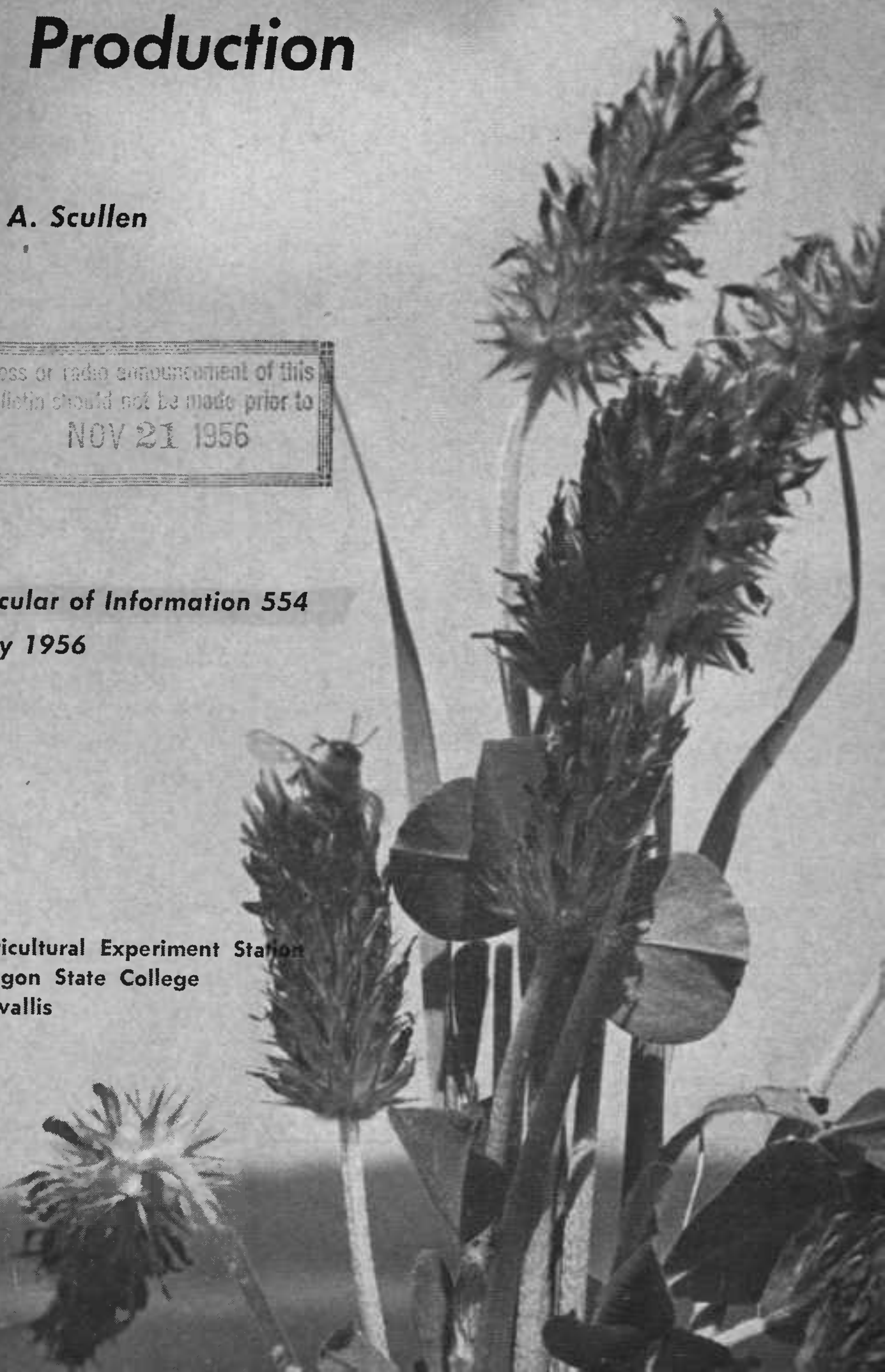
# *Bees . . .* for Legume Seed Production

***H. A. Scullen***



***Circular of Information 554***
***July 1956***



**Agricultural Experiment Station**
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# *Bees* . . . for Legume Seed Production

*H. A. Scullen*

## Bees . . . *in general*

The past 25 years has been a period of outstanding growth of legume seed production in Oregon. The following crops have been important: alfalfa, alsike clover, white clover, crimson clover, Austrian field peas, hairy vetch, Hungarian vetch, common and Willamette vetch, Lotus, Ladino clover, subterranean clover, and strawberry clover. Some seed crops, like Hungarian vetch, have come into the picture, then have all but disappeared. Some have reached a relatively stable acreage while others are showing a marked increase. Future years will doubtless show a fluctuation of all crops now grown for seed in Oregon, and new crops will appear from time to time.

Total legume seed production of crops for which pollination by bees is considered essential (white clover, sweet clover, Ladino clover, alsike clover, red clover, crimson clover, alfalfa, hairy vetch) has shown a fluctuating but marked increase during the past quarter century. The increase was slow during the first 9 years but from 1935 to 1942 the production of these seed crops rose from 33,000 to 174,000 acres. This period was followed by a sharp drop to 84,000 acres in 1945 and a second rise to 136,000 acres in 1950. Acreage dropped slightly in 1951 and 1952. Future acreage will depend on both demand and competition with other producing areas. However, it is reasonable to expect Oregon will continue to be a leading legume seed producing state.

