

IMPORTANCE OF POLYCLONAL GARDEN IN PRODUCTION OF SUPERIOR PLANTING MATERIALS IN COCOA

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Introduction

Cocoa (*Theobroma cacao* L.) is highly heterogeneous and cross pollinated. The mechanism of self incompatibility existing in this crop facilitates cross pollination. Ensuring superiority of parental material is very much necessary in cocoa. Even though the mother plant is excellent in all characters, there is no guarantee that this superiority can be transferred to the progenies. This is because the source of male parent is unknown and there is every chance for the progenies to express undesirable characters of male. Hence it is recommended to ensure the superiority of female and male parents before going for seed material production.

Hand emasculation and pollination

The best method to ensure the superiority of parents is by hand pollination between selected superior female and male parents. But artificial pollination in cocoa is advocated only for crop improvement and research purpose. For example to combine characters of two divergent parents into one, to test incompatibility position, combining ability of clones etc. Artificial pollination is not practically feasible for commercial seed production. The reasons are furnished below:-

- 1 Flowers are too small which make artificial pollination a tedious process. A single person can pollinate to a maximum of 30 flowers per day.
- 2 Success rate of artificial pollination is very less due to the pollination hazards. Artificial pollination will definitely impart stress on flowers because we have to prepare the flower for pollination by removing staminodes. Generally if 100 flowers are pollinated chance for pod set is one.

- 3 Pollen grains for artificial pollination are collected either by plucking the flower as such or by taking the stamens out. If flower as such is collected that much flower which may have set into pod under natural condition is lost. Or if stamens are collected that flower will be highly damaged since anther lobes are concealed inside the pouch of petal. Chance for fruit set in such flowers by artificially pollinating them with stamen from other plant is almost nil.
- 4 In ability to pollinate flowers on upper branches. Only flowers on main trunk and lower branches can be pollinated.
- 5 Before pollination plants have to be prepared by removing open flowers and immature buds from a cushion. This will lead to large number of flower loss.
- 6 After pollinating one flower in a cushion only at least after three days we can pollinate another flower in the same cushion.
- 7 Number of flowers produced per cushion is drastically reduced if cushions are disturbed for artificial pollination.
- 8 To ensure the pod set by artificial pollination to reach maturity all other developing pods in that tree has to be removed, which will again results in economic loss.

Poly clonal gardens

These difficulties can be overcome to a great extent by establishing poly clonal gardens. Importance of polyclonal garden in cocoa has been stated by earlier workers like Wood and Lass (1985), Edwards, (1969) etc. Knowing this Kerala Agricultural University (KAU) started establishing clonal gardens in cocoa since 1989 (CCRP report, 1989-90). At present KAU

maintains one biclonal garden and eight polyclonal gardens (CCRP report, 2013-14). Details are furnished in Table 1.

Table 1 Details of polyclonal garden maintained at KAU

	No. of parents	No. of plants	Year of planting
Polyclonal garden I	12	120	1989
Polyclonal seed garden II	38	228	1993
Biclonal Seed garden	6	1243	1996
Polyclonal Seed garden III	5	100	2000
Polyclonal Seed Garden IV	8	1100	2005
Polyclonal Seed Garden V	7	946	2006
Polyclonal Seed Garden VI	10	400	2010
Polyclonal Seed Garden VII	6	286	2010
Polyclonal Seed Garden VIII	8	299	2014
Total	86	4722	

Clonal gardens include better combiners specifically arranged for the mass production of genetically improved seeds. Superior breeding materials identified are taken to the clonal garden after further evaluation for incompatibility and combining ability. Cocoa is blessed with self incompatibility. The mechanisms of genetic control of incompatibility mechanism have been studied by many scientists (Pound, 1933; Marshall, 1933; Knight and Rogers, 1955; Cope, 1962; Bartley and Cope, 1973), but the system continues to be genotype dependent and unpredictable. This necessitates assessment of incompatibility status in every seedling derived from cocoa, before it is being utilized as parents in clonal gardens. Selfing of hundred flowers per plant is done in order to ensure self incompatibility. If no fruit set or even if the fruit sets, if it is not retained for more than 15 days (Royaert *et al.*, 2011) the genotype is classified as self incompatible.

Such self incompatible genotypes are tested for their general combining ability (GCA). Ali *et al.* (2012) reported that the concept of combining ability is fundamental in enhancing productivity among different crops especially in superior F_1 hybrid production. Parents with high general combining ability are expected to produce superior hybrids (Dias and Kageyama, 1995 and 1997).

