an Angus bull and the other half to a Hereford. They were grazed together on the same range, under the same environmental conditions except during the breeding season when they were separated but still kept under comparable conditions. Eleven steers and fifteen heifer calves were born to each group.

Weaning results

At weaning time the calves were individually identified by tattoo and individually weighed. The crossbred calves outweighed the Hereford calves by an average of 62 lbs. With $27 per cwt used as an average price at weaning the crossbreds had an advantage of $16.74 per head. Table 1 gives a statistical comparison between groups.

Postweaning results

The cattle on trial were wintered together in a large lot on the Albaugh ranch and fed long grass and alfalfa hay of good quality. Heavy snows during the winter of 1967–68 were a factor preventing normal gains during the postweaning period. In the spring of 1968 the animals were again individually weighed. Postweaning gains are shown in table 2.

Final yearling weight

Although the crossbred cattle did not gain as rapidly during the postweaning period as they did during preweaning, the final weight is economically significant (see table 3). The final weight of the crossbred yearling steers was 567 lbs, and they should bring $28 per cwt at this weight. The Herefords weighed 449 lbs and would bring $29 per cwt at this lighter weight. A calculation of returns at these prices indicates that the crossbred steers would bring a profit of $28.55 per head more than the Herefords.

In a comparison of the final weights, the crossbred yearling heifers at 502 lbs would bring $120.48 per head based on $24 per cwt for that weight. Hereford heifers weighing 418 lbs would bring $104.50 at $25 per cwt. About $16 per head more income would come from the crossbred heifers.

It is well known that heavier animals bring less per pound at market time. However, the heavier crossbred animals, of the same age raised in the same environment, return a substantial increase in total income per head over the straightbred.

The difference between the weaning weights of the crossbred steers and those of the crossbred heifers was highly significant. At yearling time, the difference was still highly significant. There was no significant difference between the performance of Hereford steers and heifers for the same periods. Considering the crossbred sex difference as a percentage of the steer weights at each period, the percentage difference is very close (10 per cent and 11 per cent for the weaning and final weights, respectively). In general, most of the advantages of crossbreeding came from preweaning gains and these were still apparent at yearling age.

TABLE 1. SUMMARY OF WEANING WEIGHTS ANGUS × HEREFORD VS STRAIGHT HEREFORD CALVES

Groups	Ave. final weight	Ave. weight difference
	lbs	lbs
(1) Hereford steers	343	78*
Crossbred steers	421	
(2) Hereford heifers	330	49*
Crossbred heifers	379	
(3) Hereford steers	343	36**
Crossbred heifers	379	
(4) Hereford heifers	330	91*
Crossbred steers	421	
(5) Hereford steers	343	13†
Hereford heifers	330	
(6) Crossbred steers	421	42*
Crossbred heifers	379	

* Significant at the 1% level.
** Significant at the 5% level.
† Not significant.

TABLE 2. POSTWEANING GAINS ANGUS × HEREFORD VS STRAIGHT HEREFORD CALVES

Groups	Ave. gain	Ave. difference
	lbs	lbs
(1) Hereford steers	117.50	26.59†
Crossbred steers	144.09	
(2) Hereford heifers	88.00	34.80**
Crossbred heifers	122.80	
(3) Hereford steers	117.50	5.30†
Crossbred heifers	122.80	
(4) Hereford heifers	88.00	56.09*
Crossbred steers	144.09	
(5) Hereford steers	117.50	29.50†
Hereford heifers	88.00	
(6) Crossbred steers	144.09	21.29†
Crossbred heifers	122.80	

* Significant at the 1% level.
** Significant at the 5% level.
† Not significant.