During the early years of this industry the importance of pollination by bees was little understood or appreciated. The small and generally scattered fields planted for seed production were probably well pollinated by native wild bees nesting in nearby uncultivated areas. In recent years increased cultivated acreage and more extended application of insecticides has materially reduced the number of available native solitary bees and bumblebees. This increased acreage of

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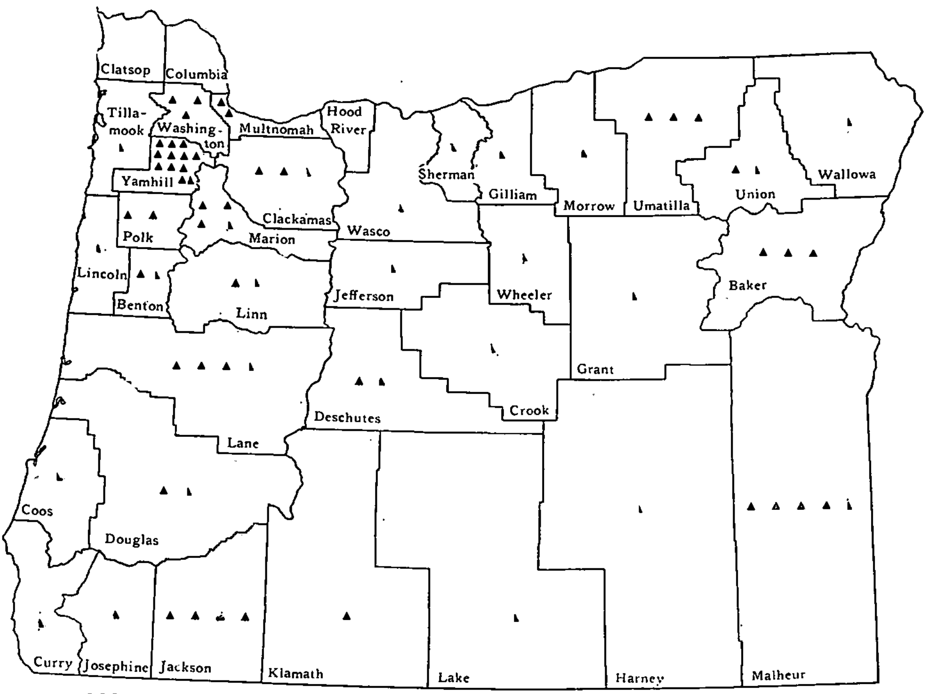
seed crops plus the loss of natural pollinators has made it necessary to use honeybees. Furthermore, several state and Federal Experiment Stations, including Oregon, have demonstrated the need of bees for profitable seed production by most legumes.

The distribution of bees in Oregon is shown on the map below. The estimated total number of colonies in Oregon for 1952 was 65,000. As a rule only colonies in commercial apiaries are available for moving into legume seed producing areas for pollination purposes. Such apiaries are, with few exceptions, located in limited areas in the state where commercial honey production is possible. These are: the Willamette Valley, the irrigated sections of eastern and southern Oregon, and to a very limited extent the fireweed area of northwestern Oregon. In some cases, like the hairy vetch section in the Willamette Valley, some commercial apiaries are kept in more or less permanent locations and function for both honey production and pollination.

Many hundreds of colonies in noncommercial bee yards of 1 to 10 or more colonies are located in seed producing areas. These scattered small groups of bees contribute materially to the pollination of Oregon seed crops.

With the present acreage devoted to legume seed production in the state, Oregon may have enough colonies to pollinate its seed crops. For the 1951-52 season, however, close to 5,000 colonies were brought from outside the state to such concentrated seed producing sections as Jefferson County.

**FIGURE 1. Distribution of honeybee hives in Oregon.**



# Bees . . . *and their legumes*

## Alfalfa

**Alfalfa seed production in Oregon.** Over the past decade the acreage of alfalfa grown for seed in Oregon has varied from a low of 4,000 to a high of 9,000. Seed is produced largely in the irrigated sections of eastern and southern Oregon with Baker, Malheur, and Union Counties taking the lead.

**Tripping and pollination.** More attention has evidently been given to the study of alfalfa pollination by state and Federal Experiment Stations and independent research workers than to all other legume seed crops combined. Outstanding progress has been made in recent years, yet there is still much to be learned. However, work completed elsewhere does not always apply in Oregon.

It is now generally agreed that alfalfa flowers must be tripped to be pollinated. Tripping alone, however, may not provide the cross-pollination necessary for good seed production. Natural agents such as wind and rain may result in some tripping but will provide little or no cross-pollination. Likewise, artificial mechanical methods of tripping have been proved unsatisfactory.

**Solitary bees as pollinators.** All native bees, except bumblebees, are solitary bees (honeybees are not native). Alfalfa depends on insects for cross-pollination. Many species of wild bees do not visit alfalfa. However, some species seem to prefer it. In some areas they are the major pollinators of alfalfa. Their value as such will depend on their abundance and the presence of other plants which serve as competing sources of pollen.

