HONEY BEE POLLINATION OF ALFALFA

Jim Berg, formerly Department of Entomology,
University of Nevada, Reno, Nevada

Honey bees are important pollinators of alfalfa in the southwest and in isolated areas elsewhere. They do best if placed in the field at 20–25% bloom, if weeds are controlled to eliminate competing pollen and nectar sources, and if colonies are strong.

CONTENTS

HONEY BEES, *Apis mellifera*, are used as primary alfalfa seed pollinators in California, Nevada, Arizona, and isolated areas in Utah. They are important as supplementary pollinators in Nevada, Utah, and Colorado. To a lesser extent, they contribute to seed yields in Washington, Oregon, and Idaho when placed near seed fields. Using approximately three hives per acre on 70–80 acres in the San Joaquin and Imperial Valleys of California, yields of 280, 435, and a projected 510 pounds per acre were attained in the years 1978–1980, respectively. Yields of more than 1,000 pounds per acre, using six colonies per acre, have been reported. In isolated valleys of Nevada, such as Silver State, Middle Reese, and Dixie, yields of 350-600 pounds per acre using three to five colonies per acre have been recorded. In the Snowville area of northwestern Utah, yields of 400 pounds per acre using approximately 2.5 colonies per acre occurred in 1979. The above areas depended solely on honey bees for pollination, with little or no contribution from wild bees (Fig. 1).

Despite the above yields, there is still some question as to the contribution of honey bees to alfalfa seed pollination. Alfalfa is a highly preferred nectar source; but due to the flowers' physiology (violent tripping mechanism) and low amount of pollen per flower, it is not a preferred pollen if other sources are available. Even though alfalfa pollen has a relatively high protein content, it is a poor source of nutrition for honey bees. When honey bees only have alfalfa on which to forage, colony strength declines both in the field and in laboratory feeding studies.

Alfalfa seed pollinated by honey bees receives a contribution from both nectar and pollen collectors.

POLLEN COLLECTORS

Pollen is the principle source of protein, minerals, enzymes, fat, and vitamins in the honey bee diet. It is essential for brood development. Pollens of different species of plants differ in their nutritional value, with protein contents ranging from 8–40%. Plants common in the seed grow-

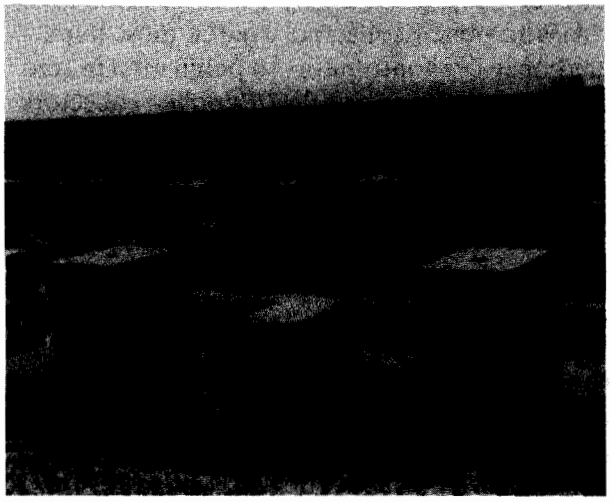

Fig. 1—Well managed honey bee colonies placed in an alfalfa seed field.

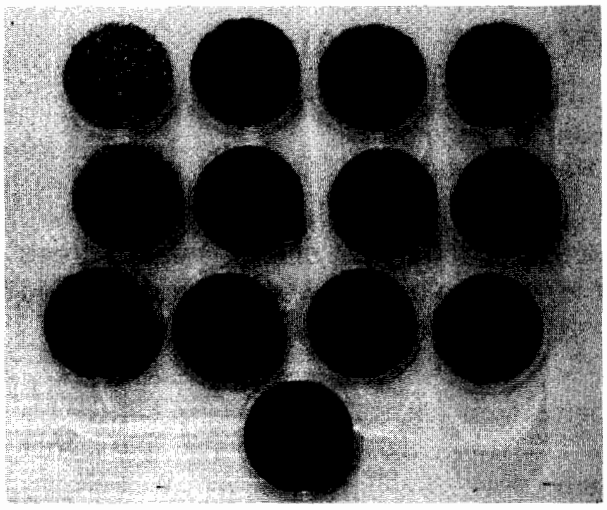

Fig. 2—Pollen pellets obtained from beehive entrance traps. Alfalfa pollen is in center dish on left.

ing areas of Nevada, as in much of the Intermountain West, have been found to have pollen proteins ranging from under 13% for plants such as povertyweed (*Iva axillaris*), Russian thistle (*Salsola kali*), bassia (*Bassia hyssopifolia*), and greasewood (*Sarcobatus vermiculatus*) to over 20% for nightshades (*Solanum spp.*), tumble mustard (*Sisymbrium altissimum*), and alfalfa itself. Honey bees are unable to detect the relative nutritive value of pollens but are guided by attractive colors and odors. It also appears likely that a mixture of pollen from several sources is necessary to give the honey bee a balanced diet.

