

J. L.

EFFECTS OF STRIP CUTTING ON PEST AND BENEFICIAL

INSECT POPULATIONS IN ALFALFA

by

V. M. Stern, Dept. of Entomology, University of California, Riverside,
R. van den Bosch, Division of Biological Control, University of California, Berkeley,
and T. F. Leigh, Dept. of Entomology, University of California, Davis.

An obvious way to reduce the hazards associated with insecticides is to diminish their use. One way to do this is to prevent insect species from attaining pest status.

This is the logic behind investigations of the strip cutting of alfalfa, a practice which we hope will directly reduce pest problems in that crop and in certain other crops intermixed with it. Preliminary investigations of strip cutting and its effects on natural enemies of the spotted alfalfa aphid were carried out several years ago by E. I. Schlinger and E. J. Dietrick. The technique is utilized to a limited degree in California today.

Strip cutting essentially involves harvesting of alternate strips of alfalfa in a given field at distinct times, so that two growth stages occur in the field. (Figure 1) This contrasts with normal harvesting practice in which the entire field is laid bare at each mowing time. By contrast, and most significantly, under strip harvesting even at mowing time half the field contains standing alfalfa. Thus, in effect, the alfalfa field becomes a relatively stable environment rather than one which passes through catastrophic upset each time a cutting is taken off.

Insofar as our interests are concerned, this stabilization of the alfalfa environment is the key attribute of strip cutting. In theory, at least, two major benefits result from this, namely; (a) the establishment of a better balance between the alfalfa pests and their natural enemies, and (b) the prevention or reduction of migration of key pests (specifically Lygus hesperus Knight) from mowed alfalfa fields into adjoining crops.

Before proceeding it would perhaps be best to describe briefly the place and importance of alfalfa in the California agricultural economy, and the magnitude of the problem with which we are dealing.

About 1.25 million acres of alfalfa are grown under irrigation in California. This comprises about one-sixth of the irrigated farmland of the state. Alfalfa is a basic factor in our tremendous dairy and livestock industries and it is also a key factor in our crop rotation programs. Annual cash value of alfalfa exceeds 100 million dollars but this represents only a portion of its true value which is greatly increased by its key role in dairy and livestock production, and crop rotation.

This immensely valuable crop is afflicted by a complex of pest insects which annually take a heavy toll in damages and control costs. Application of insecticides to control insect pests in alfalfa is uniquely hazardous because of the direct use of

this crop as a foodstuff for dairy animals and livestock. This serves to complicate the already serious pest control problem in alfalfa.

The 1.25 million acres of alfalfa in California act as a vast nursery and sheltering place for about one thousand insect and insect-like (arthropod) species. These species vary greatly in habit, some being plant feeders, others scavengers or fungus feeders, some pollinators, and still others are predaceous or parasitic. In actuality many more potentially damaging insect species occur in alfalfa than ever attain injurious status. A number of factors tend to prevent these species from becoming pests. Included among these are adverse climate, type of feeding, suppressive effects of natural enemies, etc.

For instance, Lygus hesperus occurs in enormous numbers in alfalfa hay but because of its feeding habits this insect will only with greatest rarity cause economic injury to the crop. Thus we tolerate Lygus and never chemically treat alfalfa hay to control it. However, when L. hesperus occurs in cotton, even relatively light infestations can be disastrous because the bugs feed on the fruiting bodies, the bread and butter of the cotton farmer. It is not difficult, therefore, to visualize the enormous damaging potential of L. hesperus harbored in 2/3 million acres of alfalfa in the San Joaquin Valley, when at mowing time the bugs are forced to migrate into 1/2 million acres of cotton intermixed with alfalfa.

Such migrations occur every year and we have come to realize that alfalfa hay forms a prime source of the Lygus that infest cotton in our irrigated valleys.

The factors just mentioned have led to the research approach we are reporting upon in this discussion. This approach has the dual objective of, (a) enhancing existing biological control of alfalfa pests so that the direct losses caused by them to alfalfa can be reduced, and (b) the prevention or reduction of migrations of Lygus hesperus from alfalfa hay into such highly susceptible crops as cotton, beans etc.

Preliminary experiments in this research program were carried out in Kern County during 1963. Over the course of the year a number of factors were investigated and great amounts of data were gathered. In fact some of the samples have not yet been analyzed and considerable data remain to be tabulated.