The alkali bee (*Nomia melanderi*) is efficient as a pollinator of alfalfa in limited areas. It is known to be a good pollinator in Oregon, Washington, Utah, and other western states.

Certain species of leaf cutting bees (*Megachile* spp.) which are efficient pollinators of alfalfa in Alberta and Utah are common in Oregon and doubtless help in alfalfa pollination. Several other groups of solitary bees (*Melissodes,* and others) are known to be effective trippers of alfalfa and are common in Oregon. Careful study is needed to determine what species are of value in the state and to what extent they can be protected and even increased. Every effort should be made to protect their nesting places.

**Bumblebees effective pollinators.** Some species of bumblebees are known to be effective trippers and pollinators of alfalfa but their numbers are inadequate. Furthermore some are often attracted more by other plants in the neighborhood. So far no practical method has been developed to increase their numbers although several investigators have worked on the problem.

**Honeybees as pollinators.** In some states in the absence of an adequate supply of other bees for pollination purposes, an overpopulation of honeybees has proved effective. Kansas researches have shown that honeybees, working alfalfa for pollen, trip 65 per cent of the bloom while those working it for nectar trip only 1.1 per cent. Reinhardt, formerly with the USDA, showed in 1952 that the younger bees which have not yet learned to steal the nectar trip a large per cent of the bloom. A competing

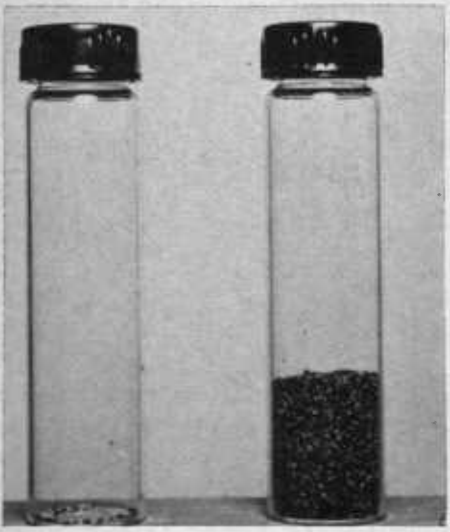


**FIGURE 2. Alsike clover: 40 seeds from 100 heads, bees excluded; 12,621 seeds when bees had access to clover.**

source of pollen will reduce the number of pollen gatherers. Although they are not as efficient in tripping alfalfa flowers as some of the wild native bees, an adequate supply of pollen collectors and plenty of younger workers will do a good job of pollinating. In the Sacramento Valley of California it has become a common practice to use up to 4 or 5 colonies per acre for alfalfa seed production. This practice has resulted in crops of seed far above the former average.

## Alsike clover

**Alsike seed production in Oregon.** For many years alsike seed production has been important in Oregon although the acreage has not been large compared to some other crops. Linn County in the Willamette Valley, and Klamath, Deschutes, and Crook Counties in eastern Oregon have led in production. The total acreage for the state has ranged from 7,000 acres in 1934 to 24,000 acres in 1938. In recent years it has averaged close to 10,000 acres.

**Bees essential for pollination.** Limited cage studies in central Oregon have shown few seeds are produced when pollinating insects are excluded. Field observations indicate that as a rule in central Oregon, honeybees are the principal pollinators. Studies in Ohio have given similar results.

**Native bees as pollinators.** Observations by the writer in the Cloverdale area of western Deschutes County and by other research workers in Klamath County have shown that the little ground nesting solitary bee (*Nomadopsis* sp.) works Alsike clover in large numbers and doubtless pollinates it.

## Crimson clover

**Crimson clover seed production in Oregon.** This acreage has ranged from 300 acres in 1939 to 10,000 acres in 1942. In 1952 there were 6,000

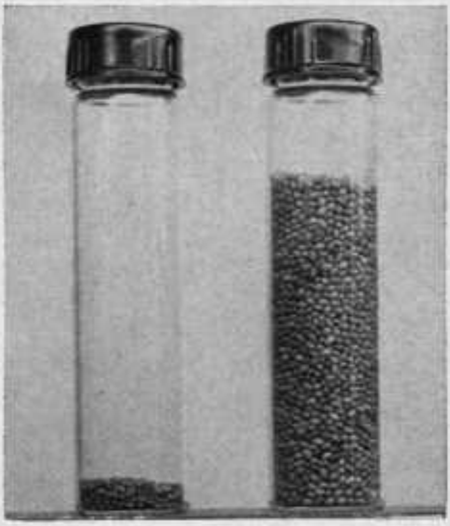


**FIGURE 3. Crimson clover: 508 seeds from 100 heads, bees excluded; 6,917 seeds when bees had access to clover.**

acres confined largely to the Willamette Valley counties.

**Crimson clover needs bees.** The need of bees for pollination of crimson clover has been demonstrated by this experiment station. Crimson clover is also attractive to bumblebees and some species of solitary bees.

### Lotus

Two species of Lotus are grown for forage and seed in Oregon. Big trefoil (*Lotus uliginosus*) is grown largely in Clatsop and Tillamook Counties since it seems better adapted to coastal conditions. Birdsfoot trefoil (*Lotus corniculatus*) has been grown mostly in Jackson County but is being introduced into other sections. Several varieties have been recognized.