TABLE 3. FINAL YEARLING WEIGHT COMPARISON ANGUS × HEREFORD VS STRAIGHT HEREFORD CATTLE

Groups	Ave. final weight	Ave. weight difference
	lbs	lbs
(1) Hereford steers	449.37	117.44*
Crossbred steers	566.81	
(2) Hereford heifers	418.00	84.13*
Crossbred heifers	502.13	
(3) Hereford steers	449.37	52.76**
Crossbred heifers	502.13	
(4) Hereford heifers	418.00	148.81*
Crossbred steers	566.81	
(5) Hereford steers	449.37	31.37†
Hereford heifers	418.00	
(6) Crossbred steers	566.81	64.68*
Crossbred heifers	502.13	

* Significant at the 1% level.
** Significant at the 5% level.
† Not significant.

S. W. Thurber is Farm Advisor, Lassen County, and Reuben Albaugh (now retired) was Animal Scientist, Agricultural Extension Service, University of California, Davis.

A progress report..

BEE

in

for

THE ONCE-OVER MACHINE HARVEST of California's cucumber crop requires a heavy concentration of fruit set to produce a profitable yield of usable fruit. The pollination of female cucumber flowers is one of the important factors limiting a concentrated fruit set; nearly all of the usable fruit obtained in a single harvest develop from flowers that are pollinated over the span of a few days.

The importance of the honey bee in the pollination of the cucumber crop has previously been recognized in scientific literature, but honey bees have seldom been deliberately introduced by growers into cucumber fields. High, multiple hand-harvest yields averaging 10 to 12 tons per acre per season have probably led growers to believe that local wild bee populations were adequate, or that perhaps other insects and wind pollination played an important role in the pollination of this crop.

Field tests

To field test the importance of bees to once-over harvesting of cucumbers, exploratory trials were conducted in 1967 in the Gilroy area of Santa Clara County.

Two replicated, duplicate plots (A and B) were established at opposite ends of an 800-foot long, 40-acre cucumber field. The only introduced difference between the plots was a two-story colony of bees near plot B.

The pollinating activity of bees at both plots was controlled by covering the plant rows with aluminum screens. Exposure of the plants to bee activity was limited to hourly intervals at specific times dur-

POLLINATION

cucumbers

pickling

Cucumber field (Obata Brothers, Gilroy) with screened plot A (center-foreground) and plot B (center, extreme rear) at beginning of two-week bee pollination test period.

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W. STANGER • P. B. PAYNE

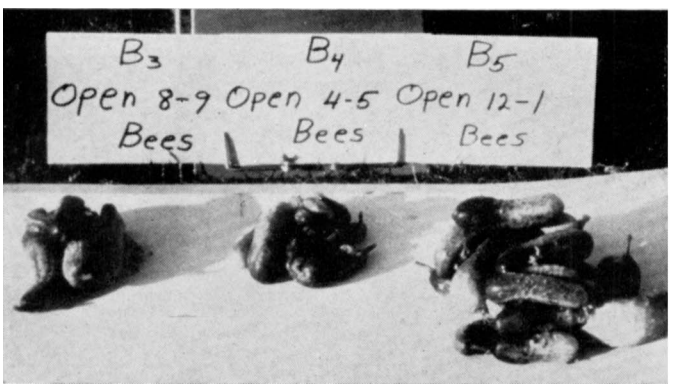
Selective admission of bees to cucumber blossoms (through use of a field screening procedure) resulted in production of fruit yields roughly proportional to the length of time the bees were admitted and to the field activity level of bees during that time. In this experiment, the continuous increase in fruit yields with increased exposure to bee pollinating activity suggested that bee populations were inadequate to insure maximum yield on a once-over (single) harvest basis. The introduction of a supplemental source of bees tended to support this theory, but technical difficulties caused limitations of the differential effects and the data were not subject to statistically valid measurement. In general, however, the experiment upheld previous reports that the honey bee is extremely important to the pollination of the cucumber crop and that the major portion of bee pollinating activity occurs during the mid-day period.

ing the day (see table). A standardized routine of screen manipulation and of bee counting was begun at first bloom and continued daily for 15 days.