Despite this, and as tentative as they are, the data already give strong indication that the key premises of our philosophy, (a) a better pest-natural enemy balance and (b) retention of Lygus populations in strip harvested alfalfa fields were largely substantiated.

It would be impossible at this time to tabulate and discuss all the data that have been gathered thus far. However, two tables and a figure depicting more or less typical aspects of our research findings are presented.

Table 1 compares the effects of strip and solid cutting on Lygus populations. The movement of adult Lygus from the mowed alfalfa into the standing portions of the strip cut field is clearly evident. Essentially 100 per cent of the Lygus adults remained in the field at cutting time. By contrast the data for the solid-cut field indicate that the Lygus adults simply abandoned the field when it was mowed

and presumably moved into whatever crops were adjacent to it. It is also noteworthy that in the strip-cut field, Lygus nymphs (immature stages) did not move into the standing alfalfa but apparently remained in the mowed portions where most (about 85%) died, probably from heat and dessication. In this respect, strip harvesting has a beneficial trapping effect that does not occur in solid-cut alfalfa. In solid-cut fields, though few adult Lygus remain after each cutting, the chances of their progeny reaching maturity are quite high for they have 3 to 4 weeks in which to complete development. By contrast in the strip cut fields the nymphs have only 2 weeks in which to develop and this is insufficient time for them to reach maturity.

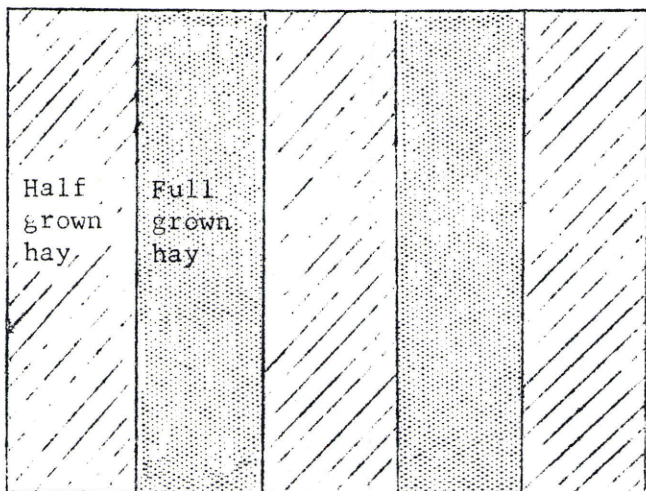
Figure 2 shows the status of a Lygus adult population in a cotton field adjacent to alfalfa before and after the alfalfa was mowed. The graph reflects a rather moderate and fairly steady population level during the month prior to mowing of the alfalfa and then a striking five fold increase in density, literally over night (from July 15 to July 16), after the alfalfa was cut. This illustrates quite dramatically the speed and magnitude of the Lygus migratory movement.

Table 2 shows the effects of strip harvesting on Aphidius smithi Sharma and Rao, a highly effective parasite of the pea aphid. It is clearly evident from the table that many of the wasps moved from the cut strips to the standing alfalfa where the population level doubled. Typically in solid-cut fields most of the wasps perish or permanently leave the fields at cutting time. We have abundant data which show similar reactions for other parasitic and predaceous species. These data give the strongest indication that a much more favorable prey-natural enemy balance occurs in strip-cut than in solid-cut fields.

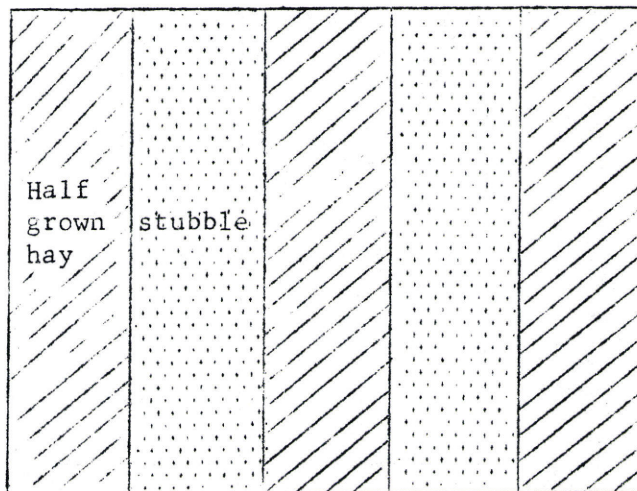
As has been mentioned previously, we are only in the preliminary phases of this research program. However, we are encouraged that, experimentally at least, our two fundamental premises seem sound. Much remains to be done and it would be a mistake for us to advocate impulsively the wide scale adoption of the strip cutting program on the basis of evidence in hand.

