Basic elements of an experimental, selective, mechanical harvester for cantaloupes, shown in the Department of Vegetable Crops field plots at Davis. The melons deposited at the edge of the bed here would be elevated on a multi-row prototype harvester and deposited in containers.

and mechanically training the vines laterally across the beds so as to facilitate harvesting. The actual harvest of the mature melons is accomplished by lifting vines and melons on a sloping rubber cleated conveyor belt which is cantilevered under the vines from the side opposite the trunk and roots. As the vines with melons are lifted, a tension force is applied on the melon-vine abscission layer by friction between the belt and melon. An additional separating force is applied by gravity as a series of small parallel belts passes under and supports the vines while the mature melons drop.

These two removal forces take nearly all the mature fruit from the vines. Fruit removed from the vines is recovered by means of a cross conveyor under the rear separating belts and is conveyed to the side for subsequent sorting and handling. The immature fruit is carried over and laid down with the vines in almost their original position until the next harvest.

Three plots of six rows each were harvested during the 1963 season. Harvesting data show that 96% of the harvestable melons were removed without damage, but nearly 20% of the remaining immature fruits showed some damage in successive harvests. Recovery of salable fruits varied from 25 to 10% less than by hand harvesting. However, the numerous changes made in the machine elements during the tests make the significance of this data questionable.

At this point it appears that selective mechanical harvesting of cantaloupes is possible. It is not possible to predict field capacity, however. Further machine development and cultural changes need to be made. The number of pickings must be reduced below those presently made by hand harvesting to aid the economics of the system. Time of planting, irrigation, fertilization and weed control practices will also be important factors in mechanizing the cantaloupe harvest.

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Strip Cutting LYGUS BUG

V. M. STERN

This progress report of research indicates lygus bug control is possible by strip cutting alfalfa to keep the bugs in the alfalfa where they do little harm, and allow survival of natural enemies. Further investigations are necessary, particularly on the agronomic, economic and long-range ecological aspects of strip cutting, before the pros and cons of this harvesting method can be fully evaluated. However, the end result could well be a very considerable saving to California farmers, and perhaps even more importantly, a significant reduction in pesticide hazard problems.

LYGUS BUGS are among the most destructive insect pests in California. They attack a wide variety of crops, including cotton, many seed crops, beans, pears and strawberries. In 1961, crop losses caused by these bugs in California were estimated at $13½ million, and about $5 million were spent for chemical control. Lygus bugs are particularly injurious because they attack the reproductive parts of the plants, that is, the flowers, bolls, seeds and fruit.

There are three injurious lygus species in California. However, *Lygus hesperus* Knight is by far the predominant species in most agricultural areas. Lygus can reproduce on a variety of wild and cultivated plant species. However, in many areas alfalfa is the key breeding place and overwintering habitat. During favorable periods, lygus populations increase to great numbers in this crop.

An important feature of the lygus problem is that they are very rarely a pest of alfalfa hay. However, when the alfalfa is cut, the adults fly to adjoining crops and to prevent crop loss, chemical treatments are often necessary to suppress the invading pest.

Since alfalfa is a key crop in California agriculture, it would be impossible to eliminate alfalfa as a means of reducing lygus populations. The problem then is how to stabilize the alfalfa hay environment to prevent or lower the probability of lygus adults leaving the alfalfa habitat where they do little or no damage.

Alfalfa for CONTROL

R. VAN DEN BOSCH • T. F. LEIGH

During the ravaging era of the spotted alfalfa aphid, University scientists found that natural enemies of the aphid tended to remain in alfalfa hay and survive in greater numbers if the fields were not completely harvested at one time. Much better biological control of the aphid was obtained in strip-cut fields than in solid-cut fields. These results suggested the possibility that the strip-cut harvesting technique might reduce or eliminate lygus migrations from alfalfa into adjoining crops at each cutting time. If successful, reductions could be made in the need for chemical control measures against lygus; the chemical residue problems on alfalfa hay caused by drift; the air and water pollution problems; and the development of resistance of insects and mites to insecticides could be delayed. Studies reported here were started in 1963 at the W. B. Camp and Sons, Fox and Williams Farms and Sill Properties Inc. ranches in Kern County. In these experiments, pest and natural enemy population trends were analyzed in both strip- and solid-cut fields.

