WELCOME

COURSE SEMINAR

ON

Causes of bearing problems in fruit crops and how to mitigate it.

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Seminar outline

- INTRODUCTION
- BEARING HABIT IN FRUITS
- CAUSES OF BEARING PROBLEM OF FRUIT CROPS
- MITIGATION OF BEARING PROBLEMS
- CASE STUDIES
- CONCLUSION

INTRODUCTION

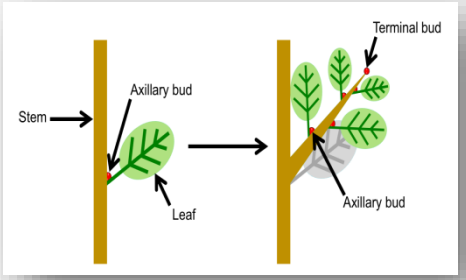
- India is an important fruit growing country in the world and having second position after China with total fruit production about 99069 (000 MT)during 2019-20 (NHB report 2019-20).

- Bearing problem is very serious problem in many fruits and their varieties resulting heavy loss to growers and make fruit cultivation less profitable.

- Unfruitfulness in fruit crops is also one of the causes where the plant is capable of flowering and bearing fruits but they are not functioning properly in a particular combination.

Bearing habit of fruit crops

1. Shoot bearing. Bearing on shoots can be terminal, lateral or both terminal and lateral. eg-Papaya,mango and ber.



2. Caulifluorous (Stem or branch bearing): The main stem or branch directly bear fruits such as - Cocoa, jackfruit, durian and Jaboticaba

3. Spur bearing: Spur is a modified shoot of more than one year that holds the fruit bud and remains productive for some years depending on the cultivates and species. eg-Apple & pear, cherry

Bearing habit in fruits

Terminal:

Old season growth- mango, litchi, pineapple.

Current season growth- pecanut, loquat, ber.

Auxillary:

Current season growth- coconut, papaya, orange, guava, passion fruit,

Old season growth- apple, custard apple, pear, peach, plum.

Mix bearing:

Pomegranate, citrus, carambola.

Source – Basic Horticulture by Jitnedra Singh

Terminal bearing in mango

Mix bearing in Pomegranate

Auxiliary bearing in Grapes and Papaya

CAUSES OF BEARING PROBLEM OF FRUIT CROPS

➢ External factors

1. Environmental factors
   i. Temperature
   ii. Rainfall
   iii. Wind velocity
   iv. Frost
   v. Hailstorm
   vi. Cloudy weather
2. Disturbed water relations
3. Nutrient supply
4. Rootstocks
5. Pruning
6. Fruit drop
7. Spraying fruit plants during flowering
8. Insect-pest and diseases

➢ Internal factors

1. Evolutionary tendencies
2. Genetic factors
3. Physiological factors

Wani, et al., 2010

(B) ENVIRONMENTAL FACTORS:

- **Temperature:** Temperature is one of the most important environmental factors, which affects the flowering pollination, fruit set, growth and development of plant.

1. The pollen of most of fruits crop germinate at temperature range 40^0 to 60^0 F in temperate climate.
2. Temperature appears to have some relation with the variability in the incidence of mango malformation.
3. Temperature can have direct influence on fruit set through its effect on the activity of pollen-carrying insects.
4. Influence of temperature on fruit set has also been reported in papaya such as sex reversing male plants

Rainfall

- Rain at the time of blossoming causes the less fruits set than any other climatic agency.
- In general, heavy rain, even for a short duration , causes washing of pollen grains causing more damage to flower and fruit set.

Wind

- ✓ Wind is an important pollination agency in many fruit plants like walnut, pecan nut, oak, hickory, hazelnut, coconut etc. (Anemophilous or Wind pollinated)
- ✓ Anemophilous fruits need a reasonable amount of wind at the time of flowering aids in securing a better fruit set.
- ✓ When wind are strong, the insects do not work at all. Wind along with rains at the time of flowering is very harmful.

Hail storm

- ✓ Hail storm has been found to be very harmful in temperate fruit orchards,
- ✓ hail destroys all the flower buds and injures almost all the developing fruits.

