DISPOSABLE POLLINATION UNITS, A REVIVED CONCEPT OF CROP POLLINATION

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I. Introduction

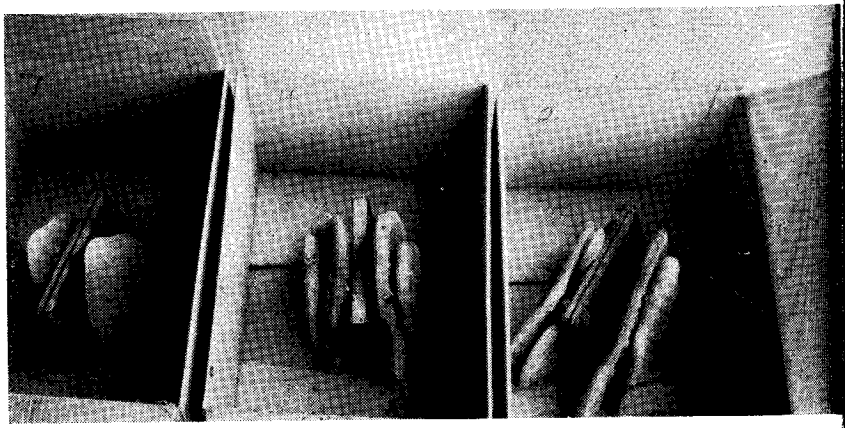
POLLINATION of many important agricultural crops depends on bees, but the cost and difficulty of obtaining sufficient numbers of honey bees has occasionally limited their use. Now the increasing demands of the growing population in the United States for food and fiber are forcing producers of many crops to turn to honey bees to insure maximum yields and quality. At the same time, increasingly unfavorable economic and ecological conditions are reducing the available supply of pollinating honey bees. Therefore, four laboratories of the Apiculture Research Branch of the Entomology Research Division, Agricultural Research Service, USDA (The Bee Breeding Investigations Laboratory and the Bee Stock Investigations Laboratory at Baton Rouge, Louisiana; The Honey Bee Pollination Investigations Laboratory at Tucson, Arizona; and The Bee Management Investigations Laboratory at Madison, Wisconsin) recently explored the possibility of temporary, disposable pollination units to solve some of these problems.

Review of Literature

Gooderham (1936,) Eckert (1936), Dunham (1938), and Vansell (1942) all reported using packages of honey bees to pollinate crops to replace colony losses during the winter to increase honey production, and to boost populations of colonies. Woodrow (1934) discussed the variation in the number of bee flights as in relation to the size of the colonies used in package bees in their shipping containers as pollination units: Hutson (1928) and Root (1938) both reported shipping packages of honey bees to Washington where the growers wrapped the screen shipping cages in tar paper and placed them in orchards for apple pollination. However, this early use of a disposable type of pollination unit was discontinued after a few years because of the cost of the screen cage, the queen, and the bees and for other reasons. Now, advances in apicultural technology may make the method more feasible at the same time that the need for pollinating units has increased. We therefore reinvestigated the concept of disposable pollination units for particular specialized pollination situations.