Both species are valuable forage crops as well as good sources of honey. Increased plantings in the Willamette Valley and other sections combined with the plant's long blooming period under irrigation could greatly improve and prolong honey production in some parts of the state.

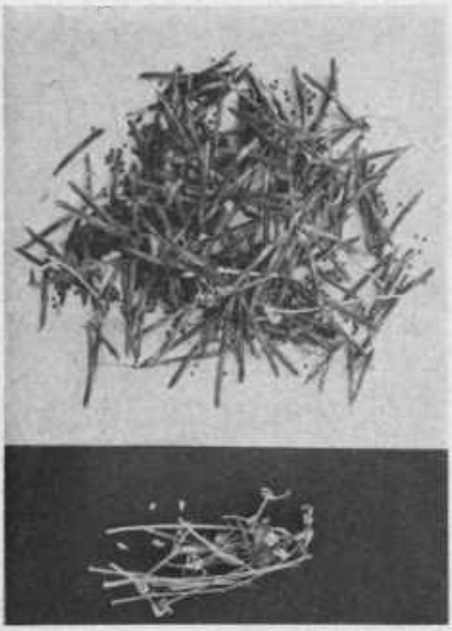


**FIGURE 4. Lotus uliginosus. A full crop of seeds with bees. No seeds without bees.**

In USDA Circular 625, McKee and Schoth have the following to say about the pollination of Lotus: "*Lotus corniculatus* is practically self-sterile, but occasional plants set a few seeds after self-pollination. Plants of *Lotus uliginosus* are, on the whole, incapable of spontaneous self-pollination; but after artificial self-pollination practically all plants are self-fertile, some to a very high degree. Thus these two perennial species are almost entirely dependent upon insect visitors for seed formation. . . ."

Cage tests have shown that bees are essential for pollination. The plants fail to produce either seed or pods without pollinating bees (see picture). Bumblebees as well as honeybees work Lotus freely.

### Red clover

Red clover has been a leading legume seed crop in Oregon and probably will continue to be. Bulk of the Oregon crop has been produced in the Willamette Valley, central Oregon and Malheur County. The acreage of red clover grown for seed in the state has varied from 12,000 to 24,000 acres.

Until recent years it was believed that bumblebees were essential for seed production and that honeybees would not be attracted to red clover when they could not obtain the nectar in the deep florets.

Observations by several researchers have shown that honeybees are attracted to red clover for pollen and in collecting it pollinate the florets. Cage work in Ohio and in Oregon (see picture) has shown that red clover is pollinated by honeybees. It is probable that a shortage of other pollen producing plants in the area will encourage honeybees to visit red clover.

### Strawberry clover

Strawberry clover seed production has been rather limited in the state and generally confined to eastern Oregon where the soil is saline or alkaline.

In USDA leaflet 176, Hollowell has this to say about the pollination of strawberry clover: "The flowers of strawberry clover are self-fertile, that is seed will form without cross-pollination, which is essential with red clover and white clover. Honeybee visitations from flower to flower, however, are of assistance in insuring a movement of the pollen to the stigma. Placing of colonies of honeybees immediately adjacent to blossoming fields is suggested as a means of increasing seed yields."

### Sweet clover

Sweet clover seed production in Oregon is rather limited. It seldom exceeds 500 acres. Production is limited to a few eastern Oregon counties with Union County leading in acreage.

Apparently no careful research has been conducted on the pollination of sweet clover by insects but field observations in North Dakota indicate honeybees greatly increase seed yields. Sweet clover is visited sparingly by many species of native bees which doubtless help greatly in pollination.

### White clover

During the period 1941 to 1950, white clover grown for seed in Oregon averaged over 1,000 acres, reaching a peak of 3,000 acres in 1946. This has tapered off since then to 300 acres. Linn, Marion, and Malheur Counties have led in production.

Most if not all research conducted on the pollination of white clover has been confined to the Ladino variety. Field observations have supported (in Ohio Extension Bulletin 253) the accepted view that bees are essential for pollination. Hollowell states that, "The presence of colonies of honeybees in the immediate vicinity of clover-seed producing fields usually insures a maximum of cross-pollination."

### Ladino clover

**Ladino clover production in Oregon.** In 1949 Ladino seed production in Oregon showed a marked increase due to plantings on the Jefferson County project. In 1951 this reached a maximum of 26,000 acres with Jefferson County leading. Second in production is Josephine County with close to 2,000 acres. By 1953 acreage had declined to a total of 8,000 acres for the state, 7,000 of which were in Jefferson County.