For instance the agronomic, economic, and long range ecological aspects of strip harvesting must be evaluated. Some growers may feel that strip harvesting and the somewhat altered irrigation program associated with it is an inconvenience not worth the effort. We shall have to provide clinching evidence that the economic advantages far outweigh the slightly greater cost and inconveniences of strip harvesting. Custom operators who harvest much of the alfalfa in this state will perhaps resist conversion to strip cutting as it is an inconvenience to them. To cover their added costs they may have to charge more for their services. The farmer in turn will have to weigh this added cost against the advantages of strip harvesting.

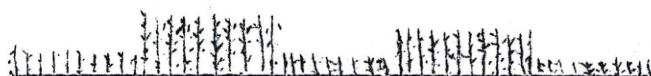
It can be readily seen that we have several years of intensive research ahead of us before we can take a definite stand, pro or con, on widescale application of the strip cutting method. Nevertheless, we are encouraged and feel that we are following a logical path toward permanent reduction of certain serious pest problems. The end result could well be substantial dollar savings to California farmers and perhaps even more importantly, a significant reduction in pesticide hazard problems.



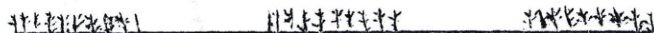
Plan view before cutting



Plan view after cutting



Profile before cutting



Profile after cutting

Figure 1. Diagram of cutting procedure used in strip harvested fields. Strips were 120 feet and 150 feet wide, respectively, in the two fields studied in 1963.

TABLE L. Effects of strip cutting and solid cutting of alfalfa on populations of Lygus hesperus, Kern County, California, June-July, 1963

STRIP HARVESTED FIELD						SOLID CUT FIELD ^{2/}			
Plot ^{1/}	Alfalfa growth June 20	No. <u>Lygus</u> ^{3/} A N		Alfalfa growth June 25	No. <u>Lygus</u> A N		Sampling Station ^{1/}	No. <u>Lygus</u> adults on July 1, before cut	No. <u>Lygus</u> adults on July 9, after cut
1	1/2 grn.	51	73	1/2+grn.	104	83			
2	Mature	97	498	Cut 6-21	3	77	1	163	13
3	1/2 grn.	63	80	1/2+grn.	160	108	2	135	6
4	Mature	104	512	Cut 6-21	5	75	3	189	3
5	1/2 grn.	49	73	1/2+grn.	167	61	4	196	11
6	Mature	101	436	Cut 6-21	4	78	5	180	6
7	1/2 grn.	69	129	1/2+grn.	185	104			
8	Mature	94	549	Cut 6-21	3	69			
Total <u>Lygus</u> in:	1/2 grn. hay	232	355	in 1/2 grn. after cut:	616	356	Total adults	863	39
	Mature hay	396	1995	in stubble after cut:	15	299			

^{1/} 100 square feet per plot or station sampled by D-vac Sampler.

^{2/} Field mowed July 2 and 3.