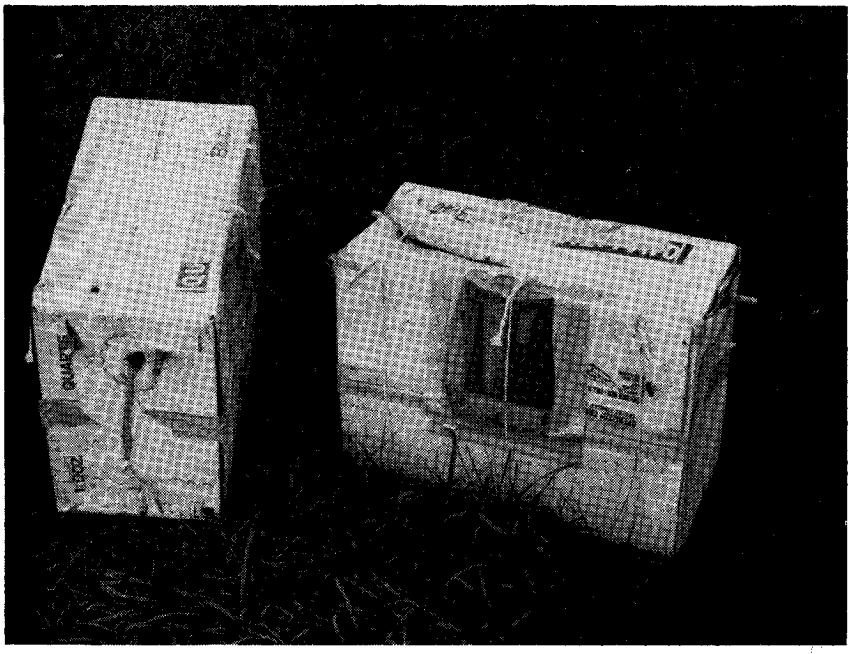
Methods and Materials

We made three tests: one to ascertain whether there was an optimum size or population for such units; the second to study the effect on flight activity of the presence or absence of a laying queen or a substitute; and the third a field test in Wisconsin in which we compared the pollination of cucumbers achieved by disposable pollination units (DPU's) containing virgin queens treated with CO_2 with that of "standard" colonies. The results were measured by forager flights per unit time from the entrances of the DPU's, the number and size of combs constructed, the square inches of brood, pollen, and honey produced, and the pounds of cucumbers produced per acre. Because these were primarily preliminary tests, the detailed data are not presented.



Comb production of seven pounds of bees with no queen after three weeks. Tucson, Arizona.

Comb production of seven pounds of bees with laying queen after three weeks. Tucson, Arizona.



Temporary disposable pollination units after six weeks in the field at Madison, Wisconsin.

Results and Discussion

The activity of bees from DPU's indicated that colonies with laying queens, caged or uncaged, gathered more pollen and honey than those with caged virgin queens, no queens, or queen substance. DPU's with uncaged laying queens had the greatest amounts. However, for the first three weeks of the test, DPU's with virgin queens treated with CO_2 had about as much bee flight and as many pollen collectors as those with mated laying queens. During the second three weeks, bee flight was greater from DPU's containing mated laying queens. This greater sustained activity and collection of nectar and pollen in the queenright DPU's can be attributed to the regular emergence of worker brood to replace losses in the aging adult bees. DPU's headed by the treated virgin queens built drone comb and also stored honey and pollen.

Queenright DPU's that contained from 2000 to 21,000 bees had total numbers of flights which were closely related to population size. Flights per thousand bees in the nest were essentially the same for all populations, indication that larger units do not have an advantage in flight efficiency and that the size of population used can be determined on the basis of other factors.

The yield when 36 3-lb. DPU's were scattered throughout the 6-acre field of cucumbers (the equivalent of 2.3 colonies per acre) was 98 cwt. per acre. A similar field of about 5 acres pollinated by 25 standard colonies placed in a group along the edge (5 colonies per acre) had a yield of 117 cwt. per acre.

Thus, the study demonstrated that the use of bees in their shipping containers for short-term pollination, abandoned many years ago, needs new evaluation. Perhaps inexpensive disposable containers of cardboard or styrofoam filled locally or elsewhere with convenient numbers of bees (3 to 8 lb.) and a suitable queen or queen substitute (Jaycox 1969) can provide pollination that is economically competitive with the pollination provided by complete colonies. When the necessary economic comparisons have been made, we will know better the full potential of this procedure. We can expect that shipping and dispersal costs will be much less because these small units are lighter and less bulky than standard colonies. Also, the responsibility for the care and maintenance of the bees and for any damage due to applications of pesticides would be shifted from the beekeeper to the grower. When the usefulness of the units is over, the bees can be gassed, and the units buried or burned. (Bee inspectors will have some educational or followup work to do to insure compliance with laws and sanitation practices.)

Further research is therefore under way to determine the comparative costs of this technique and the answers to many of the questions raised here. We hope that members of the beekeeping industry will also give this revived concept some thought since past experience tells us that they will work out practical problems of application. ●

Literature Cited

Dunham, W. E. 1938. Package bees in honey production. Ohio State Univ. Agr. Ext. Ser. Bull. 159, P. 16.

Eckert, J. E. 1936. Preparation, shipment and installation of package bees. J. Econ. Entomol. 29(5):877-885.

Gooderham, C. B. 1936. Package bees and how to install them. Can. Dept. Agr. Farmers' Bull. 507(8).

Hutson, Roy. 1928. Package versus overwintered bees for orchard use as pollenizers. Amer. Bee Jour. 68(3):128.

Jaycox, E. R. 1969. Honey bee queen pheromones and worker foraging behavior. Ann. Entomol. Soc. America. In press.

Root, A. I. 1938. Package bees. pp. 1-8. In The Bee Hive.

Vansell, G. H. 1942. Factors affecting the usefulness of honey bees in pollination. USDA Circ. 650, P. 31.

Woodrow, A. W. 1934. Effect of colony size on the flight rates of honey bees during period of fruit bloom. J. Econ. Entomol. 27(3):624-629.

Comb production of three pounds of bees with laying queen after six weeks in the field at Madison, Wisconsin.