LIBRARY OF
E. EUGENE SAUNDERS

211CA

File 3.061
3.21
10.62
10.7

University of California
Division of Entomology and Parasitology
Berkeley, California

LIBRARY OF
E. EUGENE SAUND

April 1947

THE RELATION OF INSECTS TO ALFALFA SEED PRODUCTION

by
Ray F. Smith and E. G. Linsley

THIS IS NOT A FINAL REPORT. It is a progress report of research being conducted by the California Agricultural Experiment Station in cooperation with the Agricultural Extension Service. Since the information developed to date has some immediate practical application, it is made available before completion of the research.

Extensive investigations by both federal and state agencies have indicated that the factors influencing alfalfa seed production are many and complex. However, it has been shown that insects are very important in relation to seed production. The pollinating insects must be abundant and the harmful insects must be controlled for maximum seed production.

Importance of Bees

The seed-forming parts in alfalfa flowers are hidden and must be exposed to permit cross-pollination and the production of viable, high quality seed. This process is known as "tripping" and is accomplished on a large scale only by insects. Furthermore, honeybees* and native wild bees** are the only insects which are important in tripping and cross-pollinating alfalfa.

With regard to production, the histories of certain of our large alfalfa seed-producing regions (most notably Utah) have been significant. In recent years yields per acre have been very much smaller than those which prevailed 20 years ago and in some cases alfalfa seed has ceased to be a profitable crop. Although this reduction has probably resulted from a combination of factors, it may, at least in part, have been the result of a decline in the numbers of native bees per acre of seed. Unlike the honeybees with their man-made hives, the native bees must construct individual nests in uncultivated ground or in small (1/8 to 1/4 inch) holes in dead trees, logs, twigs, fence posts, etc. But as more land in each area is brought under cultivation and more logs and old trees are pulled out and burned, the number of suitable nesting sites has decreased. The result has been that although there is a great abundance of food (nectar and pollen), the native bees, instead of increasing with the increase in the acres of seed grown, have actually decreased. As a consequence, there has been a great reduction in bees per acre. However, as native bees decrease in new areas they may, under proper conditions, be partially replaced by honeybees.

Habits of Bees

With the exception of the bumblebees (which appear to be important in northeastern California), native bees do not form colonies or hives, but each female builds her own nests (normally several in each season) and fills a few cells in each nest with pollen and a small amount of honey. The female deposits a single egg in each cell as it is completed and provided with a store of food. After hatching, the bee grub lives on the stored food but does not complete its development and become an active adult until the next year. Under natural conditions, the abundance of native bees is affected by their normal food plants, climatic conditions, diseases, parasites, predators and competition with other bees. Also, an uncontrolled increase in the number of lygus bugs frequently results in a

---

* This term refers to both commercially kept and escaped domestic honeybees.
**This term refers to bumblebees, leaf-cutting bees, alkali bees and all kinds of bees other than domestic honeybees.

reduction of the number of blossoms to such an extent that the amount of nectar and pollen available to bees is greatly limited. In cultivated areas man has increased the factors operating against native bees by destroying their nesting sites through cultivation, drowning, and killing bees by mold resulting from irrigation, and frequently has poisoned the bees through careless or indiscriminate use of chemicals, especially those containing arsenic. On the favorable side is the man-made increase in available food which partially balances the unfavorable conditions which he creates. However, it should be pointed out, that the emergence of native bees is closely timed with the blooming period of the native vegetation. This normally varies from season to season with temperature and rainfall. The flowering period of alfalfa seed fields, which is man-controlled, will frequently fail to coincide with the time of greatest abundance of native wild bees.

Practically every blooming alfalfa field contains large numbers of bees but experience has shown that this does not always insure a good yield. Most of the bees are nectar gatherers and these are generally able to take nectar from the flowers without tripping them. Satisfactory pollination is dependent almost entirely upon the activities of the tripping insects. The tripping is done by a relatively small number of pollen-gathering honeybees and native wild bees.

