

Alternate Bearing in Fruit Crops

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SUMMARY

Alternate bearing (AB) phenomenon, common in fruit crops, is a challenge for maintaining consistent incomes from different fruit orchards. Selection of suitable variety, shoot and root pruning, use of plant growth regulators, fruit thinning, de-blossoming are some important recommendations for alternate bearing management. The quantity of flowering shoots in a canopy, one of many indices used to quantify AB, has direct correlation to estimates of fruit yield in recurrent years. This article examines each factor carefully in order to successfully induce flowering in perennial fruit trees on a regular basis. The information may pave way for better regulation of flowering shoots towards enhanced fruit productivity under subtropics.

INTRODUCTION

Alternate bearing (AB) or biennial bearing (BB) is a big economic issue for growers and traders of fruit crops. Usually, it begins with abnormally heavy crop in trees (on year), followed by a light or no succeeding crop (off year). When on and off year sequence does not follow a systematic pattern, it is called periodicity of cropping or irregular bearing. It disturbs the orchard maintenance cycle also. Alternate bearing is primarily due to genetic factor while irregular bearing may be due to lack of good orchard management practices (Kumar *et al.*, 2021). Alternation becomes entrained and difficult to change unless severe climatic events intervene, or drastic management interventions are made. A heavy "on" crop results in reduced vegetative shoot and root flushing, and less carbohydrate (energy reserves) build-up (Wolstenholme *et al.*, 2010). Alternation phenomenon is more pronounced in the perennial fruit crops particularly in Anacardiaceae (mango and pistachio), Rosaceae (apple, pear, plums, apricot etc), Carylaceae (Hazelnut), Oleaceae (olives), Rutaceae (orange, Tangor, Satsuma etc) and also tamarind, jamun etc (Sharma *et al.*, 2017). In mango some cultivars are regular while others are alternate bearer e.g., Amrapali is regular while Langra is strongly alternate bearer.

Development of Alternation

Alternate bearing cycle are because of genetical, environmental and orchard management practices leading to either an exceptionally heavy or an awfully poor (or no) crop in young trees. Before this, the vegetative: reproductive balance favoured vegetative growth. In some fruit crops, a large amount of photosynthates transferred from the leaves to the fruits during the fruit development processes. Such enhanced photosynthetic rates of leaves near fruits cannot compensate for the high fruit "carbon" (energy) demands. As a result, there are less carbon reserves available for vegetative renewal like development of roots and initiation of new growth flushes and also development of new fruiting sites/fruit bud differentiation processes necessary for the next season's fruiting. The result is very low fruiting or "off" crop. It is assigned due to detrimental effect of "on" crop on the subsequent crop's flowering and fruiting. The crop bearing behaviour can be affected by environmental conditions, rootstock, cultivar, and its management.

Causes of Alternate Bearing

Alternation is mainly caused by Environmental triggers and Endogenous factors.

Environmental Factors

Various environmental factors have been found to influence alternation like climatic stress (frost, cool weather, low air humidity), Edaphic factors (salinity, drought, water table), pests and diseases etc. Frost has greater influence on terminal bearing fruits. It is more damaging during spring season. During early fruit development phases, excessive fruit drops were observed in olives, oranges, avocado and mango due to low air humidity. Edaphic factors such as high salinity enhance leaf drop and reduced the photosynthetic area. In olives, moisture stress during flower formation increases sterile flowers, while summer drought has resulted in excessive fruit drop in pome fruits. Shallow water table (about 1 m) causes low yield in mandarin and Washington Navel oranges. Severe attack of pest and diseases damage the whole crop and bring the trees towards alternation.

Endogenous Factors

There are number of endogenous factors which are responsible for alternation in fruit trees such as inhibition of flower initiation by growing fruits, lack of suitable pollinizers and pollinators that leads to poor fruit set, effect of seed on prevention on fruit drop and encouragement of extremely heavy crop load etc. Contribution of leaves to reproductive growth, competition between vegetative and reproductive sink, genotypic differences, tree age and vigour, fruit load, C:N ratio and imbalances of hormones are other important contributors to the alternation (Bajpai and Bajpai, 2021).

Control/ Management of Alternation

The basic aim of management of alternate bearing situations is to reduce overload in an “On” year and induce flowering in “Off” year. The intensity of alternation or irregularities in bearing can be reduced by adopting some horticultural operations which are given below:

1. Planting of Regular bearing varieties: Planting of fairly regular bearing varieties like Arka Anmol, Arka Punit, Amrapali, Banganpalli, Bangalora and Neelum, Mallika, Arka Aruna, Ambika, Ratna, PKM 1, Mahmood Bahar, Prabha Sankar, Sundar Langra (RM1), Alfazli (RM2), Jawahar, Neeludin, Neelgoa, Neeleshan, Nellphonso, AU Rumani in mango are suggested for getting regular fruits.

2. Proper maintenance of orchard: It is necessary to follow a proper orchard management schedule by providing adequate nutrients and irrigation. Adopt proper management practices for control of mango hopper, powdery mildew, and litchi mite. Spraying Carbaryl (0.25 per cent) or Diazinon (0.1 per cent) for mango hopper and wettable sulphur @ 2g/ lt of water for powdery mildew. Dicofol @3ml/ lt to control mite in litchi.

3. Pruning: Pruning has been found to decrease alternate bearing by restoring the vegetative vigour where it is declined excessively due to over-cropping. Girdling reduces excessive vigour, and improve flowering and fruiting - either of the whole tree or of selected branches or shoots. Girdling can be used to increase cropping in a branch renewal/rotation management system, where branches are treated as distinctive modules (mini-trees) which are re-cycled in an orderly manner by pruning.

4. Deblossoming: About 50 per cent of flower clusters recommended to remove soon after they emerge during “on” year. This process can be done manually or by using 3-chloroisopropyl-N-phenyl carbonate at a concentration of 250-300 ppm. NAA @ 200 ppm is used for deblossoming of panicles during “on” year.

5. Fruit thinning: Fruit thinning reduce the crop load in the "on" season as the overbearing leads to alternation. Early hand removal of smaller fruits, before the summer drop has been shown to reduce alternate bearing phenomenon. NAA @ 100 -200 ppm has a strong thinning activity. Benzyladenine (BA) is a synthetic cytokinin is used for fruit thinning at 75-175 PPM. Ethylene directly induces fruit abscission as well as flower formation. Ethephon (e.g., Ethrel) is used for fruit thinning at 400 - 600 PPM.

6. Use of growth retardants: Growth retardants like Paclobutrazole (Cultar) in mango, uniconazole in Avocado has been found to reduce alternation. Paclobutrazol checks gibberellic Acid biosynthesis, increases cytokinin level, chlorophyll content, improves mineral uptake and carbohydrate gradient of the entire plant system (Upreti *et al.*, 2013). Shoots have low GA levels that leads to accumulation of total non-structural carbohydrates, predominantly starch, in the leaves and buds. These series of events eventually result in formation of floral initials.

7. Root pruning: Root pruning is a good option for managing excess shoot growth during “off” year. It has a direct effect on annual shoot growth extension which terminates vegetative growth for terminating buds to form new flower buds.

CONCLUSION

Alternate bearing is an economic problem for fruit industry affecting fruit size and net economic return, causing a price fluctuation between “on” and “off” year. It is governed by interaction between vegetative growth and fruit load. Environmental factors are the primary cause all the metabolic alterations leading to alternate

bearing expression. Horticultural interventions viz., pruning, thinning, girdling, de-blossoming and other cultural and nutritional means can minimize and even eliminate alternate bearing in regions with favorable and stable climatic conditions.

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