Under the strip-cutting technique, the alfalfa is harvested in alternate strips so that two different-aged hay growths occur in a field simultaneously, as shown in the schematic diagram. When one set of strips is cut, the alternate strips are about half grown and thus the field is never completely bare of hay. The field becomes a rather stable environment and the insects remain or move to the standing alfalfa strips, instead of leaving or perishing at cutting time. When the hay is cut, under normal harvesting practice, the entire field is suddenly laid bare and this has a catastrophic effect on the insect populations. Many of the insects die quickly because of direct exposure to the sun and unfavorable humidity conditions. However, lygus adults, being strong fliers, simply take flight and move into the shelter of adjoining crops. These migrations are often massive and very frequently produce severely damaging infestations in such crops as cotton, beans, and tree fruits.

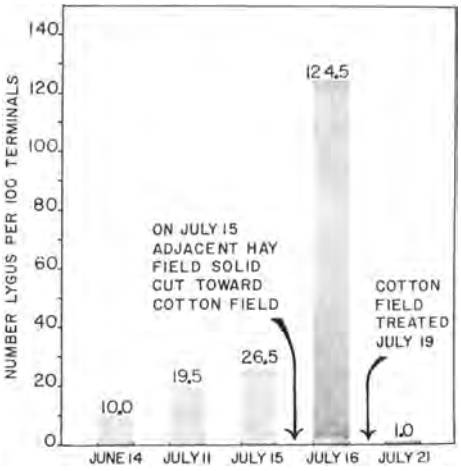
Two fields were selected for this 1963 study, from 1,200 acres of strip-cut alfalfa at the W. B. Camp & Sons ranch in Kern County. In one field of 160 acres, the alternate strips were three borders or 150 ft in width, and in the second field of 60 acres, the strips were five borders or 125 ft in width. Both fields contained 12 strips, but only eight strips were sampled for insects in each field.

Beginning with the second cutting, every other alternate strip was cut. Then, 14 days later when this first-cut alfalfa was about half grown, the uncut strips were harvested. This alternate harvesting technique continued throughout the season until sheep were placed in the fields in late fall. During irrigating and harvesting, the two sets of strips in each field were farmed as though they were two separate fields.

Field sampling

Field collections were made with a D-vac suction sampler, and the insects were separated from the leaves and trash by a Berlese funnel separator. On each sampling date, collections were made from 100 sq ft in eight strips in each alfalfa field—four replicates from each of the two growth stages.

Pre-cut samples taken on June 20 show



Graph of lygus movement into a cotton field following solid cutting of an adjacent alfalfa field. The alfalfa was cut from west to east and the cotton was on the east edge of the alfalfa.

that there were about 100 lygus adults and about 500 nymphs per 100 sq ft in the mature alfalfa strips. In the half-grown strips, there were about 60 adults and about 80 to 90 nymphs per 100 square feet.

