components in the juice from fresh fruits was controlled by immediate processing and adequate blanching practices, the addition of 1 percent commercial slow-set pectin to lychee jelly was sufficient for good gel formation. Jelly prepared with 1½ percent pectin was too firm.

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A NEW TECHNIQUE FOR INDUCING EARLY FRUITING IN MANGO HYBRIDS BASED ON THE MOVEMENT OF HORMONES

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With a view to evolve a regular bearing commercial variety of mango, hybridization was started long back at various research centers in India, and later in Florida, but not a single hybrid plant with the desired characters has yet been released (Sen et al., 1946; Naik, 1948; Roy, 1953; Young & Ledin, 1954 and Singh, 1957). Usually the hybrid seedlings take five to six years to flower and yet another five years when their bearing behavior can be studied (Singh, 1960). Consequently, the hybridization in mango, is, so far, confined to the study of F_1 hybrids only. However, to get a hybrid plant incorporating most of the desirable characters, one will have to raise F_2 or even further progenies. In several cases, the selected hybrids may have to be backcrossed. The success in hybridization of mango can, therefore, be speeded only after evolving suitable techniques which may induce flowering in young seedlings and thus shorten the time-factor involved in their bearing. Singh (1959) studied the movement of flowering substance from scion to rootstock seedlings and visualized the possibility of inducing flowering and fruiting even in one to two-year-old seedlings. The present study was, therefore, conducted with the aim of developing a technique whereby the movement of flowering substance could be utilized for inducing flowering in young hybrid seedlings.

One-year-old mango seedlings were selected for inarching on full-grown trees of Totapari Red Small, a regular bearing variety. The stock seedlings were raised in pots and then placed on a four legged wooden platform. The branches of the scion tree were lowered by pegging them down. This enabled inarching very easily. Since the platform was four feet high, it was not difficult to manage the watering of the pots.

With a view to record observations on flowering and fruiting in the next blooming season, i.e., January-February 1962, inarching was done in July, 1961. The following five treatments were given to each set of 20 seedlings after the graft-union was complete:—

(1) Scion girdled below the union and stock seedlings headed back above the union.

(2) Scion girdled below the union and the stock seedlings defoliated.

(3) Scion and stock both were girdled below the union and the stock seedlings defoliated.

(4) Scion and stock both were girdled below the union and top of the stock was pinched off.

(5) Stock and scion after grafting were left as such—control.

RESULTS

The results of all these five treatments are represented in Figures 1 to 6.

A perusal of Figs. 1 & 2 will show that besides normal flowering in the scion, the stock seedlings also produced inflorescences and fruits. This indicates that the flowering hormone produced in the scion moved down from the apex but could not go further down due to girdling. It, therefore, moved to the stock seedling and induced flowering on it; whereas in the second treatment, where stock seedling was not headed back, but only defoliated, the terminal as well as the axillary buds of the stock seedlings produced normal inflorescences and fruits (Fig. 3). Under both these treatments, new leaves on the stock seedlings appeared during first week of March, which later helped the stock seedlings in regaining vigour and normal fruit development. The mode of movement of flowering substance in this treatment also appeared to be similar to the first.

Figure 1.—Induction of flowering in young mango by approach grafting to a mature plant. Note girdle on limb of the mature plant.
Left: Flowers developed on the defoliated young plant. Right: The young plant remains vegetative if leaves are not removed.

Under the third treatment where both scion and stock seedlings were girdled below the union and the stock seedlings were defoliated, the inflorescence on the rootstock seedlings appeared only above the union (Fig. 4). This indicates that the flowering hormone coming from the scion could not go down to the lower part of the stock seedlings due to girdling but it moved on the upper part and induced flowering there.

In the fourth set of experiment, pinching was done with an idea that the flowering hormone coming from the scion directly goes to the apex of the stock seedling and is utilized there thus inhibiting flowering in the axillary buds. However, despite pinching, no flowering occurred on the stock seedlings (Fig. 5). Similarly no inflorescences appeared on the rootstock seedlings under control (Fig. 6). These treatments, thus, show that the flowering on rootstock seedlings depends on the presence or absence of leaves on them.