Frost

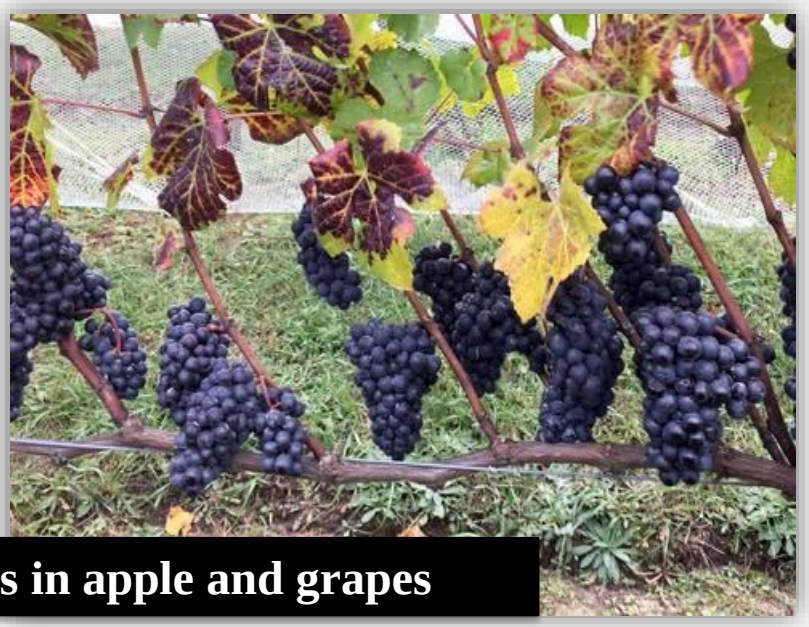
- Spring frost are particularly harmful to the in temperate climate.
- Frost may either kill the several organs of a flower or completely destroys the blossoms there by influencing the fruit set and ultimately the fruitfulness.

Cloudy weather

- Cloudy weather may cause unfruitfulness by making conditions favourable for disease development and spread of disease e.g. powdery mildew, Anthracnose in mango etc.
- It is most destructive during March-April, especially during cloudy weather.

Rainfall cause fruit cracking in pomegranate

Hail storm damaged in apple



Frost causes in apple and grapes

Disturbed water relations

- Flowering stage supply of water may lead to the formation of an abscission layer resulting in the dropping of the blossoms.
- Moisture deficit may be responsible for disturbance in C:N ratio and composition of other chemicals which are responsible for fruit drop.

Nutrient supply

- Inadequate supply of nutrients also influences fruit set and fruitfulness of the plant.
- Excessive feeding causes sterility is still an stigma or produce abnormal flower or juvenile period.

Root stocks

- In some instances stock exerts considerable influence on flowering and fruit set of the scion cultivar e.g. Quince rootstock precocity in bearing in pear.

Pruning

- Judicious removal of plant part to obtain better and qualitative yield is termed as pruning.
- Pruning is started in later part of plant life, when it becomes capable to produce flowers and fruits e.g. ber, apple, grapes etc.
- Some plant disturbed by heavy pruning like there are no flowerings.

Fruit drop

- In fruit, between 20% to 80% of the initially set drop off from the tree during developing.
- Fruit drop occurs at different stages fruit development such as post-set drop and may drop or pre-harvest drop.

Insect, pest and disease

- ✓ At the time of flowering some insects are beneficial but fruit plant attacked by insect (Thrips, mealy bug, gall midge etc.) and diseases like fungal(Powdery and Downey mildew, apple and pear scab).
- ✓ Among diseases blight is most serious diseases, which limits fruit setting in pears considerably.

Spraying in fruit plants during flowering period

- ✓ Spraying of insecticide and pesticides during flowering is not desirable causes poor fruit setting and affecting fruitfulness of the orchard.
- ✓ **Example:** Jhumka, the disorder has occurred in orchards due to excessive spraying of insecticides, which result in decline in pollination of pollinating insects.

B. INTERNAL FACTORS:

It is a common observation that some fruit plants even produce abundant flower, but usually fail to adequate number of fruit and some time they do not produce fruits.

This failure of fruit set may be due to various reason

A- Evolution

- **Sex distribution**: The female and male flowers are borne on different plants, **e.g., date palm and papaya**. For proper fruit set require sufficient number of male plants in a cluster of female plants is necessary.

- **Structural diversity**: Flowers of many fruit plants have structural diversities or peculiarities of form and structure such like heterostyly, protandry and protogyny.

- **Abortion of pistils or ovules**: fruit setting and subsequent fruit development depend on the union of sex cells. Basically it is also one of the primary causes of unfruitfulness in fruit plants.

- **Pollen impotence**: It is very likely that even perfect flowers of many fruit plants produce small amount of pollen and sometimes a considerable amount of the produced pollen is not viable.

(1) Evolutionary tendencies

- Due to evolutionary tendencies, cross fertilization must be done in order to maintain the vigor of the species. In these species, self fertilization is difficult.

The evolutionary factors leading to unfruitfulness are:

- **Imperfect/defective flowers-**

  a) Monoecious (Cashewnut, Annona, Aonla, Ber, Litchi, Jackfruit)

  b) Dioecious (Papaya, Date palm)

- **Dichogamy**

  a) Protandrous (Ber, Passion fruit)

  b) Protogynous (Sapota, Annona, Mango, Avocado)

Sharma, R. R. (2006). Fruit Production.

