peak moth flight periods, although the number of adults caught in the traps was small. During the summer of 1970, a sex pheromone trap for OLR was developed and used for the survey.

The traps (see photo) were constructed of 17 × 38 cm round cardboard cartons, each with a 1 pint 8½ × 9 cm round ice cream carton in the middle. The sides of the small carton (which served as the virgin female cage or pheromone source chamber) were screened to allow the free circulation of female attractant. The female cage carton was held in position by a stopper cork. The sides of the cardboard carton traps were left open. The inside surfaces of cardboard cartons were painted with Stickem to trap attracted males.

Comparison

Both the light traps and virgin female (VFT) traps were hung in the vineyards with a short cord 6 to 8 ft from the ground. One newly hatched virgin female was placed in the central cage of the pheromone trap. Females were changed twice a week, and fed on 10% sugar solution. The effectiveness of sex pheromone traps was compared with black light traps by placing them in the same general area, one mile apart from each other.

Results (see table) indicate that the virgin female traps (pheromone traps) were significantly more effective than the light traps. The total monthly counts indicate that during July 1970, light traps attracted an average of 3.7 moths per night, whereas pheromone traps attracted 24.2 moths per night. A similar trend was exhibited in the catches of August, September, October, and November 1970. On an average, pheromone traps attracted 6.6 to 9.3 times more moths than light traps. This indicates the remarkable effectiveness of sex pheromone trapping.

Considering the importance of OLR in the San Joaquin Valley vineyards, and the lack of information on its field biology, ecology, and overwintering habitats, it would seem that pheromone traps are an urgently needed tool. Study of OLR will not only help in detection and survey, but will also be advantageous in determining the proper timing for insecticidal applications, the number of generations, overwintering habitats, specific pattern of spread, and the damage potential of the pest.

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DAVID RIRIE

MINIMUM SPACING

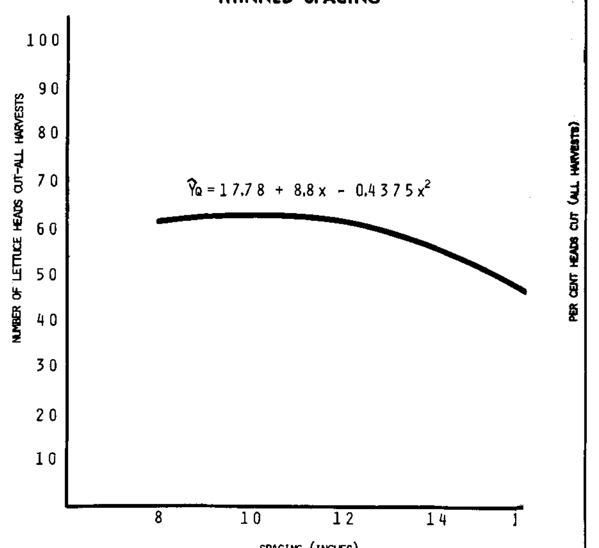
TWO POSSIBILITIES exist as ways to eliminate hand thinning in lettuce production: (1) to combine precision planting with the use of a selective thinner; and (2) to plant to a stand, utilizing improved seed environment control with respect to plant protection, soil crust prevention, and moisture control. Regardless of which system the grower chooses, he must decide on a minimum spacing that can be tolerated, without sacrificing head size, quality or yield. If the thinner is used, the cutting mechanism should be set to leave plants as close as possible to that minimum spacing. If planting to a stand is practiced, then the minimum spacing will result in maximum plant population, thereby giving better yield insurance to cover any loss of stand. The purpose of this study was to determine the minimum plant spacing that could be tolerated without yield or quality loss under field conditions.

Eight experiments were conducted beginning in 1967 and concluding in 1969. Harvest dates ranged from May 10 to August 6. To guarantee that lettuce plants would be thinned to nearly exact spacings, marked strings were placed beside the rows to be thinned, and the thinning crew was instructed to leave a plant opposite each mark. At harvest time the commercial crew cut the lettuce from the variously spaced plots. Yields were reported in terms of heads cut or in cartons per acre. All plots were arranged as 5 × 5 Latin squares except one which was a 6 × 6 Latin square. Spacings ranged from 6 to 16 inches in increments of 2 inches in the first test, but in subsequent tests the 6-inch spacing was omitted.

A statistical analysis of the data showed that the percentage of the theoretical stand surviving, mean number of heads cut per plot at each spacing, and percentage of heads cut at each spacing could be represented by highly significant quadratic curves. As determined by number of heads cut, the minimum spacing giving the best yield (of two-dozen-per-carton size lettuce) was 10 inches. Stand losses were greatest at 8 inches, with some stand loss also occurring at the 10- and 16-inch spacings. The 12- and 14-inch spacings produced slightly over 100 heads per 100-ft row, suggesting that the desired stand was slightly exceeded. This may have been because plants were left exactly at both the beginning and end of each line and/or because of the presence of occasional double plants.

The lowered survival at 8- and 10-inch spacing was probably due to hand weed-

GRAPH 1. RELATIONSHIP OF TOTAL NUMBER OF LETTUC HEADS CUT PER 100-FT ROW (ALL HARVESTS) TO THINNED SPACING



studies for lettuce

ing losses caused by laborers who were not used to the closer spacings hoeing out more plants than normal. More loss from disease also occurred at the closer spacings. The percentage of heads cut was highest at 16 inches and lowest at 8 inches, but total heads cut was highest at 10 inches. Relationships of yields, percentage cut, and number of surviving plants are represented in graphs 1, 2, and 3.

