



Alternate Bearing in Fruit Crops: Causes and Management

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Alternate bearing (AB) or biennial bearing (BB) is a significant difficulty for fruit crop growers and traders. It usually starts with an extremely heavy crop in trees (one year), followed by a light or no crop the following year (off year). Periodicity of cropping or irregular bearing occurs when the on and off year sequence does not follow a predictable pattern. Alternate bearing is caused by a hereditary element, whereas irregular bearing can be caused by poor orchard management. Unless extreme climatic events interfere or substantial managerial actions are made, alternation becomes ingrained and difficult to modify. A heavy "on" crop results in reduced vegetative shoot and root flushing, and less carbohydrate (energy reserves) build-up. Phenomenon of alternation is more prominent in the perennial fruit crops particularly in Anacardiaceae (mango and pistachio), Corylaceae (Hazel nut), Oleaceae (olives), Rosaceae (apple, pear, plums, apricot *etc.*), Rutaceae (orange, Tangor, Satsuma *etc.*) and also tamarind, jamun *etc.* fruit crops. Within a tree species some cultivars are regular while others are alternate bearer. *e.g.* in mango Amrapali is regular bearer while Langra is strongly an alternate bearer.

Development of Alternation

Genetical, environmental, and orchard management methods cause an alternate bearing cycle in young trees, resulting in either an unusually heavy or a very low (or nil) harvest. The vegetative: reproductive balance previously favoured vegetative growth. During the fruit growth processes of some fruit crops, a large amount of photosynthates must be moved from the leaves to the fruits. The increased photosynthetic rates of leaves around fruits are insufficient to meet the high "carbon" (energy) demands of the fruits. As a result, there are fewer carbon stores available for vegetative renewal processes such as root formation and the commencement of new growth flushes, as well as the establishment of new fruiting sites/fruit bud differentiation processes required for the following season's fruiting. As a result, there is no or very little fruiting, or an "off" crop. It was given due to the negative impact of the "on" crop on future crop flowering and fruiting. Environmental circumstances, cultivar and rootstock selection, and management can all influence a crop's bearing behaviour.

Alternate bearing index (ABI)

Pearce and Dobersek Urbanc (1967) proposed the Alternate Bearing Index to quantify the level of alternate bearing in scientific study (ABI). It's calculated using the formula below:

$$ABI = \frac{\text{yield, year 1} - \text{yield (years 2)}}{\text{yield, year 1} + \text{yield, year 2}}$$
 in kg/tree for two consecutive (on/off) years.

It ranges from 0 (no alternate bearer) to 1 (complete alternate bearer). ABI can be expressed as a percentage by multiplying by 100.

Plant height, flowering, yield and quality including alternate bearing can be overcome by various horticultural practices like pruning, thinning of fruits, use of chemicals like Paclobutrazol etc. out of these use of **Paclobutrazol** is commonly practiced by the horticultural growers.



Alternate Bearing (On and off Year) in Mango (*Mangifera indica* L.)

Causes of Alternate Bearing

Broadly two causes have been assigned for alternation namely, Environmental triggers and Endogenous factors.

Environmental Factors

Several environmental triggers 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 more influences on terminal bearing fruits. It is more damaging during spring season. Due to the cool weather in November, fruit setting in Valencia produced in Australia was observed to be impacted. Low air humidity during early fruit growth phases caused excessive fruit drops in olives, oranges, avocado, and mango. Edaphic factors such as high salinity favours leaf drop and reduction in photosynthetic area. Moisture stress during flower formation increases sterile flowers in olives, 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 devastate the whole crop and bring the trees towards alternation.

Endogenous Factors

Endogenous causes of fruit tree alternation include the suppression of flower initiation by developing fruits, a shortage of adequate pollinizers and pollinators resulting in poor fruit set, the effect of seed on fruit drop prevention and encouragement of excessively heavy crop loads, and so on. Other key components to the cycle include leaf contribution to reproductive growth, competition between vegetative and reproductive sinks, fruit burden, C:N ratio, and hormone imbalances.

Control/ Management of Alternation

The primary goal of alternate bearing management is to prevent overburden in "On" years while inducing flowering in "Off" years. Few horticultural operations are capable of reducing the degree of bearing alternation or abnormalities.

1. **Proper orchard management:** It is necessary to follow a proper orchard management schedule by providing adequate nutrients, irrigation, proper weed, pests and disease management etc cultural operations.
2. **Pruning:** Pruning has been shown to reduce alternate bearing by restoring vegetative vitality that has been lost owing to over-cropping. Girdling is an ancient horticultural technique for reducing excessive vigour and improving flowering and fruiting of the entire tree or specific branches or shoots. Girdling can be employed to boost cropping in a

branch renewal/rotation management system, in which branches are viewed as distinct modules (mini-trees) that are pruned and re-cycled in a systematic manner.

3. **Deblossoming and Fruit thinning:** 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.
4. **Fruit thinning:** Fruit thinning is a technique for reducing crop load during the "on" season, when overcrowding favours alternation. It has been proven that removing smaller fruits before the summer drop reduces the alternate bearing phenomenon.
5. **Use of growth retardants:** Growth retardants namely, Paclobutrazol (Cultar) in mango, uniconazole in Avocado has a proven role in reducing alternation.
6. **Planting of Regular bearing varieties**

Conclusion

In many fruit crops, irregular or alternate bearing is a serious challenge for long-term productivity, especially in a changing climate situation. The net return to the farmer during the off-year crop is poor, and it disturbs orchard maintenance cycles, which is a major economic challenge for growers. Some essential management considerations include selecting an appropriate variety and controlling fruit load through various agronomic approaches.