^{3/} A= adults; N=nymphs

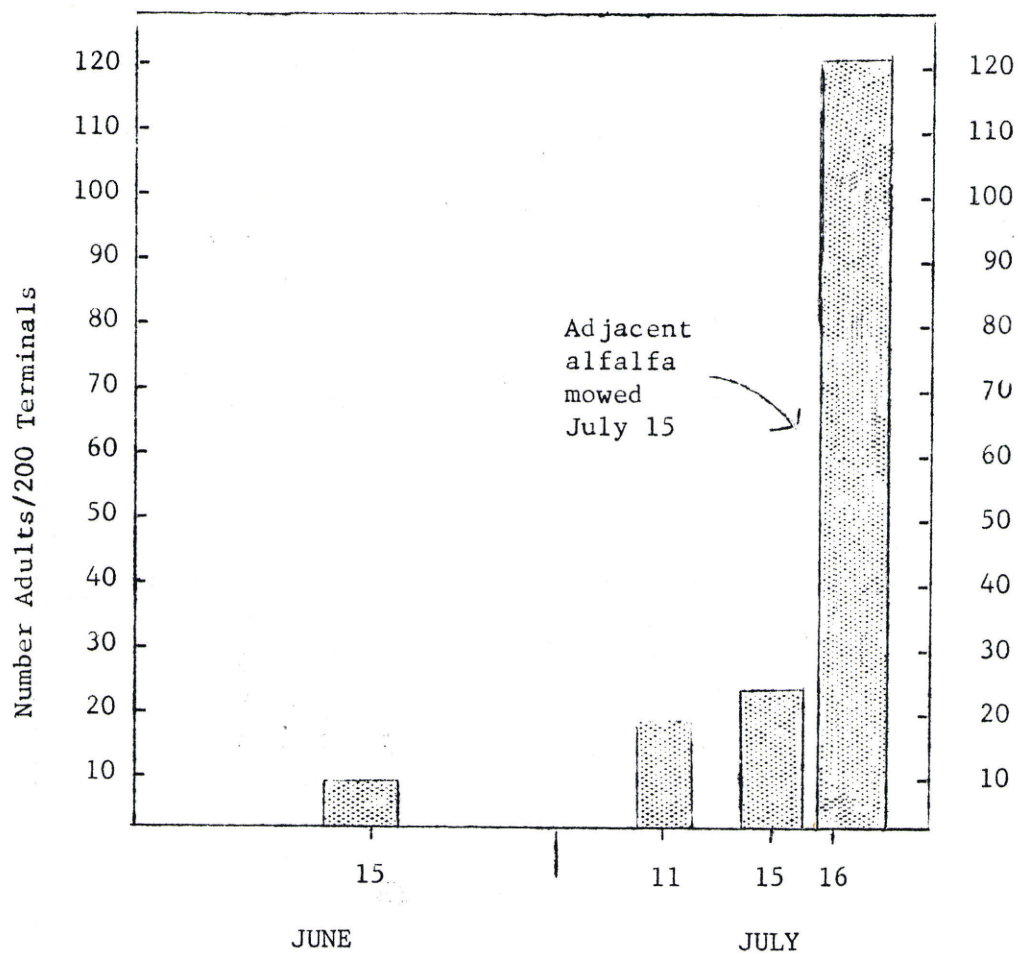


Figure 2. Numbers of *Lygus hesperus* adults collected by D-vac sampler from cotton adjacent to a solid cut alfalfa field, Shafter, California, June-July, 1963. Alfalfa cut July 15; pre cutting sample taken from cotton the morning of July 15 and post cutting sample taken July 16.

TABLE 2. Effect of mowing on a population of Aphidius smithi, a parasite of the Pea Aphid, in a strip harvested alfalfa field near Shafter, California, August-September, 1963.

<u>1/</u> PLOT	Stage of Alfalfa <u>2/</u> August 19	#. Aphidius	Stage of Alfalfa August 29	#. Aphidius	Stage of Alfalfa <u>3/</u> Sept. 5	#. Aphidius	Stage of Alfalfa Sept. 12	#. Aphidius
1	3/4 grown	8	Stubble	0	1/4 grown	6	1/2 grown	21
2	1/4	0	1/2 grown	5	2/3 "	20	Stubble	1
3	3/4	4	Stubble	0	1/4 "	6	1/2 grown	16
4	1/4 "	0	1/2 grown	13	2/3 "	20	Stubble	0
5	3/4 "	1	Stubble	0	1/4 "	5	1/2 grown	3
6	1/4 "	2	1/2 grown	6	2/3 "	20	Stubble	0
7	3/4 "	2	Stubble	0	1/4 "	6	1/2 grown	4
8	1/4 "	0	1/2 grown	7	2/3 "	20	Stubble	1
Total Wasps In	3/4 grn. hay 1/4 grn. hay	15 2	In stubble In 1/2 grn. hay	0 31	In 1/4 grown hay In 2/3 grown hay	23 80	In 1/2 grown hay In Stubble	44 2

1/ 100 square feet per plot sampled by D-vac Sampler

2/ Alfalfa mowed between August 19 and August 29

3/ Alfalfa mowed between September 5 and September 12