Alfalfa pollen collectors are the most important honey bee contributors to pollination in seed alfalfa fields. Ranges of 0–20% pollen collectors have been recorded in California, 4–100% in Arizona, 0–75% in Utah, and 0–27% in Nevada. In the northern seed growing areas of North America, such as Washington, Montana, Alberta, Wyoming, and Saskatchewan, pollen collectors comprise only 0–1% of the field force, possibly due to climatic factors such as higher relative humidities and cooler average temperatures during the seed growing season.

By using pollen traps placed on colonies used for alfalfa seed pollination, various researchers have looked at the percentage of alfalfa pollen collected during the seed setting period (Fig. 2). In 1944, Hare and Vansell recorded an average of 32% alfalfa pollen collected in six hives over a three-week period in Delta, Utah. Over a 15-day period in Howell Valley, Utah, Levin and Bohart reported 41–80% alfalfa pollen collected from three hives in 1955. Investigations in Nevada in 1979 and 1980, trapping pollen one day a week for four to eight weeks over the pollination period, showed the percentage alfalfa pollen collected ranged from 0–93%. Higher percentage alfalfa pollen collected during these two years was generally found in the more isolated seed growing valleys of Nevada, where there was less competition from other pollen sources.

The kinds and abundance of other pollen sources determine the extent to which alfalfa will be visited by pollen collectors. Plants competing with alfalfa for pollen collectors include:

thistles (*Circium* spp.)
mustards: black (*Brassica nigra*), tumble (*Sisymbrium altissimum*), and hairy whitetop (*Cardaria pubescens*)
Russian knapweed (*Centaurea repens*)
yellow starthistle (*Centaurea solstitialis*)
sweetclover (*Melilotus* spp.)
poverty weed (*Iva axillaris*)
tamarisk (*Tamarix gallica*)
fivehook bassia (*Bassia hyssopifolia*)
greasewood (*Sarcobatus vermiculatus*)
Russian thistle (*Salsola kali* var. *tenuifolia*)
lambsquarters (*Chenopodium album*)
gumweed (*Grindelia* spp.)
annual sunflower (*Helianthus annuus*)

Other crops can also be competitors with alfalfa for pollen; some of these are corn, safflower, mellons, dill, carrot seed, and sunflowers.

NECTAR COLLECTORS

Nectar collectors contribute a certain amount to alfalfa pollination by accidental tripping. This has been proven by finding alfalfa pollen under the "chin" (*proboscis fossae*) of such bees. In examining fields and observing nectar collectors on flowers, the following percentages of accidental tripping have been recorded in various locations: about 2% in Oklahoma, Arizona, and California; 1% in Kansas, Utah, and Nebraska; 0.7%

in Alberta; 0.3% in Manitoba; and 0.2% in Washington and Idaho. In Utah, it has been calculated that, on a field with good agronomic potential, six nectar collecting bees per square yard tripping 1% of the flowers visited could set approximately 350 pounds of seed per acre. In the more northern locations, most tripping seems to involve leg tripping which leads to the same outcome as selfing (i.e., few seeds per curl; low viability).

The above tripping is contributed by experienced nectar collectors. There is another important aspect of accidental pollination by honey bees: the role of the inexperienced nectar collector. During the learning period of new field bees, tripping of from 7–85% of all alfalfa flowers encountered has been recorded. This learning period commonly lasts no more than half a day before the new nectar collector learns to avoid the stigmatic process by becoming a "side" nectar collector.

Other factors affecting pollination of alfalfa include field conditions and plant variety.

The seed field should be an open, upright, strongly flowering type of alfalfa growth to attract both nectar and pollen collectors. Honey bees prefer drier portions of the field under slight amounts of stress. Not only is sugar more concentrated in the nectar, but flowers are more easily tripped by pollen collectors.

Some alfalfa varieties are more attractive to honey bees than others. In Nevada, Vernal and Ranger attract good numbers of bees.

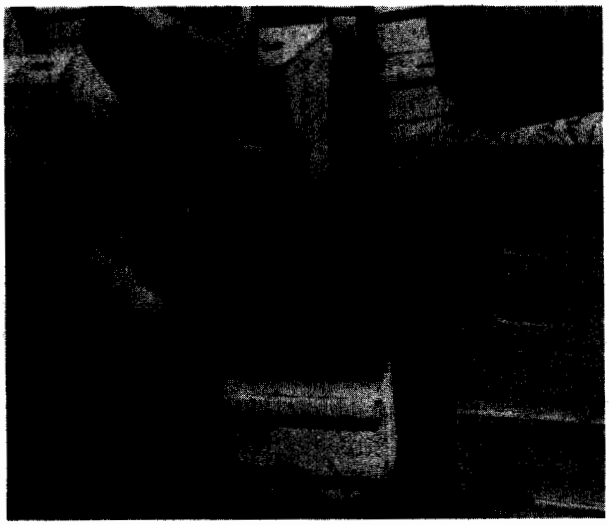

Fig. 3—Examining honey bee colony in alfalfa seed area.

RECOMMENDATIONS

Colonies to be placed in alfalfa seed fields for pollination need actively laying queens with brood of all stages (about 800 square inches) and enough workers to serve the colony and pollinate the flowers.