Harvest results

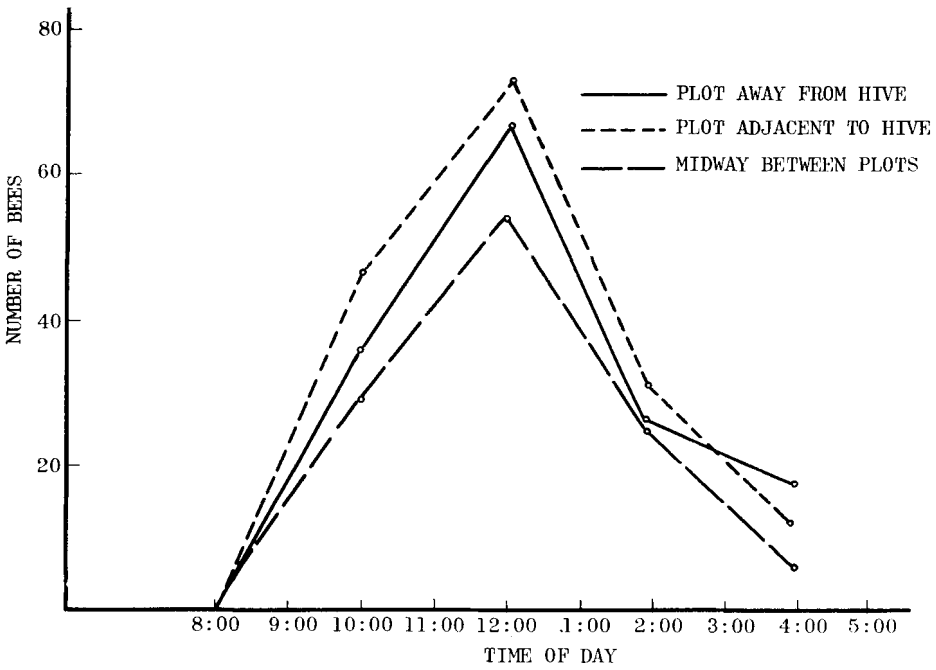
Harvest results by weight and number of fruit per treatment (see table, graphs 1 and 2) show the effects of different plant exposure times to bee activity at different times during the day. Yields, by numbers and weight of fruit, follow the same pattern at both plots. The lack of significant yield differences between the one and two-hour mid-day exposure is not presently understood but may be due to the effects of the screening process on the physiological functioning of the plant. Yield results generally confirmed both the singular importance of bees to the pol-

Comparison of yield differences at Plot B resulting from exposure of plants to bee activity at different times of day. Total exposure time (1 hour per day) was the same in each case. Hours of exposure were in the morning, noon, and afternoon, as indicated on photo.



Contrast of yield differences between treatment extremes at Plot B (near hive). On left, zero hours of plant exposure to bee pollinating activity. At right, complete (no screen) exposure of plants to bee activity. Similar results were produced at Plot A (away from hive).

BEE COUNTS BY PLOT LOCATION AND TIME OF DAY IN POLLINATION TESTS WITH PICKLING CUCUMBERS



linating of cucumbers and prior reports that maximum bee pollinating activity takes place during mid-day.

The graph shows results of bee counts by location and time of day. Standardized counts (50 feet of row per minute) were made five times daily (at 8:00 a.m., 10:00 a.m., 12:00 noon, 2 p.m., 4 p.m.) at each of the six stations adjacent to and between the two duplicate plots.

The highest counts were recorded adjacent to plot B (near the hive), but these were not significantly different (5 per cent level) from counts obtained at plot A (away from the hive). The lowest counts were recorded at the midway stations between plots A and B. These counts were significantly less than those recorded at B, but not significantly less than counts taken at A (5 per cent level).