In some of the tests, only one cut was made because the prices on the prevailing lettuce market were too low to pay for the second cut. Consequently, the plots in which two harvests were conducted were analyzed separately to show the relationships between the percentage cut at the first or second harvests (see graphs 4 and 5). A comparative study of the regression curves representing the percentage of heads cut and the total cut (yield) shows a maturity lag at the closer spacings at the first harvest date. After the first cut many of these heads became marketable, however. Even though the percentage of cut was decidedly lower at both harvest dates, and when both dates were combined, the actual yield was higher at the 10-inch spacing, because more heads were available for cutting.

At the 8-inch spacing the yield tended to begin to drop, and if the curves were extended to a 6-inch spacing, a larger yield loss would most likely occur. At 8 inches, commercial quality appeared to be reduced because of decreased head size and some peaking of heads. At 16 inches, quality of some heads was lower due to softness. Spacing appeared to have no effect on color.

In conclusion, these data suggest that where lettuce is grown for a summer harvest in the Salinas Valley, a 10-inch spacing between plants on double-row, 40-inch beds offers the best chance for maximum yields of marketable two-dozen-per-carton-sized heads. This spacing would be best where exact spacings could be maintained by precision planting to a stand, or where selective thinners are used. However, where plants are hand thinned, this spacing may not be best since hand thinners directed to thin at 10 inches might leave too many plants at spacings closer than 10 inches. These tests were conducted at high fertility levels and it is possible that closer spacings, 8 to 10 inches, could result in more problems of attaining size on low fertility fields or under adverse weather conditions.

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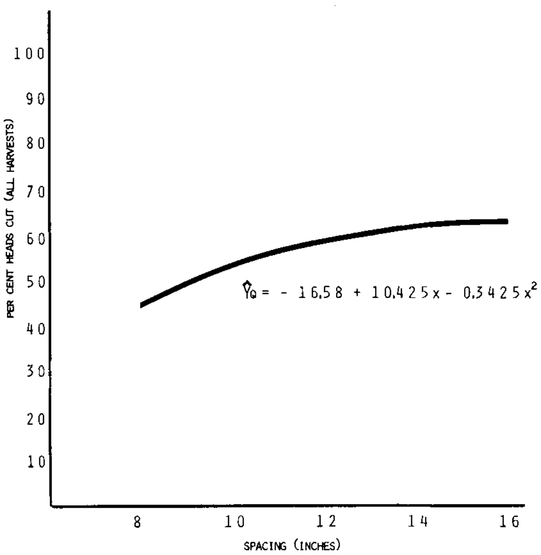
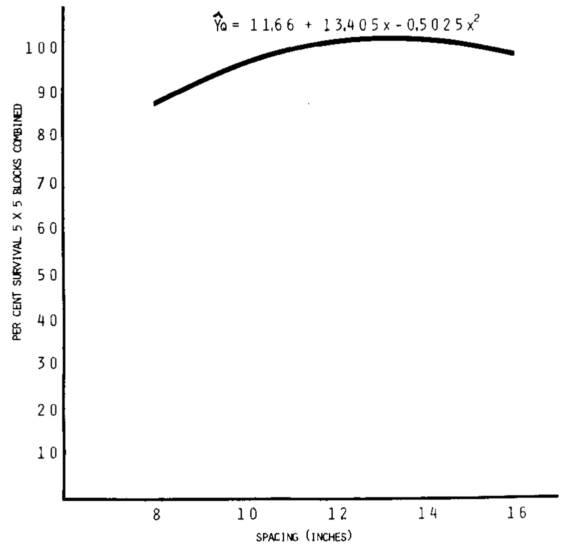
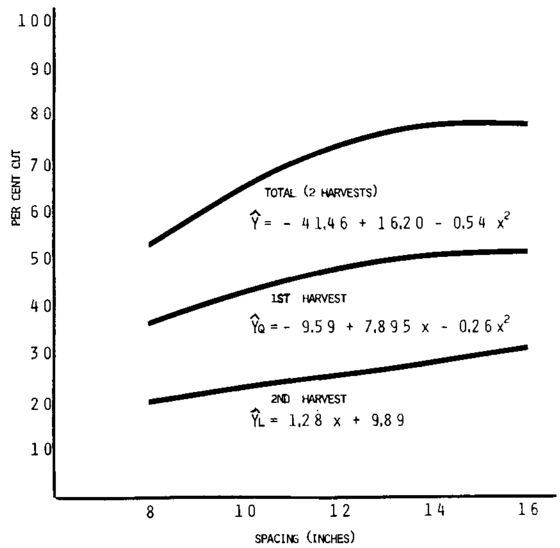
GRAPH 2. RELATIONSHIP OF PER CENT LETTUCE HEADS CUT PER 100-FT ROW (ALL HARVESTS) TO THINNED SPACING



GRAPH 3. RELATIONSHIP OF PER CENT SURVIVAL OF LETTUCE PLANTS TO THEORETICAL THINNED SPACING



GRAPH 4. RELATIONSHIP OF PER CENT OF LETTUCE HEADS CUT (TWO HARVESTS) TO THINNED SPACING



GRAPH 5. RELATIONSHIP OF NUMBER OF LETTUCE HEADS CUT (TWO HARVESTS) TO THINNED STANDS