POLLINATION OF CHERIMOYA IN NEW ZEALAND

P.A. ANDERSON and A.C. RICHARDSON

*The Horticulture and Food Research Institute, P.O. Box 23, Kerikeri***Keywords:** *Annona cherimola*, cherimoya, hand pollination, pollinators

The cherimoya (*Annona cherimola* Mill.) is a subtropical fruit which is native to the highlands of Ecuador and Peru. Although the fruit has been popular throughout Central and South America, its commercial potential in Asian, European and North American markets has only recently been recognised. In response, commercial orchards have been established in California, Chile, Spain, Australia and New Zealand. However there is only limited published information on the cultivation of the crop. In New Zealand, cherimoya fruit are harvested from July until November when few other subtropical fruit are available. The attractive fruit vary from 400 - 1000 g in weight, are conical or heart shaped and may have shallow depressions or knobby protuberances on the green skin depending on cultivar. The cream flesh of the cherimoya is sweet, moderately juicy and contains many black seeds.

Internationally the major problem for cherimoya growers is the inability to reliably set large numbers of uniformly shaped fruit. A maximum of 5% of flowers set naturally in our studies, but few of these fruit were retained on trees until harvest (Richardson and Anderson 1990). This paper outlines the cause of the poor set and describes methods to improve pollination.

The cherimoya flower

The cherimoya flower, shown in Figure 1, has three long succulent petals which enclose a syncarpium in which each carpel contains a single ovule (Schroeder 1970). There are several whorls of anthers at the base of the syncarpium and these develop during anthesis (Hopping 1982). Although flowers are hermaphroditic, they exhibit protogynous dichogamy (the stigmas are receptive before pollen is shed by the anthers) (Venkataratnam 1959). In New Zealand, cherimoya flowers open and the stigmas are receptive early in the morning, but pollen is not shed from the anthers until the evening of the second day. At this stage the stigmas are no longer receptive and this mechanism precludes pollination within a single cherimoya flower.

Natural pollen transfer mechanisms

Fruit set in cherimoyas depends on the transfer of pollen from flowers at anthesis to newly opened flowers with receptive stigmas. Transfer of pollen between flowers of the closely related *Annona* spp. hybrids has been investigated in Australia by George *et al.* (1989). They found that there was very limited movement by wind and this was attributed to the large sticky nature of pollen grains and the orientation of the flower. Limited access to the syncarpium of newly opened cherimoya flowers prevents large insects such as honey bees from entering the flower to effect pollination (Hopping 1982). Studies in Israel and Australia have shown that smaller insects, particularly beetles from the family Nitidulidae, will transfer pollen between *Annona* spp. flowers (Gazit *et al.* 1982; George *et al.* 1989). It is thought that the beetles are attracted by the strong, fruity smell of the flower rather than the pollen or nectar. However the success of beetles as pollinators is strongly influenced by the availability of decaying fruit and vegetation as a food source, high temperatures and high relative humidities. Despite up to two beetles visiting a single flower, a maximum of 12% of flowers set but no yield data were recorded (George *et al.* 1989). In New Zealand, Hopping (1982) observed *Carpophilus hemipterus* L. beetles on cherimoya. However, in the course of extensive pollination studies over several seasons, we have rarely seen insects on cherimoya flowers. Therefore it is unlikely that insects can be regarded as the major pollen vector for local cherimoya orchards.

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Figure 1: Cherimoya flower and fruit in cross section (Sanewski 1991).

Hand pollination

Many studies with cherimoya and other *Annona* spp. have shown that hand pollination is the most satisfactory pollen transfer mechanism with 50-90% of pollinated flowers producing fruit (Schroeder 1941; George *et al.* 1989; Richardson and Anderson 1990). The standard technique developed by Schroeder (1941) requires partially open flowers to be collected in the evening, stored in humid conditions at room temperature overnight and pollen extracted the following morning. Pollen is then applied directly to newly opened flowers using a small paint brush. Hand pollination of cherimoya flowers is relatively fast (200 - 350 flowers per hour with 80 - 100% success rate) and therefore economically viable (George and Campbell 1991).

This technique has been refined to suit New Zealand conditions. Studies by Richardson and Anderson (1990) have shown that there is a degree of incompatibility between cultivars and therefore no need to plant more than one cultivar in an orchard. Pollinating flowers in the evening with freshly collected pollen was compared with storing pollen overnight to pollinate flowers in the morning. Evening pollination gave a higher level of fruit set and produced larger and more symmetrical fruit than using pollen which was stored overnight (Table 1). This suggests that pollen viability is a greater limitation than declining stigma receptivity.

TABLE 1: Effect of pollination time on fruit set, shape and mean weight.

Time of pollination	Fruit set (%)	Mean fruit shape ¹	Mean fruit weight (g)
Morning	46	3.8	248
Evening	59	2.2	491
SED	3	0.2	21

¹ Fruit shape scale: 1 = highly symmetrical 5 = asymmetric

Flowering of cherimoya trees occurs over a period of 4-6 weeks. Although it may vary due to environmental conditions, fruit set is generally most consistent during the peak of flowering. The mean weight of fruit declines and their relative seed content increases for flowers pollinated later in the flowering period.

CONCLUSION

Fruit set in cherimoya is limited by floral biology and a lack of suitable pollen transfer vectors. Therefore hand pollination of flowers is required to set good crops of saleable fruit. Local research has demonstrated that pollination success is improved if flowers are pollinated in the evening during the peak of the flowering period.

REFERENCES

- Gazit, S., Galon, I., and Podloer, H., 1982. The role of Nitidulid beetles in natural pollination of *Annona* in Israel. *J. Amer. Hort. Sci.* 107 (5): 849-852.
- George, A.P., and Campbell, J., 1991. Hand pollination in subtropical Australia. *California Grower Feb*: 36-38.
- George, A.P., Nissen, R.J., Ironside, D.A. and Anderson, P., 1989. Effects of nitidulid beetles on pollination and fruit set of *Annona* spp. hybrids. *Scientia Hort.* 39: 289-299.
- Hopping, M.E., 1982. Pollination and fruit set of cherimoya. *The Orchardist of N.Z. Mar*: 56-60.
- Nadel, H., 1990. Beetle pollination of sugar apples and atemoyas, or why a rotten fruit is not all bad. *Tropical Fruit News May*: 4-5.
- Richardson, A.C. and Anderson, P.A., 1990. Is hand pollination of cherimoya necessary? *The Orchardist of N.Z. Nov*: 21-25.
- Sanewski, G.M., 1991. Pollination. Pp 68-72 In: Custard Apples Cultivation and Crop Protection. G.M. Sanewski (Ed); Queensland Department of Primary Industries, Brisbane, Australia.
- Schroeder, C.A., 1941. Hand pollination effects in the cherimoya (*Annona cherimola*). *Californian Avocado Society Yearbook 1941*: 94-98.
- Schroeder, C.A., 1970. Fruits of the *Annonas*. *California Avocado Society Yearbook 54*: 117-118.
- Venkataratnam, L., 1959. Floral morphology and blossom biology studies on some Annonaceae. *Indian J. Agric. Sci.* 29: 69-76.