The question is frequently asked as to how many colonies of honey bees per acre are necessary to insure adequate cross-pollination. This cannot be answered specifically, but any calculations which are made must be made on an area basis, not on the basis of individual fields. Both the percentage and total number of pollen-collecting bees in alfalfa fields vary from season to season and with the condition of the plants. For instance, investigations in the central valleys and southern California in the 1945 season showed that most of the tripping and cross-pollination of alfalfa was accomplished by several kinds of native wild bees and a smaller amount by honeybees. In 1946, this relation was reversed and honeybees which were collecting pollen showed an increase in total numbers and also in percentage, while at the same time there were fewer native wild bees in most areas. Variation in the number of colonies of honeybees in these areas in the two seasons was insufficient to account for these differences in pollinating activities. Probably competing pollen sources (see below), overwintering strength of the colonies, and various other factors were involved. In the Tracy area, where commercial honeybees were moved out to avoid arsenical dusting on tomatoes, seed yields were greatly reduced except in certain isolated fields which were able to rely on native wild bees for pollination. Thus about all that can be said at this time is that every effort should be made to encourage bee-keepers to bring as many bees into the area as possible. Thus far we have seen no area which appeared to be overstocked with bees from the standpoint of alfalfa seed production.

Pollen Competition

Among the most important factors which cause variation in the number and percentage of pollen-gathering bees from season to season is the availability of pollen sources other than alfalfa. In general it may be said that honeybees as well as many of the native bees prefer to take pollen from plants which do not have a tripping mechanism and which produce larger amounts of pollen in each individual flower. Alfalfa flowers must be cross-pollinated with alfalfa pollen. Unfortunately from the standpoint of alfalfa pollination, many of our common weeds provide larger amounts of pollen than alfalfa and in more readily available form. Among these are: mustard, sunflower, arrowweed, plantain, tamarisk, goldenrod, and even certain grasses such as Bermuda grass.

Also certain commercial field and seed crops, especially carrots, beans, and melons, attract a large number of pollen-collecting bees away from alfalfa. Preliminary studies have indicated that the number and percentage of pollen-collecting bees in alfalfa fields may be increased if these alternate pollen sources are destroyed as the seed fields come into bloom. Their complete elimination too early in the season may have an unfavorable effect upon honeybees which need quantities of pollen for brood rearing throughout the season. Also, destruction of all weeds along ditch banks and in waste places, if carried to the extreme, may interfere with nesting sites of native bees.

Importance of Lygus Bugs***

Lygus bugs are in many fields the most important factor in reducing alfalfa seed yields. Both the adults and nymphs feed on all parts of the alfalfa plant above ground. This is done by inserting their fine stylet-like sucking mouthparts into the tender plant growth. Damage results from the withdrawal of plant juices, mechanical injury and the injection of a toxin. The feeding of the nymphs is reported to be more harmful than that of the adults. The feeding upon new growth causes it to turn white. This "blasting" is frequently followed by a reduction in bloom and under severe conditions in a stunted many-branched plant. Lygus bugs also feed on the succulent portions of the flower, resulting in flower drop known as "stripping." Finally, they may feed on the developing seeds which become brown and shrivelled.

Life History of Lygus Bugs

Under favorable weather conditions, lygus bug adults may be found active throughout the year, and in the desert areas nymphs may also be found during most of the winter. As the weather warms up in the spring, the adults lay eggs in the more succulent portions of alfalfa and other host plants. These eggs hatch in from seven to twelve days into young lygus bugs or nymphs which somewhat resemble aphids. They are easily distinguished from the slow awkwardly-moving aphids by their well-developed legs and rapid movements. In the later instars the beginnings of wings appear as small pads. The nymphs pass through five stages of growth (called instars) each terminated by the shedding of the insect's outer skin. In from approximately ten to thirty days depending on temperature conditions, the nymph casts its skin for the last time and becomes a greenish or brown winged adult about 1/4 to 3/8 inches long. There are from three to over five generations each year.

Lygus bugs live and breed in large numbers on many hosts other than alfalfa. These include sugar beets, sweet clover, cotton, potatoes, beans, numerous members of the sunflower family, and many uncultivated plants. The migration of adults from these hosts and from neighboring alfalfa fields, especially as the latter are cut for hay, is an important factor in influencing the population trends in alfalfa seed fields. During warm weather lygus bugs are very active at night and much of their migration probably occurs at this time.

***The most common species of Lygus in California is L. hesperus Knight which occurs throughout the state. Lygus elisus Van Duzee is also widespread in the state and L. oblineatus (Say) occurs in Palo Verde and Imperial valleys.