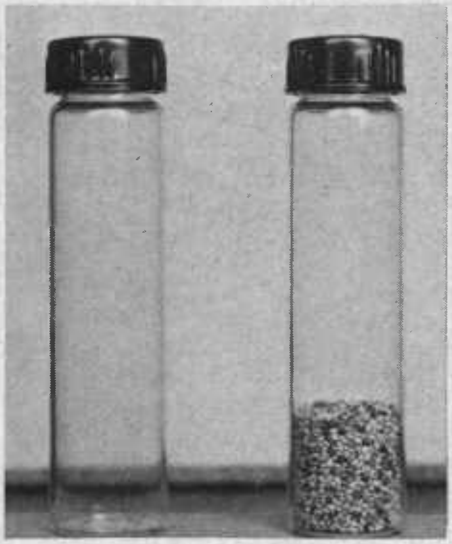


**FIGURE 5. Red clover. No seeds from 100 heads, bees excluded; 4,446 seeds when bees had access to clover.**

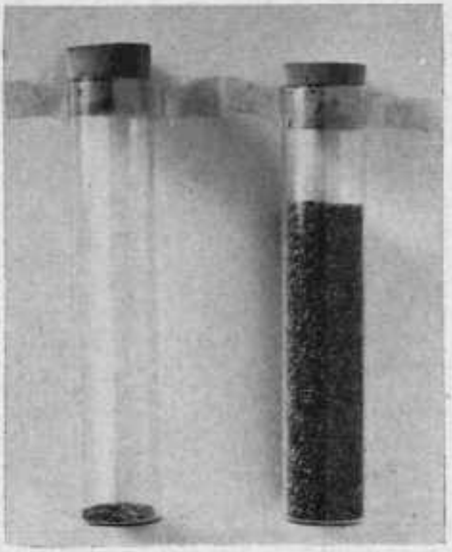


**FIGURE 6. Ladino clover: 365 seeds from 100 heads, bees excluded; 13,946 seeds when bees had access to clover.**

**Bees needed.** Studies in Oregon have shown the need of bees for satisfactory seed set in Ladino clover (see picture). In the central Oregon district bees other than honeybees are rare on Ladino. In southern Oregon the bumblebee population is greater possibly due to more available nesting places. In the Ladino fields of Josephine County bumblebees may equal one-fourth or one-third the number of honeybees. Occasionally, species of solitary bees (such as *Agapostemon*) may be seen visiting the flowers of this clover but their number is small and ensuing pollination of minor importance.

**How many honeybees are necessary to pollinate Ladino clover?** This is often asked not only for Ladino but for many other crops needing bees for pollination. One of the primary objectives of OSC research in recent years has been to find an answer to this question and to develop a method of approach which could be applied to other crops. By these studies, we have arrived at the following conclusions:

- One floret visit by a honeybee pollinates 1.21 seeds.
- One bee averages 5.4 floret visits per minute. Thus, one bee would make an average of 2,592 floret visits in one 8-hour day (the average working day for bees in Jefferson County).
- The average number of heads with open florets per square yard is 127.
- The average number of open florets per head is 12.3.
- The average total number of ovules to be pollinated in each square yard per day is 6,247.4.
- One bee will pollinate 3,110.4 ovules in one day. ($2,592 \times 1.2 = 3,110.4$)
- Therefore, it would take close to *2 bees per square yard* to pollinate the 6,247.4 ovules ready for pollination in each square yard each day. Bee counts have shown the usual population on Ladino in Jefferson County is around 1 bee or less per square yard. Only in rare cases does it reach 2 bees per square yard.

When the open head count is above the average of 127, the number of bees per square yard should be increased in proportion. It would probably be reasonably safe to assume that 1 bee will pollinate 60 open heads in one 8-hour day. These counts can easily be made under good working conditions for bees which would be a temperature of 75° to 80° with little or no wind.

- From the fact that there was somewhat less than 1 colony per acre in Jefferson County when these counts were made in 1949-51, it would appear that *1 colony per acre will result in about 1 bee per average square yard of bloom.* Colonies of bees in nearby woods and available colonies of bumblebees will reduce the number of honeybee colonies required.

**Climatic conditions important.** Wind and temperature both limit bee activity.

- Wind is of some, but slight, value in pollinating Ladino clover. OSC experiments showed that a strong artificial wind applied frequently to a plot of Ladino from which bees were excluded produced 1,627 seeds per 100 heads while a similar plot screened to exclude bees but without the artificial wind produced 271 seeds from 100 heads. In the same field 100 heads fully exposed to the normal population of bees produced 21,325 seeds per 100 heads. (See picture.) On the other hand, wind is an important item in reducing bee activity in the field, and thus any pollination resulting from wind is more than offset by decreased bee population.
- Temperature also greatly influences bee activity. This is due in part to the direct influence of temperature on bee flight and in part to the influence of temperature on nectar secretion. Relative humidity, wind, and soil conditions also affect nectar secretion and concentration. Bee activity on Ladino clover in Jefferson County was negligible below 70° F.

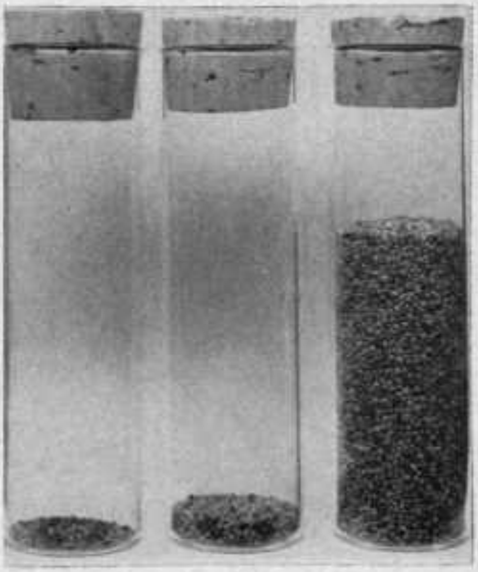


**FIGURE 7. Ladino clover seeds produced in 100 heads: 271 seed in cage without bees or wind; 1,627 seeds in cage without bees but with strong wind; 21,325 seeds in open field with bees and normal wind.**

**Nectar production in Ladino clover appears to limit pollination by bees.** Observations in Jefferson County have shown that bees lose weight when Ladino clover is the principal source of nectar. This is apparently due to a limited amount of nectar rather than low sugar content. Ladino nectar has an average concentration of 45.57 per cent sugar. This compares favorably with alsike clover, a good honey producing plant.

