus appeared to sustain a 100% loss of buds prior to onset of bloom and yet produce a normal yield of seed.

When 100% of both buds and seed heads were destroyed before bloom, the final seed yield and viability of those seeds finally produced was significantly reduced. Complete defoliation at this time (lower photo, page 3) also seriously impaired seed production. Results of a similar experiment begun two weeks later (at onset of bloom) are also included in table 3, and showed that disbudding and deheading at this late date caused even greater head and seed losses. Loss of both buds and heads at this stage was so severe that the plants could produce very few heads, and seed yields, size, and viability were seriously affected.

The recuperative ability of this variety was clearly demonstrated. The results agree very well with field work in demonstrating that moderate infestations of thrips and lygus bugs do not appreciably depress yields of safflower seed. Economically significant seed losses related to insect feeding and blasting of buds were not evident until very high numbers of insects were present and bud losses were between 38 and 45%.

Insecticides

The effect insecticidal control of thrips and lygus bugs might have on plant damage and seed yield was also investigated. Periodic samplings of the insect populations within the field plots on the variety U.S. 10 indicated that all of the pesticides applied prior to the onset of bloom gave excellent control of the lygus bugs, but only a fair degree of reduction in numbers of flower thrips. Very large percentages of the buds showed symptoms of injury attributable to either or both of these pests. The damage attributable to flower thrips, and classified as severe (browned, blasted, or dead buds), was greatly reduced in each of the spray plots. Severe damage to buds by lygus bugs amounted to approximately 1% and was not obviously reduced by any of the sprays.

Although the amount of severe bud damage due to thrips was greatly reduced by the insecticides, there were no corresponding increases in the crop production estimates. In this trial, the amount of severe bud damage—as high as 32%—was below the 50% allowable level and little benefit was obtained by spraying.

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TABLE 3. THE EFFECTS OF DISBUDDING, DEHEADING, AND DEFOLIATION ON SAFFLOWER PLANTS, DAVIS, 1963

Treatments	Averaged production values				
	Number of good seed heads per plant	Diameter of seed heads in inches	Weight of seeds per seed head in grams	Weight of seeds per plant in grams	Weight of 100 seeds in grams
	Treated 13 days before bloom*				
Check	38.8 c	0.94 b	1.31 b	48.5 b	3.76 b
50% Disbudded	32.5 bc	0.97 bc	1.53 b	49.9 b	3.74 b
100% Disbudded	20.0 a	1.09 c	2.42 c	48.3 b	4.85 a
100% Disbudded + Deheaded	21.1 a	0.80 ab	1.08 ab	21.8 a	3.75 b
100% Defoliated	25.5 ab	0.72 a	0.77 a	19.9 a	3.26 bc
	Treated at the onset of bloom†				
Check	40.5 d	0.94 b	1.37 b	54.8 c	3.95 b
50% Disbudded	27.6 c	0.95 b	1.67 bc	46.0 bc	4.39 b
100% Disbudded	15.5 b	0.99 b	2.27 c	35.5 b	4.37 b
100% Disbudded + Deheaded	5.2 a	0.21 a	0.36 a	2.2 a	1.70 a

* At this time the correct percentages of buds, seeds, and foliage per plant were adjusted according to plan.

† The plants were 10% into bloom when the given manipulations were made.

EASTER LILIES GROW TALLER AT CLOSER SPACING

IT HAS BEEN observed in previous studies that Easter lilies grow taller at lower light intensities. From data recently collected at the Los Angeles campus, it was also found that closer spacing is equivalent to lower light intensity insofar as height is concerned. The data summarized in the graph indicate that plants from commercial-size bulbs were of minimum height when 100 sq inches or more were allowed per plant. At higher light intensities, this critical value would be expected to be lower and at lower intensities, higher.—*Harry C. Kohl, Jr., and R. L. Nelson, Department of Landscape Horticulture, University of California, Davis.*

EFFECT OF PLANT SPACING ON STEM LENGTH OF EASTER LILIES