Population Trends of Lygus Bugs

Immediately after a cutting, the lygus bug population in an alfalfa field is very low and consists mainly of adults. These adults and others which later migrate into the field lay eggs. As these eggs hatch, the nymphal population will usually increase very rapidly. The total population rises slowly at first and then very rapidly after the field begins to bloom. The peak is usually reached at full bloom or shortly thereafter. Then a marked decline in the population occurs which is associated with competition, action of predators and parasites, and the less favorable condition of the alfalfa. This unfavorable condition of the alfalfa is mainly brought about by the feeding of the lygus bugs and the drying up of the plants as maturity is reached. As the alfalfa seed crop matures, many of the nymphs die and the adults migrate to more favorable fields. Where the growing period of the seed crop is very long there may be a second build-up of the lygus bug populations as new growth starts following the complete blasting of buds by the earlier lygus bug population.

Large populations are more likely to develop in fields that are in a lush, rapidly-growing condition than in those where the growth is sparse and poor. Likewise population increases will be greater in those fields where the growth of the seed crop is normal as compared to fields that dry rapidly due to lack of moisture. The length of time necessary for the population trend to complete its cycle varies widely. In some fields, it occurs in a period of a few weeks while in others it may take two months or more. The length of time is largely dependent upon the conditions under which the alfalfa is grown, as, for example, temperature and soil moisture. The largest populations are most likely to occur in those fields which bloom for a long time and consequently in which the population increases for a long time. Large migrations from neighboring crops may alter this picture somewhat. Table 1 gives the maximum lygus bug counts which have been encountered in undusted fields in various portions of the state during the past two seasons.

Table 1. Comparison of Maximum Lygus Populations in Untreated Alfalfa

Locality	Season	No. of fields	Average no. of Lygus per sweep	
			Range	Mean
Palo Verde Valley	1945	9	17.5 to 60.0	33.3
	1946	16	1.7 to 37.8	12.1
Hemet Valley	1945	11	11.1 to 41.8	20.7
	1946	9	8.7 to 55.5	25.2
Northern California	1945	4	25.3 to 102.0	53.0
	1946	15	6.6 to 76.9	23.1

The Determination of the Lygus Bug Population in an Alfalfa Seed Field

The basis of good control of lygus bugs is the proper timing of DDT dust applications. At present this must be based on the trend of the population count. Population counts are determined by taking two sweeps of a standard insect net at representative spots in the field and counting all the lygus bugs in the net. The standard insect net has a 24-inch handle and a hoop fifteen inches in diameter. The net bag is made of muslin and is about 24 inches deep. The lower edge of the net is held eight to ten inches

into the alfalfa and as the sweeps are made, the rim of the net should be held perpendicular to the ground. The sweeps are made through a half circle from one side of the sweeper to the other. A step is taken between each sweep. Counts should be made at several locations across the field and not restricted to the margins. The number of locations will vary according to the uniformity of growth in the field. An average of several counts should be taken for each type of growing condition in the field to determine whether dusting is necessary. Most comparable counts are obtained between 9:00 a.m. and 4:30 p.m. The alfalfa should be dry, no strong wind blowing, and the temperature not greatly exceeding 100° F. For further instruction, consult your farm advisor.

Timing of Control Applications

Control measures should only be applied to alfalfa seed fields when it is proven to be necessary. As we have observed conditions in California, lygus bugs are not likely to cause any material damage until an average of at least five can be collected per sweep of an insect net and severe loss of seed is not likely to result until the population reaches a much higher level. The objective should then be to time the control measures so as to keep the population below five per sweep for as long a time as possible.

Since the relation of DDT dusting to bees has not been fully determined, all precautions should be taken to protect these beneficial insects. At first glance, it would appear best to dust in the bud stage before the bees come into the field in large numbers. However, our experimental data does not indicate the most satisfactory control from dusting at this time (Table 2). Due to the great variation in growing conditions in alfalfa fields