- ✓ **Heterostyly:** Difference in the length of style and stamens.
- ✓ Pin (Sapota, Pomegranate) and Thrum (Carambola) type flowers.

Sharma, R. R. (2006). Fruit Production.

- ✓ **Stigmatic receptivity**

- ✓ **Abortive flowers or aborted pistils or ovules**

Fruit plant	Causes of flower abortion
Grapes	Degeneration of nucleus
Mandarin	Abnormal pistil
Litchi	Embryo abortion
Olive	Pistil abortion
Kiwi fruits	Pollen degeneration

Wani, *et al*., 2010.

Male

Female

Flower of Papaya

(2) Genetic influences

Sterility

- Sterility or unfruitfulness has primarily been associated with the protoplasm and due to these factors in inherited.
- The impotence may be complete, in which either no flower or no sex organs are formed, or it may be partial, in which either stamens or pistils are abortive

Unfruitfulness due to sterile hybrids

- ✓ Hybridity is associated with sterility as well as unfruitfulness.
- ✓ The degree of sterility increase with wider crossing.

Unfruitfulness due to incompatibility

- ✓ Incompatibility may be defined as the inability of the pollen grains to germinate freely in the ovules of the some plant of a variety.
- ✓ It is also regarded as one of the most common causes of self-unfruitfulness or self sterility in many fruit plants. E.g. aonla, apple, peach, plum, ber, apricot, etc.

(3) Physiological influences:

- Slow growth of the pollen tube.
- Poor pollen germination.
- Pre-mature or delayed pollination .
- Nutritive condition of the of the plants.

SOLUTION OF BEARING PROBLEMS:

➢ **Balancing fruiting and vegetative growth**:

- Pruning is also primarily adopted to maintain a proper physiological balance between growth and fruiting.

- Thinning is the practice of fruits recommended with a view to reduce the crop load in on year, so as to get some crop every year e.g. apple, pear, peach, mango, oranges, litchi etc.

Pruning of Apple tree

Thinning of Apple and Peach fruits

Control of pollination:

- Use of pollinizers- Pollinizer is plants, which produce abundant pollen grain for the adequate pollination of self-incompatible varieties of fruits.
- Some pollinizer varieties of fruit: Apple-Golden Delicious, Pear-Flemish Beauty, Plum-Beauty, Santa Rosa, Mariposa.
- Introduction of pollinators-Honey bees are considered to be the most effective pollinators.
- In fact, cross pollination of entomophilous fruit crops as apple, pear, peach, plum, apricot, guava, mango, litchi, citrus etc.

Pollination in Mango by House fly

Pollination of litchi by honey bee

Use of suitable varieties

Growing of regular bearing cultivars is perhaps the most suitable and desirable alternative to overcome the problem of alternate bearing.

Name of fruits	Regular bearing varieties
Mango	Neelam, Totapari, Himsagar, Gulabkhas, Hybrid- Mallika ,Amrapali, Arka Aruna, Ratna.
Apple	Golden Delicious, McIntosh, Cortland, Tydes Man Early Warcester.
Plum	Santa Rosa, Beauty, Victoria
Apricot	Nugget, Tilton

Source – Fruit growing by J. S. Bal

Control of fruit drop

- Use of growth regulators

Fruit crop	Plant growth regulator	Concentration	Time of application	Reference
Mango	NAA Ethrel	50ppm 50ppm	Pea stage of fruits development Flower bud differentiation	Baghel and Tiwari, 2003
Sweet orange	2,4-D NAA	8-20ppm 15-20ppm	Pre-harvest stage August and October month	Ghosh et al. (2012).
Apple	NAA	20ppm	Pre-harvest application	Gautam and Jindal (2003)
Sweet lime	GA_3 2,4-D	10ppm 20ppm	May end Pre-harvest application	Rokaya et al., (2016).
Apricot	NAA	10ppm	Pre-harvest drop 10 days after fruit set	Sharma et al. (2008).

Proper management of orchard

- Supply to nutrients adequate and require dose at appropriate time of fruit plant.
- Avoid to irrigation at the time of flowering.
- Flowering time less spraying of insecticide because pollination affected.
- To prevention of insect, pest and disease.

Use of plant growth regulators

- ✓ Use of some chemicals are regulating flowering and fruiting of plant.
- ✓ Cultar (Paclobutrazol) @5g/tree application 100-120 days before application of NAA to improve flowering and fruiting.
- ✓ SADH promotes flowering in apple, pear, peach, lemon fruits.
- ✓ Litchi application of TIBA and KNO_3, Increase pollen fertility (Sanyal et al., 1996)

The Asian Journal of Horticulture, Volume 8 (2) December, 2013 | 635-640

Influence of pre-harvest foliar application of micronutrients and sorbitol on pollination, fruit set, fruit drop and yield in mango (*Mangifera indica* L.) cv. ALPHONSO

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Aim: To study the influence of pre-harvest foliar application of Calcium, Boron and sorbitol along with a control on pollination, fruit set, fruit drop, fruit growth parameters and yield of mango cv. Alphonso.