### Hairy vetch

Hairy vetch began to appear as a seed crop in Oregon about 1930. Acreage devoted to seed production increased to a maximum of 125,000 acres in 1942 but has since declined. In recent years it has been around 70,000 acres, confined to the Willamette Valley. Weevil caused marked decrease in hairy vetch seed from 1943 to 1946. When weevil control methods were developed seed production increased. Hairy vetch is also the leading surplus honey producing plant in the Willamette Valley.

OSC cage tests (see picture) have demonstrated that bees are essential for a good seed crop. Hairy vetch is worked freely by bumblebees and they assist materially in its pollination. No work has been done to determine how many bees are necessary for complete pollination.

**Hungarian vetch**

This vetch was an important seed crop from about 1920 to 1944. In recent years it has about disappeared from Oregon farms as a seed crop.

Due to the low nectar concentration in the flowers (25.2 per cent) compared with that produced on the stipules (47.7 per cent) honeybees seldom visit the flowers and thus do not pollinate them. Any pollinating by bees is probably done by bumblebees or other native bees.

**Willamette vetch**

This vetch, an improved strain of common vetch, is largely confined to western Oregon. In recent years the acreage has run from 102,000 acres in 1946 to 25,000 acres in 1951. As with Hungarian vetch, the floral nectar is low in sugar (22.6 per cent) compared with the stipular nectar (56.5 per cent). As a result, bees seldom visit the flowers.

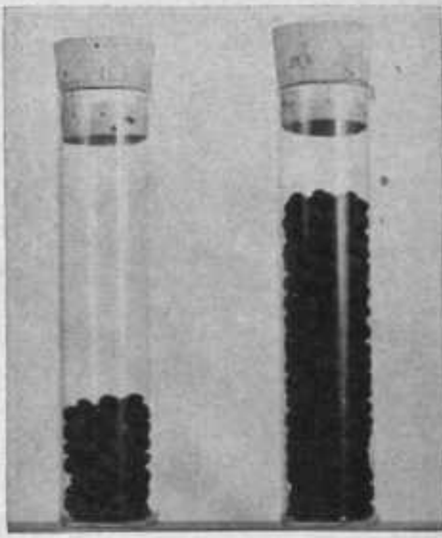


**FIGURE 8. Hairy vetch: 118 seeds, bees excluded; 390 seeds from equal number of pods in open field.**

# Bees . . . *providing them for pollination*

**Ownership or rental of bees**

Growers confronted with the problem of securing bees for pollination have two alternatives: they can either purchase or rent them. In general it has not proven practical to purchase bees unless the grower has had previous experience in their management or is in a position to study the problems involved in their care. It has not been found practical to depend on finding an experienced beekeeper who has time to care for the bees.

Renting bees for pollination purposes, therefore, has proven more satisfactory for most seed growers. In Oregon the usual practice has been to pay the beekeeper a flat rental. In a limited number of cases a crop sharing formula has been agreed upon. This latter method of obtaining bees is becoming more common in some sections of the country.

The usual principle followed in crop

sharing is to guarantee the beekeeper a minimum price per colony. When the seed crop is harvested the beekeeper receives a percentage above a predetermined acreage production. This crop sharing method is likely to result in a better supply of bees and better cooperation between the seed producer and the beekeeper, for each will be interested in the largest possible seed crop.

**Six problems involved**

**Labor.** Migratory beekeeping, whether for honey production or for pollination purposes, demands considerable manual labor. This labor may be separated into: first, that involved in the care and management of bees, and second, that concerned with their transportation. The former calls for special skill and training or experience in addition to physical labor. Either the owner-beekeeper must do this skilled labor, or hire a trained helper.

Labor involved in the transportation of bees and equipment to and from the seed fields calls for less skilled labor, but the work is heavy and much of it must be done at night. In recent years devices have been developed to assist in lifting heavy colonies of bees on and off trucks, but the cost of such equipment is too high for most beekeepers. Uniformity in bee equipment parts, rapid methods of fastening hive parts together, and other short cuts have materially reduced labor in many cases.

**Transportation.** Hundreds of truckloads of bees involving thousands of colonies are moved each year into and within the state for pollination purposes. Anyone considering migratory beekeeping should study truck body construction and handling methods developed by some of the more experienced and extensive operators. Costs involved in transportation operations are very important and should be held to the minimum.

In recent years the practice of moving bees without closing the entrance has become the common practice. This has eliminated the chore of closing and opening colonies. To avoid the scattering of stray bees along the highway many cover the entire load with well ventilated material which will confine the bees to the truck. This is highly desirable for protecting the traveling public.