Table 2. Comparison of Dusting in Various Stages of Growth

Stage of Growth at Time of Dusting	Percentage of Fields Giving Satisfactory Control	
	For over 20 days	Until harvest
Bud stage	40.0	10.0
Early bloom	63.1	36.8
Full bloom	84.6	71.8

and in the subsequent infestation, it is impossible now to predict at bud stage the trend of the population of lygus bugs. Consequently, many fields will be dusted unnecessarily and others will be redusted in bloom because of heavy re-infestation. Thus it would seem that the general use of dust in the bud stage would increase the total amount of dusting without eliminating the hazards. With this in mind the following tentative recommendations are made for 1947. In the bud stage, dust only if the nymphal population exceeds the adult population and the total count exceeds two per sweep. In early bloom to full bloom, dust only if the nymphal population exceeds the adult population and the total count exceeds five per sweep in short-cycle fields (having a total blooming period of less than 30 days on the basis of previous history) or ten per sweep in long-cycle fields (having a total blooming period of over 30 days on the basis of previous history). In late bloom, dust only where there is considerable secondary growth and the field is expected to continue to bloom for some time. In late bloom the count should exceed 10 to 15 per sweep and a field should never be dusted after it has started to dry up.

Finally, the following points should be considered in determining the desirability of treatment: 1) expected increased yield as weighed against cost of treatment; 2) probable size of lygus bug population as affected by vegetative condition of alfalfa, possible migration from crops grown in adjacent fields, period remaining until harvest, and the population of predacious insects; 3) the effect of dusting on pollinating bees and other beneficial insects; 4) use made of alfalfa straw following harvest.

Composition of Dust

Results over the past two years have indicated that at 30 pounds per acre, 5 per cent DDT and 10 per cent DDT are better than 3 per cent DDT both in initial control and residual action (Table 3). There is apparently no marked difference between 5 per cent and 10 per cent DDT in the control of lygus bugs. However, where 10 per cent DDT is used, the hazard to bees and other beneficial insects may prove to be greater. The lowest possible concentration which will give satisfactory control should be used. The incorporation of 50 per cent or more sulfur in the dust mixture gives some increase

Table 3. Comparison of 3, 5, and 10 per cent DDT at Thirty Pounds per Acre

Material	Average Number of Days of Effective Control	Average Reduction under Previous Count (Per Cent)
3% DDT 97% Inert	8.4	61.9
5% DDT 95% Inert	20.8	82.5
10% DDT 90% Inert	21.2	82.7

in control, but since sulfur will cause injury to alfalfa flowers in hot weather its use is not recommended.

Several materials in addition to DDT are under investigation. These include 5 per cent dichloro-diphenyl-dichlorethane (DDD), 3 per cent Velsicol 1068, 10 per cent sabadilla, 1 per cent of the gamma isomer of hexachloro cyclohexane (666), and 3 and 5 per cent dimethoxy-diphenyl-trichlorethane. Although all of the new materials tested gave fair to excellent control of lygus bugs in the field, none showed any quality which would recommend their use over DDT at this time. It is recommended that 5 per cent DDT in talc or pyrophyllite be used.

Pounds of Dust per Acre

Additional studies during the past season have permitted the lowering of dosages. The lowest possible dosage which will give satisfactory control should be used. In the Blythe area, the results were not uniformly as good as in cooler parts of the state. This is probably due to the very high temperatures in midsummer. To compensate for this effect, slightly higher dosages are recommended for the hot desert areas. The recommended dosages to use under various conditions are given in Table 4.

Table 4. Recommended Pounds Per Acre of 5 per cent DDT

Type of Duster	Bud Stage Dusting	Bloom Stage Dusting	
	All Fields	Central Valley and non-desert areas of So. Calif.	Hot desert areas or where growth is unusually heavy
Ground Machine	25	20	25
Airplane	30	25	30

Means of Application

Every effort should be made to obtain a thorough, even application and to keep the drift to a minimum. Uneven applications will result in uneven control and reinfestation will be more rapid. Satisfactory dusting can be done with both ground rigs and airplanes. Drift from airplane applications cannot be controlled, but in the case of ground rigs, a canvas drag will reduce the drift. Some evidence was obtained during the past season which indicates that dew on the plants at the time of dusting improves control. It is recommended that the dusts be applied before 6:30 a.m. when there is a minimum of air movement and when the number of bees in the field is very low.

Hazard of DDT Residue

If the straw remaining after seed harvest is burned or is used as fertilizer, there will be no problem of DDT residue. In spite of the fact that we do not expect toxic effects in animals fed this straw, there is still a problem involving human health. The Federal Food and Drug Administration has not placed a tolerance for DDT in meats or milk. Until a tolerance is set, the feeding of straw from alfalfa seed fields which were dusted with DDT cannot be recommended. Results of the analysis for DDT on straw from fields treated with DDT dusts are given in Table 5.

