

At least three distinct types of cages will be recommended to the trade: (1) A 2-pound combless package; (2) a 3-pound combless package; and (3) a nucleus, or comb package. The adoption of these



FIGURE 13.—Shaking bees into a 3-pound package

standard cages will result in a great reduction in the number of types and sizes of packages that have been used by package shippers in the past.

WARREN WHITCOMB, Jr.,
Assistant Apiculturist, Bureau of Entomology.

BEET Leaf Hopper's Annual Migrations Studied in Desert Breeding Areas

The spring of 1930 witnessed extensive migrations of the beet leaf hopper into many of the important sugar-beet growing areas of the Western States. The Sacramento Delta and other districts of California, southern Idaho, Utah, and western Colorado all received migrations of more or less severity, and all were accompanied by injury due to the curly-top disease which the beet leaf hopper transmits. A rather extensive migration also occurred in New Mexico from the insect's breeding area along the Rio Grande. These migrations are of interest to other than sugar-beet growers as the curly-top disease also affects other crops, including tomatoes, beans, tobacco, table beets, peppers, spinach, and various melons.

Inasmuch as the insects breed in tremendous numbers in desert areas and migrate under favorable conditions into the cultivated sections, a knowledge of the location of the desert regions involved and the cultivated sections infested from each area is highly important. More extensive desert surveys and studies of desert conditions have been made to obtain all the information possible which has any bearing on the habits and distribution of the insect in the desert.

Although this leaf hopper probably breeds in any place throughout the arid West where the winter climate and the host plants are favorable, there are certain regions more favorable for its abundant development than others. The host plants most favored in the desert are the mustards, filaree, Russian thistle, and annual *Atriplex* or saltbush. Other plants also are able to support the insect, but some combination of these favored plants appears to be important in producing the more extensive breeding areas. Such large regions favorable to abundant development are located in southern Idaho, in western Washington, in western Oregon, in southern and western Utah, in western Nevada, in California along the border ranges of some of the interior valleys, and along the Rio Grande in New Mexico and Texas.

The migratory movements are of a most concerted nature, tremendous numbers coming into a given area overnight. The insects are not discernible in the air at the time of flight, except in rare cases, the movement being detected by their discovery in cultivated areas where they were previously absent. The factors responsible for this concerted movement are under observation and are probably at least twofold. One stimulus to the movement, at least on some occasions, is the drying of the host plants so that those in the winged stage of development are impelled to move, because of the food scarcity, to more favorable host-plant locations. During the spring migrations of 1930 it appears that migrations occurred, in some instances at least, from places where the host plants were in excellent condition. The other stimulus likely to be found of importance is the mating urge, and some migrations possibly partake of the nature of a mating flight.

Height of Movement Important

There are a number of points concerning these annual spring movements which are not entirely clear and concerning which additional information is needed. The height of movement, for example, is of considerable importance in connection with ability to cross the barriers offered by high mountain ranges. Evidence obtained this year indicates that in at least one flight, probably a short one, the insects maintained a very low altitude. This was shown by traps devised for the purpose and placed at various heights on a pole support. The largest number of leaf hoppers were obtained at about 10 feet above the ground. There is good evidence, however, that in long-distance flights the insects reach high altitudes.

The distance covered by the migrating insects is also of importance in determining what areas are a potential menace to sugar-beet production. It is apparently certain that flights in the California area can be measured by 200 or 300 miles. Possibly some flights have considerably exceeded that. It appears quite likely, however, that the areas of a more local nature relative to a given beet region are of far greater significance than breeding areas at a distance.

In California there is a definite fall movement, correlated with plowing operations in the valleys and later drying of host plants, which results in repopulating the dry depopulated hills where filaree appears with the first rains. This return movement has not been recognized in other areas but its occurrence is a possibility. Its detection is more difficult where a fairly large population has been able to maintain itself in the desert all summer.

There is undoubtedly a close correlation between climatic conditions and the size of a migration and the time of its occurrence. In at least some areas this correlation can be used in predicting the probability of leaf-hopper damage with an excellent chance of accuracy. The degree of accuracy obtainable is dependent on the extent of the information available regarding both the size and location of the breeding areas involved and on observations of the effect of various weather types in previous years. The cumulative data obtained through successive years adds to the probability of accuracy in following seasons. Prediction of outbreaks is at best, however, only a palliative which gives the grower an opportunity to profit as far as possible by favorable years.

Direct Control Desirable

As far as the insect is concerned, permanent solution of the problem lies in the development of some method of direct control or in the destruction of the insect in the breeding areas through some of its parasitic enemies. Spraying of beets with various insecticides, including light emulsified oil, has again proved unsatisfactory as a method of control. The migration extended this season in Idaho from May 24 to at least as late as June 16. Control by spraying the beets would necessitate from two to four applications, even with 100 per cent kill, which has not been obtained as yet. If spraying were delayed until all leaf hoppers were in the field, many insects would have been feeding for nearly three weeks.

Breeding-area control offers possibilities in some instances where the areas are of a local nature. These possibilities, which are at present under investigation, include not only those of direct insecticidal operations, but the destruction of host plants by other means, both direct and through the association of insects occurring thereon.

A number of parasites of the leaf-hopper eggs and of the insect itself are known to exist in the territories infested. For some reason these are rarely effective in bringing about an appreciable reduction in the numbers involved in the spring migration. There is a possibility that where the factors responsible for this failure are known, selection of parasites not affected by these conditions will be possible. Investigations with this object in view are now under way. It is probably true that ultimate control where necessary will involve the utilization of both parasitic enemies and direct insecticidal operations.

P. N. ANNAND,
Entomologist, Bureau of Entomology.

BBLACK Stem Rust The parasite black stem rust causes serious losses each year in some of the grain-growing regions of the United States. Spores Combed from the Air by Fliers This rust depends for its development upon the presence of the tiny spores or reproductive bodies of the rust fungus together with warm, moist weather during the time grain crops are rapidly growing.

One of the activities of the Office of Barberry Eradication is to determine the source of the first stem-rust spores to appear in the northern spring wheat growing States. They may develop on the infected leaves of common barberry bushes growing on farms or city properties