**Financial investments.** The principal items included in the original investments are bees, bee equipment, trucks, and buildings.

It is important that the operator keep complete cost records not only for income tax purposes but to better determine equitable rental charges.

The following estimates may be of help. They are based, in part, on cost studies made in 1931 and 1932 (Oregon Sta. Bulletin 362, 1939) and in part, on present prices of equipment and labor.

- Bees will represent close to 20 per cent of the original investment exclusive of trucks and buildings. Based on present prices for 3-pound packages with queens plus transportation, this cost will run close to $6.00 per colony.
- Beekeeping equipment required will represent around 75 per cent of the total investment exclusive of trucks and buildings. This will be close to $25.00 per colony. This is assuming the beekeeper will use a minimum of 3-hive bodies per colony. More bodies will be needed if surplus honey is being produced.
- Trucks are essential for moving bees. The type and size of the truck will be determined by the extent of

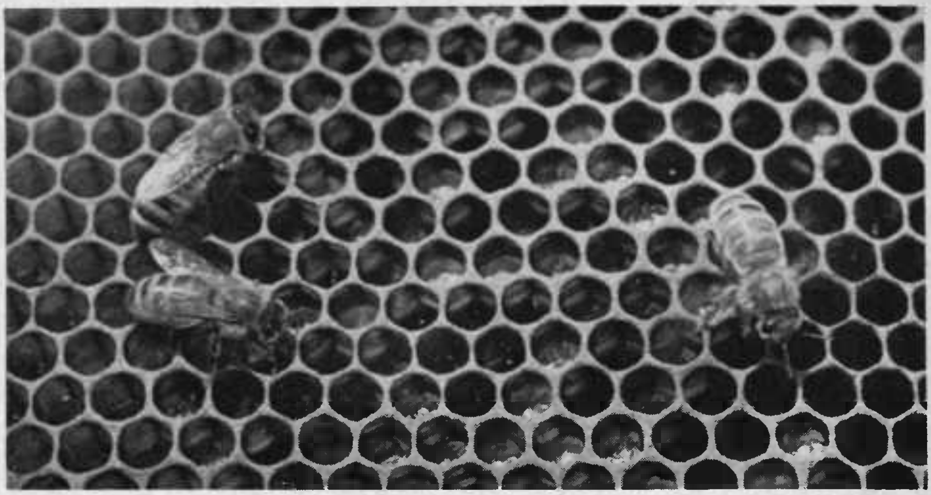


**FIGURE 9. Abundance of pollen in frame indicates bee activity in nearby legume field. Misuse of insecticides during peak bloom will drastically curtail bee activity and limit pollen collection.**

moving operations and other uses, if any, to be made of the truck. Four-wheel trailers equal in size to the truck double the carrying load at considerable less than twice the cost with a truck alone. It is difficult to even give an estimate of truck costs without more available information. The cost of a new 1½- or 2-ton truck with a specially built body will be around $2500 at 1953 prices.

• Buildings or building space must be provided for storage of equipment and for shop purposes. In most sections this should also include garage space for trucks. The total cost of such facilities is difficult to estimate, but the minimum will be an important item of investment and can run into several thousand dollars.

**Operating costs.** Included in operating costs are many items some of which seem of little significance, but when totaled for the year, are important. These include labor, truck operation and depreciation, depreciation and replacement of bee equipment, interest on invested funds, taxes, registration, and queens. Of somewhat less importance are telephone service, sustenance when away from home, and numerous other items. We have no definite information on which to base cost estimates.

• Labor is probably the major item of operating costs. In 1931-32, the average Oregon commercial beekeeper was spending 4.8 hours per colony per year when managing bees for honey production. It is reasonable to think that an equal amount of time is necessary when operating for pollination purposes. What this 4.8 hours represents in cash value will depend on what the operator considers his time worth or what he would need to pay a trained and experienced helper.

• Truck operation costs represent one of the major items of operational expense and complete records should be kept. Farm cost studies have shown that cost per mile for small trucks (1½- and 2-ton) will run close to 12 cents.

Total yearly mileage and age of trucks will have a bearing on cost per mile. A trailer will reduce trucking costs.

- Depreciation of equipment is especially important in migratory beekeeping. Depreciation of hive parts ranges from 10 to 12 years when bees are managed for honey production. When managing bees for pollination purposes, it is necessary as a rule to move colonies much more often and equipment is subject to greater wear.
- Interest on money invested in the enterprise is usually figured at 5 per cent. This is a cost item all too often overlooked.
- Taxes, registration, queen rearing, insurance, sustenance when away from home, and other minor items add materially to the cost of providing bees for pollination purposes.

**Bee diseases.** The seriousness of bee diseases is probably the most important reason why bees being used for pollination purposes should be under the management of an experienced person. The movement of hundreds of colonies into and out of a concentrated seed producing section and the tendency of owners living long distances away to neglect colonies, all greatly increase the danger of infection from nearby colonies.

**Management.** The problem of securing a maximum number of strong pollinizing colonies at the beginning of the blossoming period calls for special management. Furthermore, this colony strength must be maintained during the entire blooming period of the seed crop. Colonies which have just passed through a heavy surplus honey producing period may not be able to maintain adequate strength for pollination.