Table 5. Residues of DDT on Alfalfa Straw from Treated Fields*

Area	No. of Fields	Lbs./acre of dust	Days of Weathering	DDT in parts per million			
				Before Thrashing		After Thrashing	
				Range	Mean	Range	Mean
Hemet	7	26.5-37.6	53-68	0.7-17.0	7.5	0.0-19.7	6.0
No. Calif.	5	25.7-38.8	60-67	-	-	0.5-12.4	7.2
Blythe	9	28.8-40.7	24-50	2.7-14.5	7.3	0.0-12.9	3.2
Blythe	7	28.8-41.8	51-67	0.0-20.0	7.9	2.8-8.9	5.1

* Analysis made in the laboratory of insect physiology and toxicology, Division of Entomology and Parasitology, University of California.

Results of DDT Applications

Marked increases in yields have resulted from properly timed and applied DDT dusts. A comparison of the yields of No. 1 seed and cleanout in treated and untreated alfalfa seed plots is given in Table 6. The largest increases will occur where the lygus bug population is high. These figures are given as an indication of increases in yields under favorable conditions. DDT dust should never be applied to alfalfa seed fields merely as insurance against damage. The application of DDT dust may decrease yields when the lygus populations are low.

Table 6. Results of applications of DDT dust at approximately 30 pounds per acre by airplane, Palo Verde Valley, Riverside Co., 1945

Stage of Growth	Per Cent Cleanout		Lbs. of Clean Seed per Acre		Per Cent Increase in Lbs.
	DDT	Check	DDT	Check	
	3 per cent DDT				
Late bloom	--	--	360.4	181.5	98.6
Prebloom	--	--	252.8	171.3	47.6
Full bloom	24.9	21.2	177.4	133.5	32.9
Late bloom	22.6	25.0	99.4	85.0	16.9

Table 6 (continued) - Results of applications of DDT dust at approximately 30 pounds per acre by airplane, Palo Verde Valley, Riverside Co., 1945

Stage of Growth	Per Cent Cleanout		Lbs. of Clean Seed per Acre		Per Cent Increase in Lbs.
	DDT	Check	DDT	Check	
	5 per cent DDT				
Late bloom	14.6	23.5	428.8	181.5	136.3
Early bloom & Late bloom	10.5	11.9	489.5	302.1	62.0
Prebloom & Late bloom	3.6	28.7	479.6	300.5	59.6
Prebloom.	21.7	16.1	500.0	376.7	32.8
Early pre-bloom	34.3	40.8	267.2	158.8	68.3
Full bloom	20.7	18.3	300.1	227.8	31.7
Full bloom	21.7	22.3	183.4	136.5	34.4
Full bloom	11.9	21.2	176.6	133.5	32.3
Late bloom	19.1	23.0	118.4	85.0	39.3
	10 per cent DDT				
Late bloom	15.8	23.5	385.9	181.5	112.6
Late bloom	20.2	23.0	105.9	85.0	24.9

Relation of DDT Applications to Beneficial Insects

There are two groups of beneficial insects in alfalfa seed fields. One group is the parasites and predators which destroy other harmful insects. Certain predators including the minute pirate bugs (Anthocoridae), big-eyed bugs (Geocoris spp.) and the common damsel bug (Nabis ferus) are particularly effective against lygus bugs. These beneficial insects fortunately are less affected by DDT than lygus bugs at dosages of 30 pounds of 5 per cent DDT dust per acre. For this reason it would seem wise to maintain this favorable balance by holding the amount and concentration of DDT to the absolute minimum that will give satisfactory control of lygus bugs. During the past season, higher dosages of DDT, both in poundage and concentration, and some of the new materials tested had a harmful effect on these predators.

The other group of beneficial insects is the pollinating insects. In connection with the use of DDT and other insecticides for the control of lygus bugs on alfalfa seed crops, one of the most important questions to be answered is the effect of these materials upon bees. The answer to this question is extremely difficult to obtain. Under normal conditions the number of bees in an alfalfa field varies from day to day and throughout any one day in response to a variety of conditions, including temperature, relative humidity (air moisture), wind velocity, cloudiness, nectar secretion of the alfalfa flowers, etc. Further, only a portion of the bees visiting a field are present at one time. This normal variation in numbers makes it difficult to measure the effect of the insecticidal dusts.