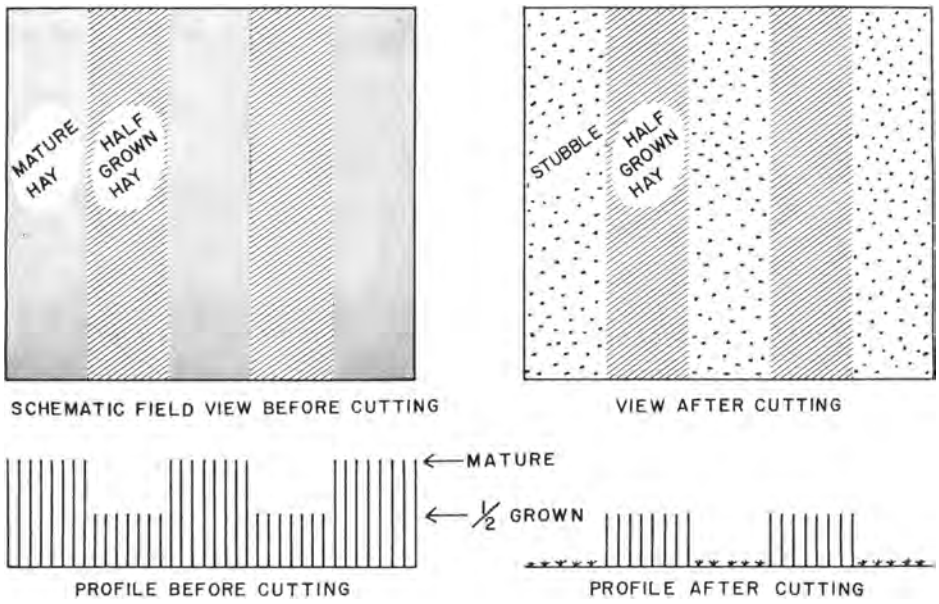
The mature alfalfa strips were cut on June 21 and post-cut samples were taken on June 25. At this time lygus adults had virtually disappeared from the cut plots while their numbers had increased by approximately 100 in each half-grown plot—about the same number that had left each cut strip. At the same time that the lygus adults were moving from the cut strips to the half-grown hay, the nymph population in the cut strips was reduced by about 85%. However, there was no evidence of nymphal increase in the half-grown hay. There seems to be little doubt that the drop in nymphal abundance in the cut strips was due to mortality caused by exposure to the sun and low humidity.

By July 2, the hay in the strips cut on June 21 was about one-fourth grown and

Table 1. Movement of Lygus hesperus adults in strip-cut alfalfa and effects of cutting on nymphal populations, Kern County, California

Plot No.	Stage of alfalfa growth on pre-cut sampling date June 20	No. lygus/ 100 sq. ft. A*	N*	Plots 2, 4, 6 & 8 cut June 21	Stage of alfalfa on post-cut sampling date June 25	No. lygus/ 100 sq. ft. A	N	Stage of alfalfa growth between cutting dates July 2	No. lygus/ 100 sq. ft. A	N	Stage of alfalfa growth on pre-cut sampling date July 8	No. lygus 100 sq. ft. A	N	Plots 1, 3, 5, & 7 cut July 12	Alfalfa growth stage on post-cut sample date, July 14	No. lygus/ 100 sq. ft. A	N
1	½ grown	51	73		½+ grown	104	83	¾ grown	158	182	mature	103	503	cut	stubble	1	259
2	mature	97	498	cut	stubble	3	77	¼ grown	10	120	½ grown	55	67		¾ grown	132	169
3	½ grown	63	80		½+ grown	160	108	¾ grown	140	144	mature	156	524	cut	stubble	1	330
4	mature	104	512	cut	stubble	5	75	¼ grown	19	52	½ grown	72	88		¾ grown	131	133
5	½ grown	49	73		½+ grown	167	61	¾ grown	168	208	mature	85	405	cut	stubble	2	211
6	mature	101	436	cut	stubble	4	78	¼ grown	27	92	½ grown	72	83		¾ grown	175	114
7	½ grown	69	129		½+ grown	185	104	¾ grown	108	161	mature	102	585	cut	stubble	3	287
8	mature	94	549	cut	stubble	3	69	¼ grown	26	82	½ grown	64	74		¾ grown	157	100
Total Lygus in Plots as Indicated		A*	N*			A	N		A	N		A	N			A	N
	½ grn. hay plots	232	355		½+ grn. hay plots	616	356	¾ grn. hay plots	574	695	mature hay plots	446	2017	cut	stubble plots	7	1087
	Mature hay plots	396	1994	cut	Stubble plots	15	299	¼ grn. hay plots	82	346	½ grn. hay plots	263	312		¾ grn. hay plots	595	516

* A = Adults; N = Nymphs.