Nevada recommends two to three strong colonies, or more depending on level of leafcutting, alkali, and other wild bee pollinators. Utah recommends three to four colonies per acre if competing bloom is scarce. If 10% of the field force is pollen collectors, fewer hives can be used. If only 1% of the field force is pollen collectors, five to six colonies could be beneficial. Increasing the number of colonies in a field causes the honey bees to forage closer to their own hive. Recommendations should actually be made on an area-wide basis, so all seed acreage benefits equally.

Eliminate competing sources of pollen and nectar when alfalfa comes into bloom. Good weed control in and around seed fields is very helpful in increasing seed production using honey bees. Again, this can be best accomplished on an area-wide basis by use of herbicides or mowing of plants before they bloom. Utah recommends that alfalfa for hay not be allowed to bloom excessively and crops that compete with alfalfa for honey bees should not be grown within a 1½ mile radius of a seed field.

Placement of colonies in the field should be made when the alfalfa has 20–25% bloom. Placement before sufficient bloom may cause bees to become oriented to other, more attractive fields or weeds. Alternate strategies include: 1) a Utah recommendation to bring in one-quarter of the required number of colonies at about 10% bloom and the remainder at 50% bloom; 2) replace a portion of the colonies during the middle of the pollination season with new hives that have never worked alfalfa pollen. In the Imperial Valley of

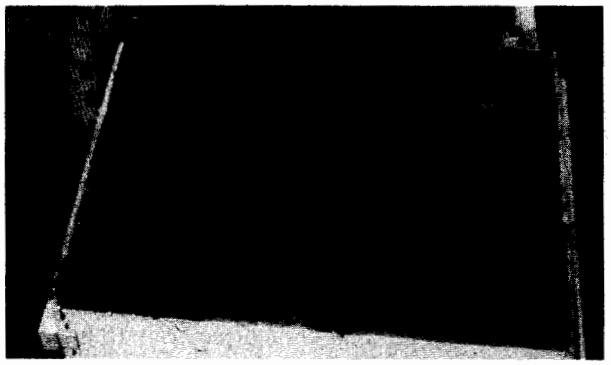

Fig. 4—Strong colony with many worker bees on top bars of frames.

Fig. 5—Beehive frame showing good quantity of pollen stored in the cells.

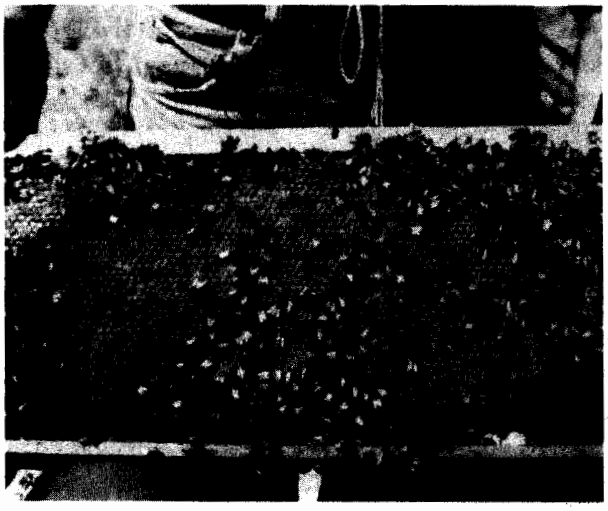

Fig. 6—Good frame of honey bee brood with many capped cells containing mature larvae and pupae.

California, after two cuttings of hay, if the price of seed looks good, growers will contract for up to 10 colonies per acre. Five colonies will be brought in when the alfalfa first starts blooming. At full bloom, the other five colonies will be added. When about 50% of the flowers are tripped, the first five colonies will be removed. The whole pollination period is completed within 10 days to two weeks.

California recommends drops of 72 colonies per apiary distributed throughout the field (or along field roads, if within field is not practical) for good service by the beekeeper.

Beekeepers need to check hives often to provide adequate space for brood. This is particularly important during a nectar flow so that the brood chamber does not become "plugged-out." Increased brood production stimulates increased pollen collection.

Growers should utilize the utmost caution in selecting insecticides for use during the pollination period. Besides notifying the beekeeper, colonies should be removed or covered prior to application of any insecticide considered highly toxic to honey bees.

In 1978, S. E. McGregor made a number of recommendations on the Honey Bee Pollination Project sponsored by the Lovelock Alfalfa Seed Growers Association. Included are:

1. Colonies should contain a minimum of 800 square inches of brood.

2. Bonus payments should be made to beekeepers for stronger colonies.

3. A certain percentage of colonies should be inspected within one week following delivery to estimate strength—size of brood and number of frames of bees (Figs. 3-6). The grower should pay on the basis of this inspection. Emphasize that bees pollinate alfalfa, hives do not!

4. Investigate the possibility of developing a pollination contractor with whom growers in an area could deal instead of the beekeeper directly. The contractor could handle pollination contracts, inspect colonies for strength, and arrange to bring in one or more beekeepers for a grower's fields. If a beekeeper failed to deliver colonies on time, the contractor could contact other sources of honey bees for the grower.