In spite of this difficulty, a number of facts have emerged from studies made in the 1945 and 1946 seasons. Shortly after dusting experimental fields with DDT, markedly fewer bees were present in the treated portion of the field than in the untreated portion, or than were in the field the day before dusting. On the day after dusting, this reduction was less marked and within another day or two was no longer evident. Ultimately, especially when the lygus population was high at time of dusting, more bees were usually found in the treated area than at any time previously. After dusting, some bees were observed which were behaving abnormally and were presumably being affected by DDT. When such bees were placed

in cages, some of them died. Whether or not they would have died if left in the open fields was not determined. No significant number of dead bees were observed in fields after dusting, even in row plantings where the ground could readily be observed. Nor were unusual accumulations of dead bees observed in apiaries coincident with dusting programs.

In addition to these facts certain additional points are involved in which the evidence is not yet clear-cut. A number of beekeepers have reported serious reduction of their force of field bees following applications of DDT to alfalfa in bloom. Other beekeepers have reported no such reduction or have accounted for loss of colony strength on some other basis. Evidence from other parts of the country is equally contradictory; some investigators in Oregon, Arizona and Utah indicate that they were unable to find a measureable reduction of bees following dusting of blooming alfalfa, while others indicate a possibility of serious injury.

In view of the present uncertainties as to the effect of DDT on bees, it is therefore recommended that during the 1947 season, the following points be kept in mind: (1) DDT is a poison, (2) DDT should be applied to blooming alfalfa fields only when absolutely necessary, (3) when DDT is required for lygus control, it should be applied as early in the growth of the alfalfa as the lygus population warrants, (4) rates of application (lbs./acre and per cent DDT in dusts) should be kept as low as satisfactory control will permit, (5) dusts should be applied as early in the morning as possible, certainly no later than 6:30 a.m., (6) care should be taken to control drift of dust, and (7) beekeepers in the vicinity should be notified if alfalfa is to be dusted with DDT while in bloom.

If these precautions are heeded, it is hoped that any loss of bees may be kept below an economic level. A small loss in the field force of honey bees may not be serious, especially if it is compensated by increased honeyflow as a result of protecting the blossoms from lygus bug damage. However, any reduction which will affect the overwintering strength of colonies would be a serious matter. Furthermore, native bees cannot stand any significant reduction in numbers since they do not have the replacement ability of a colony of honey bees. Killing of native bees, season after season, will result in their virtual extermination. Thus, the question as to the effect of DDT on bees is of vital concern in alfalfa seed production.

SUMMARY OF CONTROL RECOMMENDATIONS FOR LYGUS BUGS IN ALFALFA SEED FIELDS

1. Dusts should only be applied to alfalfa seed fields when proven to be necessary. This is especially true when fields are in bloom, since any hazard to bees would be greatest at this time.

2. Rates of application (pounds per acre and per cent of DDT in the dust) should be kept as low as satisfactory control will permit. Five per cent DDT in talc or pyrophyllite at the poundage given in Table 4 (page 8) is recommended at the present time.

3. Every effort should be made to obtain a thorough, even application of dust and to keep drift to a minimum.

4. Bud stage dusting. Dust in the bud stage only if the nymphal lygus bug population exceeds the adult population and the total count exceeds two per sweep.

5. Bloom stage dusting. Although our work during the past two years has shown that best control will result from dusting in bloom, we cannot recommend it because we do not know for sure that it will not harm the pollinators. However, since some dust may be applied in the bloom stage, the following suggestions are made in the hope that any loss to bees will be minimized.

   a. In early bloom to full bloom, it is suggested that dust only be applied if the nymphal population exceeds the adult population and the total count exceeds five per sweep in short-cycle fields (having a total blooming period of less than 30 days on the basis of previous history) or ten per sweep in long-cycle fields (having a total blooming period of over 30 days on the basis of previous history).

   b. In late bloom it is suggested that dust only be applied when there is considerable secondary growth and the field is expected to continue to bloom for some time. Do not dust in this stage unless the count exceeds 10 to 15 per sweep. Do not dust a field which has started to dry up.

   c. If alfalfa is to be dusted in bloom, beekeepers in the vicinity should be given advance notice and the applications should be made before 6:30 a.m.