Schematic diagram of a strip-cut alfalfa field. The alternate strips may be two or more borders wide or about 50 to 150 ft in width.

the samples reflected an increasing trend in adult and nymphal abundance. There was also an increase in nymphs in the plots with three-fourths grown hay. Pre-cut samples taken on July 8 were opposite to samples taken on June 20. That is, in the mature hay (half grown on June 20) there were high adult and nymph populations; while in the half-grown strips (mature June 20), populations were considerably lower. During this cutting the harvesting of the mature hay plots was inadvertently delayed until July 12 which was about four days later than the normal cutting date. Post-cut samples taken on July 14 showed almost a complete absence of lygus adults in the cut strips. On the other hand, adults had increased markedly in the three-fourths grown hay strips. This increase very closely approximated the numbers of adults that had left the cut strips. However, on this occasion the nymphs were not reduced in the cut strips to the extent that they were on June 25. This apparently reflects the shorter period of exposure (two days, as compared with four days) of the nymphs to unfavorable temperature and moisture conditions.

Table 2. Movement of Lygus hesperus in a solid-cut field as the mowers moved from the west end of the field toward the east end on a hot day.

Pre-cut samples taken July 12, 1963		Samples taken 15–20 feet ahead of mowers as field was cut July 15, 1963	
Distance of sampling stations from west end of field toward east end	No. lygus adults/ 100 sq. ft.	Distance of sampling stations from west end of field toward east end	No. lygus adults/ 100 sq. ft.
100 ft.*	50	....	....
300 ft.	114	300 ft.	419
500 ft.	148	....	....
700 ft.	130	700 ft.	760

* Field edge plot which probably affected size of lygus catch.

Lygus movement

The shepherding of lygus adults from cut strips to uncut strips occurred in both fields from one cutting to the next throughout the summer. The data also show that the lygus populations did not increase to excessive numbers in the strip-cut fields. This is partially due to the natural enemies of lygus which also move from strip to strip and continue to feed on their hosts.

However, of equal significance is the fact that strip-cut harvesting appears to trap the lygus. When the adults move from the cut strips to the uncut strips, they begin immediately to deposit eggs in this half-grown hay. Since this hay is only 15 days from maturity and harvest, there is not enough time for the nymphs hatching from these eggs to complete their development. Thus when the hay is harvested, the fragile young nymphs and unhatched eggs die from exposure to unfavorable temperature and humidity conditions.

Season studies

Season-long studies were also made of lygus population trends in two solid-cut alfalfa fields, and typical data from one field are summarized in table 2 and the graph.

Data shows that in pre-cut samples taken at various distances across the alfalfa field there were about 110 to 150 lygus adults per 100 sq ft, except in a sample taken near one edge along a paved road (table 2). The hay was cut on a hot day. The maximum temperature the day the hay was cut exceeded 100° F, and to avoid the heat, the lygus adults moved from west to east, along with the mowers, literally as fast as the hay was cut. Thus, there was a shepherding of the bugs toward the eastern edge of the field (table 2) and an eventual massive movement of these bugs into an adjacent cotton field, as indicated on the graph. This mass of invaders, coupled with the subeconomic numbers of adults and nymphs already present, created a severe economic threat to the cotton and the grower was forced to take rapid chemical control measures. This type of lygus movement seems to be commonplace and demonstrates how harvesting entire alfalfa fields contributes to the lygus problem.

No treatments

No chemical treatments were required to control lepidopterous larvae in the alfalfa under the strip-cut program on the W. B. Camp & Sons ranch. On the other hand most solid-cut alfalfa fields in the area were treated one or two times during the late summer or fall for the alfalfa caterpillar and western yellow-striped armyworm. This would seem to indicate that strip cutting on the Camp ranch was beneficial in helping reduce pests of alfalfa. Accounting records by another cooperator also indicate that there is little added cost involved in the strip-cut harvesting process on large acreages. Cost accounts are not available for small fields, but there may be additional costs in moving the cutting and baling equipment from one small field to another. Nevertheless, lygus movements were minimized and pests of alfalfa reduced at little or no extra cost or inconvenience to the grower, according to these 1963 studies.

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