Bee counts

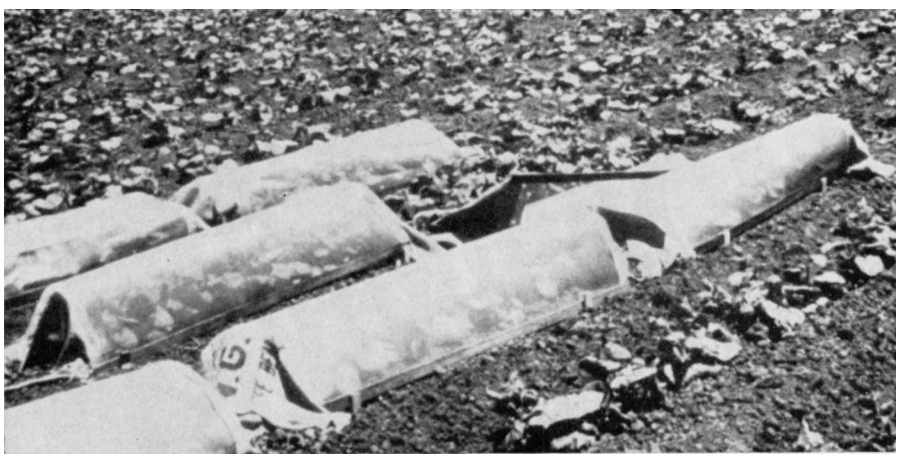
Bee counts recorded at noon constituted 46 per cent of the total number of bees counted. Counts recorded at 10:00 a.m. were 26 per cent of the total, and counts recorded at 2:00 p.m. were 19 per cent of the total. Thus, 91 per cent of all bee pollinating activity was recorded as having taken place between 10:00 a.m. and 2:00 p.m.

Bee counts during the course of this 15-day trial were taken largely for the purpose of determining the comparative populations of foraging bees at each of the two plots. It is hoped that future work will establish a simple, reasonably accurate in-field counting procedure that will tell the grower whether the number of bees in his field at a given stage of bloom is above or below the minimum needed for optimum pollination

In this trial, the highest bee count obtained was slightly less than one bee per minute per fifty feet of row. If it is assumed that this count represented a reasonably accurate picture of the bee population in the field at that particular moment, calculations based on 13,000 feet of row per acre and one bee per fifty feet of row, result in a projected population of 260 bees per acre.

Per acre bee requirements *should not and cannot be made* from such a projection of the data until the facts concerning the "support factor" (bees engaged in other activities) are also known and correlated. Until more information is available, the present general recommendation of one to two hives per acre should be followed.

William S. Seyman and William W. Barnett are farm advisors, Agricultural Extension Service, Santa Clara County. Perley B. Payne is Extension Assistant, Santa Clara County. Robbin W. Thorp is Assistant Apiculturist, and Ward Stanger is Extension Apiculturist, University of California, Davis. *Heinz Michels supplied bees for the experiment and information on their management. Assistance was also provided by Obata Brothers, Gilroy grower-cooperators; and F. J. Hills, Extension Agronomy Specialist, University of California, Davis.*



Close-up of screening procedure. Open screen (center-rear) indicates time of day is between 11:30 a.m. and 1:30 p.m. (Plot B, treatment #6).

EFFECTS OF LIMITED EXPOSURE OF CUCUMBER BLOSSOMS TO BEE POLLINATING ACTIVITY AT VARIOUS TIMES OF DAY FROM 1ST BLOOM + 15 DAYS

	Av. number & weight of fruit per plot (24 plants)			
	Plot A		Plot B	
	No.	wt/ gms	No.	wt/ ams
*1. Full exposure	—	—	—	—
2. Full exposure (check)	16.7	338.7	21.3	791.0
3. Exp. 1 hr./day— 8:00–9:00 a.m.	1.3	10.0	3.7	74.3
4. Exp. 1 hr./day— 4:00–5:00 p.m.	2.3	32.0	4.3	75.3
5. Exp. 1 hr./day— 12:00–1:00 p.m.	9.0	180.3	9.0	227.7
6. Exp. 2 hr./day— 11:30–1:30 p.m.	7.0	143.0	9.3	233.7
7. Exp. 0 hr./day— full screen	0.3	2.0	0.3	16.3
L.S.D. A- 0.05	6.06; 158		— 0.01	8.49; 221
L.S.D. B- 0.05	3.29; 278		— 0.01	4.61; 389

* Hand harvest plant population (6 plants).