✓ The treatment were:

T_1- Calcium nitrate - 0.06% (active ingredient 0.150 %),

T_2- Boric acid 0.02% (active ingredient 0.114%),

T_3- Sorbitol -2% (fine sorbitol),

T_4- Calcium nitrate 0.06% + Boric acid 0.02%,

T_5- Calcium nitrate 0.06% + Sorbitol -2%,

T_6- Boric acid 0.02% + Sorbitol -2% and

T_7- Control (water spray).

Table 2: Effect of calcium, boron and sorbitol on pollen size, pollen viability, pollen germination and pollen tube growth of mango cv. Alphonso under *in-vitro* condition

Treatments	Pollen size (µm)	Pollen viability (%)	Pollen germination (%)	Pollen tube growthlength at 4 hr intervals (µm)					
				4	8	12	16	20	24
T_1	27.97	86.65	49.26	45.33	90.84	131.67	133.60	135.03	137.51
T_2	28.30	89.69	56.30	49.51	108.57	151.01	153.79	155.48	158.99
T_3	27.50	73.69	45.60	40.74	91.35	131.54	133.24	134.13	137.21
T_4	27.94	79.04	48.90	43.61	86.98	125.62	128.57	131.02	132.53
T_5	27.78	73.76	42.09	39.12	80.12	119.62	122.64	123.24	125.98
T_6	28.21	83.81	52.76	45.84	97.41	140.01	140.44	141.02	144.14
T_7	27.41	70.88	38.85	36.22	72.78	111.85	115.40	116.31	118.65
S.E. ±	0.953	1.228	1.482	1.3319	2.8416	2.667	2.747	2.968	3.083
C.D. (P=0.05)	NS	2.580	3.114	2.798	5.970	5.604	5.771	6.236	6.478

African Journal of Agricultural Research Vol. 5(25), pp. 3581-3589, December 2010

Unfruitfulness in fruit crops: Causes and remedies

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Aim: To know its causes and adopting effective control measures for obtaining economic orchards.

Table 5 : Percentage of fruit set in loquat varieties, 'improved golden yellow' and 'pale yellow', by using different pollinizers.

Female \ Male	Thames pride	California advance	Fire ball	Golden yellow	Improved golden yellow	Large agra	Large round	Pale yellow	Tanaka
Improved golden yellow	41.46	56.0	43.3	25.0	--	46.6	45.0	43.3	50.0
Pale yellow	43.3	50.0	41.6	40.0	45.0	53.3	45.0	--	46.6

Annals of Horticulture, 2 (1) : 124-125 (2009)

Effect of pruning on panicle production and malformation In mango cv. Amrapali under high density orcharding

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Aim: To know the information regarding the time and intensity of pruning and sustainable production of mango cv. Amrapalli.

Table 6 : Effect of pruning on panicle production (number) and malformation (%) in mango cv. Amrapali

Treatment	Total no. of panicles per plant		No. of normal panicle/ plant		No. of malformed/ panicle plant		Malformed panicle/ plant (%)	
	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001
Control	38.40	35.90	32.90	30.60	5.60	5.20	17.94 (25.03)	14.52 (22.38)
Light	42.40	40.60	39.60	37.60	2.80	3.00	6.60 (14.89)	7.38 (15.71)
Moderate	55.20	47.40	52.60	44.80	2.60	2.40	4.71 (12.50)	5.06 (13.15)
Severe	35.70	36.60	32.50	33.40	3.20	3.40	8.98 (17.36)	9.28 (17.69)
Mean	42.92	40.05	39.37	35.50	3.55	3.50	9.55 (17.98)	9.06 (17.46)

Conclusion

- ✓ From the foregoing discussion and research results of various scientists, it can be concluded that fruiting of a tree is influenced by many factors. So, it is necessary to adopt corrective measures which should begin from planning level and extends to an established orchard.
- ✓ Compatible, disease resistant, high yielding rootstocks should be selected.
- ✓ The crops or varieties should be chosen on the basis of climate and edaphic factors.
- ✓ To maintain healthy condition of the tree as well as to get profitable yield it should be supplemented with ample quantity of nutrition.
- ✓ Different varieties should be cultivated and the introduction of effective pollinizer varieties as well as pollinators were essential.
- ✓ Thinning and crop regulation should be practiced to maintain balance between vegetative and reproductive phase.

So proper planning in initial establishment of orchard must be done for effective encounter of arising problems that may leads to unfruitfulness.

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Thank You !