Thus identified genotypes with self incompatibility mechanism and high general combining ability are laid out for establishment of clonal gardens as budded plants. These gardens are taken in isolation to prevent pollination from any inferior male parent nearby. Seedlings produced from pods collected from each parent in a clonal garden will be a hybrid. To avoid any inferiority in seedling produced due to heterozygous nature of cocoa a 10 percent screening of inferior plants are done in the nursery itself.

Conclusion

Statistics reveals that more than 80 percent of cocoa garden in India is established with planting materials from KAU polyclonal garden. Good performance of these gardens confirms the superiority of planting materials. Care should be taken to ensure the source of planting materials in cocoa in order to get good returns.

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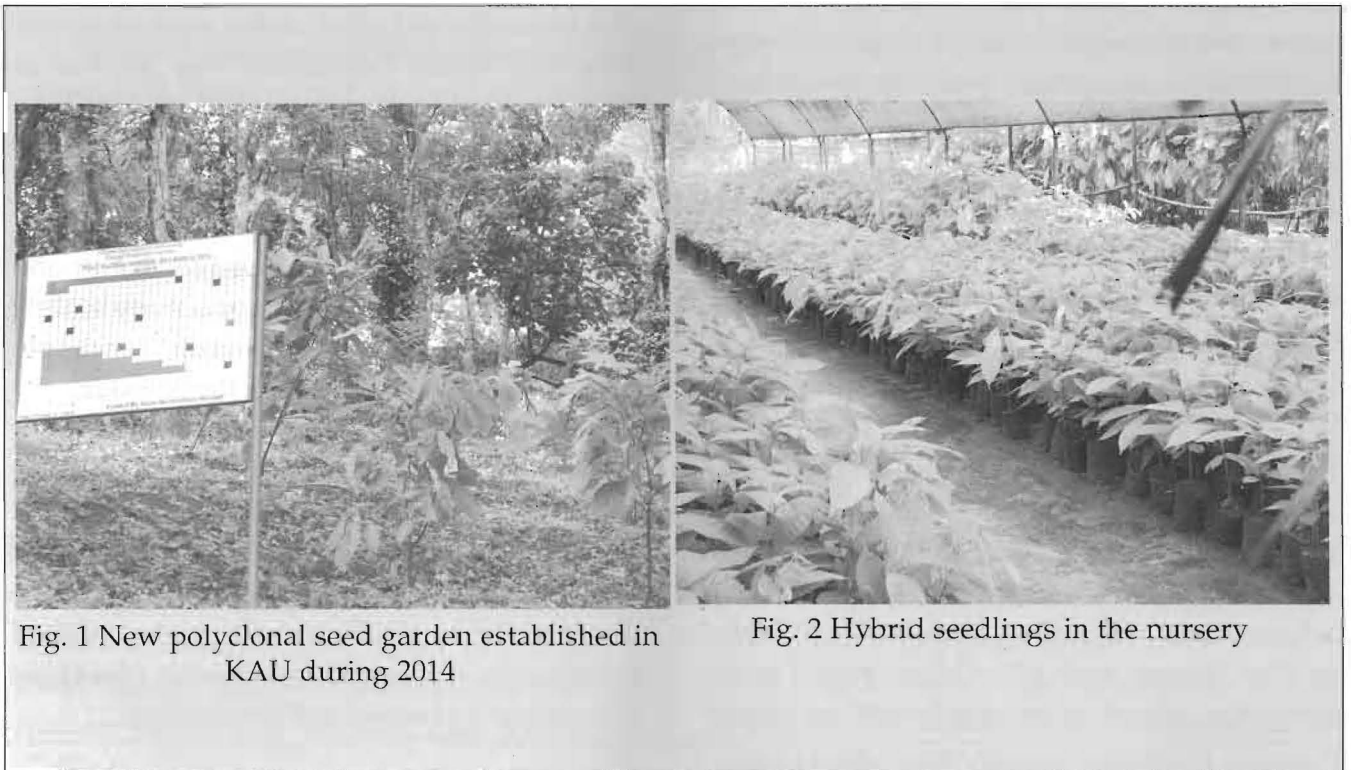


Fig. 1 New polyclonal seed garden established in KAU during 2014

Fig. 2 Hybrid seedlings in the nursery