Where the seed crop itself does not supply an adequate amount of nectar and pollen for the bees to winter on and for spring build-up, bees will need to be moved to some area where these foods are available. This has been necessary in the Jefferson County area.

### Responsibilities of the seed producer

**Location.** In arriving at an agreement between the seed producer and the beekeeper, one of the first responsibilities of the grower is to provide suitable locations for the bees. These locations should be easily reached by truck. An exception may be made for brief periods when the field is being irrigated. If possible, the beekeeper should be notified when the fields will be irrigated so he can time his visits accordingly. The location should not be subject to uncontrolled flooding or grazing by livestock.

**Insecticides and other chemicals.** Most growers recognize the danger to bees of unwise use of poisons either as insecticides or for other purposes. Insecticides least toxic to bees will be used when such chemicals effectively control injurious insects. When it is necessary to use chemicals toxic to bees, their danger can be greatly reduced by application when bees are not in the field.

When possible, apply insecticides before the seed crop is in bloom. If you must apply poison to a crop in bloom or there is danger of the chemical drifting into a nearby area where bees are working, make application either in early morning or late evening when bees are absent.

The method of applying the chemical is also important. Because of greater drift airplane application is likely to cause more damage than ground machines. Usually, dusts are more destructive than sprays.

## Responsibilities of the beekeeper

**Furnish reasonably strong colonies of bees.** They should be managed to provide good strength in working field force for the entire blooming period of the seed crop.

**Distribute bees throughout the field.** This is to provide maximum efficiency in pollination as well as minimum inconvenience to the beekeeper and the seed grower. Lacking definite information on the flight range of field bees under various climatic and crop conditions in the state, we would suggest colonies be placed in groups of from 10 to 20 colonies. Local conditions may make it desirable to have a larger or smaller number in each location. The direction of the prevailing wind should be from the field towards the bees if any choice is possible. Place colonies in a spot fully exposed to at least morning and late afternoon sun to encourage early and late flight. In the hotter sections, a shade board may be desirable on the south side of the hives.

**Care of colony.** Time visits to avoid disturbing the bees shortly before the seed grower needs to be near them for necessary field work. The grower, however, should take the precaution of having a bee veil on, or handy, when it is necessary to work near bees. Unless other arrangements are made, the beekeeper would be expected to be responsible for the entire seasonal management of the bees.

## Laws about bees

Copies of all laws relating to beekeeping may be secured by writing to the State Department of Agriculture, Salem, Oregon. These laws may be grouped as follows: a. Laws relating to disease control and registration; b. Laws relating to grading and marketing honey; c. Laws relating to strength of colonies rented for pollination purposes.

The enforcement of all regulatory matters is the responsibility of the State Department of Agriculture. Oregon State College is concerned only with research and education.

**FIGURE 10. Beekeeper is responsible for maintaining strong, disease-free hives. This can be done by inspection every two weeks. Weak colonies are of little value to either seed producer or beekeeper.**

# Native Bees . . . *and pollination*

## Bumblebees

The Pacific Northwest is blessed with a large number of bumblebees representing close to 30 species. A few of these species are rare and confined to high elevations, thus of no value in pollinating cultivated crops. Several common species of the lower altitudes are abundant and are of value in the pollination of many seed and fruit crops.

Bumblebees nest in deserted mouse nests, old burlap, piles of chicken feathers, and other similar material. These nests may be above or below ground, depending on the habits of the particular species. Farmers should preserve and even furnish such nesting places and materials.*

Only the young, mated, queen bumblebee lives over the winter. These young queens desert the old nest in late summer or fall and hibernate in protected places. In early spring they emerge from hibernation and feed for a time on early blooming plants. Later in the spring each queen will find a suitable nesting site and start a new colony. In a short time worker bumblebees will appear and the colony will reach its maximum strength in early summer. By middle or late summer, the male bees and young queens appear. At the end of the season all members of the colony will die off and the young mated queens will seek hibernation locations. Bumblebees have several natural enemies. Improper use of insecticides will also reduce the bumblebee population.

* The Department of Entomology, OSC, would appreciate nests of bumblebees for study. Information on how to collect these nests will be furnished on request.

## Solitary bees

All native bees are solitary bees except bumblebees. They are so called because they live as individuals and have no colony organization such as is true for both bumblebees and honeybees. Solitary bees, however, may live in nests located close together and give the appearance of a colony. Nests are made in the ground, in rotten wood, in other deserted insect cavities, in the pith of bramble canes, and in many other locations. Each species has its own preferred nesting place.

With solitary bees it is usual for the adults to die at the end of the breeding season and only the young immature individuals overwinter to emerge as adults the following season. The active period of brood rearing is usually confined to a few weeks during the spring or summer so their length of service as pollinators is limited. Furthermore, many species confine their attention to a single or limited number of plant species. If these plants happen to be cultivated seed or fruit crops which bloom during the time these bees are active, they may be important in pollination.

The presence of these solitary bees as pollinators in important numbers will depend primarily on the numbers and nearness of nesting bees. When the nesting locations of these wild bees are discovered, it is important to take special care not to disturb them by cultivation or in any other way. It is also important to prevent their destruction by insecticides or livestock. The reduction of native flora by the use of herbicides or other methods may also reduce the number of valuable solitary bees.