trace large numbers of foraging bees to their respective hives makes it possible to associate various genetic stock with its performance characteristics. Several research workers have demonstrated during the past decade that honeybees can be selected for crop preference, and this trait can be enhanced by controlled breeding procedures. Several thousand experimental hives throughout California are being stocked this year with a new hybrid bee, called Hy-Queen, that is being tested for its performance in gathering pollen on such crops as alfalfa.

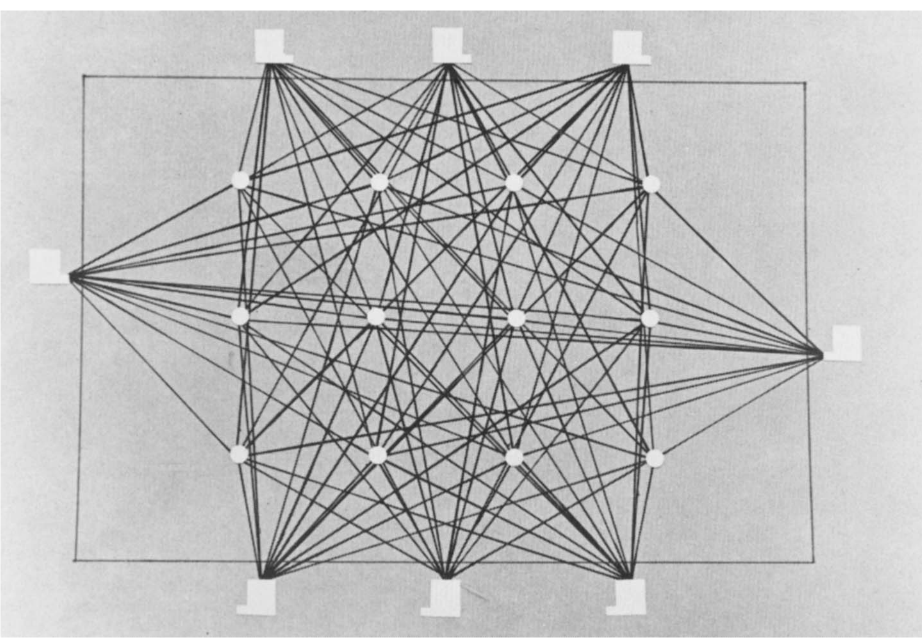
The ability to associate foraging bees with their parent colonies also provides a powerful tool for detecting colonies that may contain other genetically-carried traits affecting foraging behavior and pollination efficiency. For example, the selection of breeding stock for increasing the pollination efficiency of almonds could take place as follows. Hundreds of bees would be placed near almonds. Thousands of bees foraging on almonds would be tagged and released. Hives containing significantly higher recapture frequencies would be selected for further breeding procedures that would enhance the tendency of bees to forage on almonds. Later, the same stock could be tested on other crops to determine whether the increased efficiency is limited to almonds.

During the past year the magnetic recapture system has been used to trace the flight distribution and range of honeybees on many orchard and field crops. One of the most interesting developments appears to be the inclination of honeybees to forage on a great diversity of plant species, even when productive food sources may be closer than some of the other plants visited. Another observation was that foraging bees seem to respond to various levels of competition from bees originating from other apiaries, and to adjust their foraging territory to minimize competition. For example, when small groups of hives were dispersed within field crops, the effective foraging range frequently was restricted to less than perhaps 200 yards on that particular crop. Yet, the same bees might have flown a half mile or more had they not encountered competition from other nearby apiaries.

These studies suggest that it may be possible to control the foraging range of bees to a greater extent through manipulating inter-apiary competition (by distributing apiaries more strategically). It may also be possible to attain higher degrees of isolation for various seed crops that should be grown in relatively concentrated areas, where soil and weather characteristics are favorable. It is not always convenient or economical to space these fields far apart to prevent undesirable cross-pollination between varieties in different fields.

Norman E. Gary is Associate Professor of Entomology and Associate Apiculturist in the Experiment Station, Department of Entomology, University of California, Davis.

Possible flight patterns of honeybees from eight apiaries to 12 sample points within a "target" crop. Multiple sample points reflect interapiary competition by revealing the comparative visitation frequency at the sample points.



N. C. WELCH • W. H. HART
B. LEAR

Response SOIL *for* *in central*

LETTUCE CROPS in the central coastal district of California may follow each other in rapid succession on the same land with only a short period between the harvest of one crop and planting of another. Some growers in this area use soil fumigation after a series of 5 to 6 lettuce crops to improve yields and quality. The effectiveness of such fumigation has been attributed to such factors as nutrient release and the control of unidentified pathogens but specific data has been lacking.

During the past four years, preplant soil fumigation trials were conducted in fields infested with stunt nematode, *Tylenchorhynchus brevidens*, and with spiral nematode, *Rotylenchus robustus*, and in one field containing no significant nematode pathogens. In two experiments fumigants were injected by tractor-drawn equipment in a solid (overall) treatment with chisel shanks 12 inches apart set to deliver the chemical 8 inches deep in the soil. In two other experiments the fumigants were injected 6 inches deep and 12 inches apart by handgun in raised beds. Application rates were based on the actual area treated. All harvesting was done by commercial picking crews.