Discussion and Conclusions

The results reported above show that flowering substance produced in the scion moves freely down to the stock seedlings through the graft-union. Bonner and Liverman (1953) have also reported that florigen, which is now thought to be large molecules of nucleo-protein, is transported readily through living tissues and will pass a graft-union easily. However, it can induce flowering on the stock seedlings only in the absence of leaves. Similar results were reported by the author in an earlier study (Singh, 1959) and it was postulated that the leaves present on the stock seedlings produce auxins in the quantity sufficient to inhibit the effect of flowering substance.

It was, further, recorded in this experiment that the inflorescences and fruits produced on the stock seedlings were quite normal. The flower and fruit characters can, therefore, be relied upon for the study of genetical characters of the hybrids. With the aid of this technique, it will be, thus, possible to record the fruit characters of F_1 hybrids within two years and of F_2 in about four years. It will, thus, save at least ten years for raising F_2 population.

Out of the first three treatments, which in-

duced flowering on the stock seedlings, the second treatment is best suited for hybridization. Under this treatment, the stock seedling is least damaged and, therefore, it can be further grown to study its bearing behaviour after recording the fruit characters of F_1 progeny. The main precaution in this technique is the choice of the scion. It should be a definitely regular bearing variety of mango and the shoots selected for inarching should be well matured and healthy so that they may flower in the next blossoming season. Three varieties, viz., Totapari Red Small, Totapari Hyderabad and Romani are best suited for this purpose under North Indian conditions. The present technique is very simple, easy as well as economical and will be of immense help in assuring extensive mango breeding work.

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POLLINATION AND FRUIT SET OF YELLOW PASSIONFRUIT IN SOUTHERN FLORIDA

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Since 1936, at least 62 introductions of several *Passiflora* species have been grown and evaluated at the U. S. Plant Introduction Station, at Miami. At the present time individuals from 2 introductions—1 of the yellow-fruited form *P. edulis* Sims, introduced from Trinidad, the other a clone of *P. laurifolia* L. collected in Java—are thriving on their own roots in the field there. Only 13 introductions of the 62 are represented by at least 1 living individual. Eight of these are recent introductions, and have not yet been tested extensively in field plantings. Nothing remains of a test planting of 18 introductions planted in 1936 and 1937.

In late August 1958, it became evident that some *Passiflora* vines were dying suddenly without apparent cause. The dead and dying vines were found to be heavily infected with a species of *Fusarium* fungus. At about that time grafting onto stocks of *P. laurifolia* L. (P. I. 159620) known to have survived well at the Miami station was initiated. Deaths of individual own-rooted clones of *P. edulis* have continued to complicate this study, but 9 of the 10 vines originally grafted on *P. laurifolia* have persisted. More recently, weak clones have been grafted on rooted cuttings of the most vigorous clones of *P. edulis* (P. I. 243804) but insufficient time has elapsed to evaluate completely this cion-stock combination.

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SELF-INCOMPATIBILITY

The yellow-fruited form of the purple passionfruit (*Passiflora edulis* Sims f. *flavicarpa* Deg.) is grown commercially in Hawaii (1). Some 5 years ago it was reported that contrary to earlier belief, the yellow passionfruit is self-sterile under Hawaiian conditions (2). Carpenter bees were later found of critical importance to obtain a good fruit set in Hawaii (3). The yellow passionfruit grows well in Queensland, but is said to show a tendency to self-incompatibility (4).

Self-pollinations of *Passiflora edulis* (P. I. 243804, P. I. 243805) and *P. foetida* L. (P. I. 201504) made by P. K. Soderholm, set no fruit at the Miami station in 1959, while a clone of *P. suberosa* L. wild or feral in the area (P. I. 277483) proved self-compatible and set seed without hand-pollination. Natural crossing between adjacent plants of *P. foetida* resulted in fruit set at that time. The majority of the *P. edulis clones* had already been found to be productive only when artificially pollinated. One clone which set fair crops from open-pollination was selected in 1959. This is referred to in the rest of this paper as clone 3-43(—45). In 1959 unsuccessful attempts were made to germinate pollen of *P. edulis* in 0.5 per cent agar solutions to which 5, 10 and 20 per cent sugar was added. The pollination investigations were carried forward by J. G. Gosselink in autumn 1960 and spring 1961. These results are included in table 1 with results from the current year's work.