First experiment

The first experiment in 1967 for control of stunt nematode was made in alluvial soil of the Pajaro Valley where a nematode population of about 100 per 100 ml of soil was found. Plot size was 18 × 100 ft, and fumigants were applied in an overall treatment using tractor-

of lettuce to

FUMIGATION

nematode control

coastal districts

drawn equipment followed by a ring roller to provide a seal. Beginning five days after treatment, approximately 18 inches of rain fell over a two-month period, resulting in poor growing conditions and uneven plant growth. However, more marketable heads were produced in the treated plots than in the untreated plots (table 1).

Repeated

In 1968 the experiment was repeated in the same area on a similar soil with a comparable nematode population. The fumigant (1,3-dichloropropene, or Telone) was applied in raised beds by hand applicator two months before planting. Growth in this experiment was very uniform, and there was a significant increase of marketable heads in treated areas (table 2). While the lower rate of chemical (25 gal per acre) gave good results, the higher rates (50 and 75 gal per acre) gave heavier heads than the lower rate. Head color and weight were improved in all treated areas, as compared with the untreated, and root weight was increased in treated areas (table 3).

In 1965, an experiment was conducted for control of the spiral nematode *Rotylenchus robustus*, in lettuce with the cooperation of C. Attlee, Farm Advisor of Santa Cruz County. In the first year, plots were treated with ethylene dibromide (EDB) and dichloropropene-dichloropropane mixture (DD). The following year, half of these treated plots were re-treated with dichloropropene fumigant (Telone) providing a comparison of one and two years' treatments on the same land. All treatments (1965 and 1966) improved lettuce yield in 1966. In addition, retreatment in 1966 provided some increase over areas treated only in 1965, although this increase was not highly significant (table 4).

In 1969, a trial was established in the Pajaro Valley on soil without any significant level of plant-parasitic nematodes. Bed treatments were made by handgun, similar to the 1968 experiment. There were no appreciable yield or quality differences between treated and untreated areas (table 5).

Both nematodes

Both the stunt nematode and spiral nematode are associated with declining yield and quality of lettuce in the central coastal area of California. Production problems associated with these nematodes may be expected to increase with repeated planting of susceptible crops on the same land. Fumigation can raise production on land infested with injurious population levels of these nematodes. However, if injurious levels of plant-parasitic nematodes do not exist, soil fumigation with nematicidal chemicals will probably not provide increased production, or quality.

N. C. Welch is Farm Advisor, Santa Cruz County; W. H. Hart is Extension Nematologist, and B. Lear is Nematologist, Department of Nematology, University of California, Davis.

TABLE 1. YIELD RESULTS OF EXPERIMENTS TO CONTROL STUNT NEMATODE, T. BREVIDENS ON LETTUCE, 1967

Treatment	Rate	Yield in cartons
	gal/A	no./acre
Check		223 a*
EDB	4½	446 b
Telone	20	489 b
Telone	30	432 b

* Duncan's multiple range test (1% level). Treatments with same letter not statistically significant.

TABLE 2. COMPARISON OF YIELDS OF LETTUCE HEADS RESULTING FROM DIFFERENT RATES OF TELONE FOR CONTROL OF STUNT NEMATODE, T. BREVIDENS, 1968

Treatment	Plants per 50 ft row*	Yield in cartons: First harvest	Yield in cartons: Total	Increase over check
gal/A	no.	no.	no.	%
Check	90	80 a†	593 a	
25	91	164 b	759 b	21.9%
50	92	221 c	834 c	28.9%
75	89	221 c	825 c	28.1%
	N.S.			

* Average of 4 replications.
† Duncan's multiple range test (1% level). Treatments with same letter not statistically significant.

TABLE 3. COMPARISON OF LETTUCE ROOT WEIGHTS RESULTING FROM DIFFERENT RATES OF TELONE FOR CONTROL OF STUNT NEMATODE, T. BREVIDENS, 1968

Rate	Root weight†
gal/A	gm
Check	349.5 a*
25	400.1 b
50	479.9 c
75	481.4 c

* Duncan's multiple range test (1% level). Treatments with the same letter are not significantly different.
† Average of 10 roots, 4 replications.

TABLE 4. YIELD RESULTS OF RETREATMENT TRIALS FOR SPIRAL NEMATODE, R. ROBUSTUS, 1966

Treatment	Rate	1966 Heads cut per 100 ft of bed	1966 Wt of heads cut
	gal/A	no.	gm
Check (No treatment)		36.5 a	58.2 a*
EDB (Applied in 1965)	4	75.7 b	137.9
DD (Applied in 1965)	30	88.5 b	157.7 b
Telone (Applied 1966, over 1965 DD)	30	95.5 b	190.0 b

* Duncan's multiple range test (1% level). Treatments with the same letter are not significantly different.

TABLE 5. YIELD RESULTS OF DIFFERENT RATES OF TELONE ON PLOTS WITH NO PLANT-PARASITIC NEMATODE, 1969

Rate	Yield in cartons: First harvest	Yield in cartons: Total
gal/A	no./acre	no./acre
Check	401	643
25	418	659
50	413	657
75	409	662
	N.S.	N.S.