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Citrus Fruit Drop: Causes and Management

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Introduction

Citrus cultivation is highly productive in Haryana due to favourable agro-ecological conditions. However, a major issue that citrus farmers face is the significant shedding of flowers and fruits from the flowering stage until harvest. Although citrus trees blossom abundantly in spring, only a small percentage of flowers develop into mature fruits. For example, in Kinnow, less than 1% of flowers result in harvestable fruits. The percentage of flowers that turn into fruits varies from year to year, with heavy-blooming years experiencing lower fruit set than lighter bloom years. The primary reason for the low percentage of flowers turning into fruits is the loss of fruits during different stages of growth and development. Fruit drop does not occur at once but in waves, with more or less distinct periods or stages when significant shedding happens. In citrus, fruit shedding occurs in three distinct waves, also known as post-bloom drop, June drop, and pre-harvest drop.

First wave (post-bloom drop):

The shedding of fruits begins shortly after the flowering stage and results in the dropping of small fruits. This phenomenon is a natural occurrence caused by the over-production of fruits and does not cause significant concern for growers. This fruit drop serves to reduce the excessive fruit load on the trees (Agostini et al., 1993).

Second wave (summer or June drop):

The first wave of fruit drop usually occurs around one to two months after flowering when young developing fruits fall off from trees that have an excessive amount of fruit. This drop, known as the June drop, accounts for around 10% of the total dropped fruits in Kinnow, with the fallen fruits being about the size of marbles, measuring around 1-2 cm in diameter. The primary reason for fruit drop during this stage is the competition among young fruits for carbohydrates needed for growth and development. Although June drop is a natural

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occurrence during citrus fruit development, it can be worsened by water scarcity and high temperatures in early summer.

Third wave (comprise pre-mature and pre-harvest fruit drop):

The third wave of fruit drop affects almost mature to harvestable fruits, starting in August as pre-mature fruit drop and continuing until harvest as pre-harvest fruit drop. During this time, fruits may detach at the peduncle and calyx junction, resulting in fruit drop without the peduncle attached. This drop has significant economic consequences for growers, as it affects nearly fully-grown fruits, leading to heavy losses. The primary causes of pre-mature fruit drop are disease spread and fruit fly infestations, while pre-harvest fruit drop in December–January is mainly due to low temperatures and foggy weather (Dutta et al., 2022). Various factors, both internal and external, contribute to fruit drop in citrus, such as imbalances in growth regulators, disease, insect pest attacks, extreme temperatures, water stress, high humidity, and flooding.

Physiological fruit drop

The physiological process of fruit drop is called abscission. Physiological drop occurs due to exposure of plant to environmental or physiological stress.

Causes of physiological fruit drop:

The main cause of physiological fruit drop is

- Water stress
- High temperature
- Nutrient deficiencies
- Frost for long period of time
- Poor health of tree

In times of stress due to above reasons, plants generate ethylene which can cause the fruit to fall off by weakening the abscission layer between the branch and the fruit. Therefore, it is crucial to maintain optimal tree health and prevent stressful conditions such as insufficient or excessive moisture, nutrient deficiencies resulting in yellowing leaves, and timely management of diseases and pests. Citrus trees require a well-balanced supply of macronutrients and micronutrients to develop sufficient foliage that can support the growth of fruits. The application of recommended fertilizers is necessary to ensure the healthy and vigorous growth of the trees. Adequate drainage systems must be put in place to prevent

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water logging. During the fruiting period, citrus trees should not be deprived of water, as water stress can speed up the production of abscisic acid, which accelerates fruit abscission (Ashraf et al., 2013).

Besides physiological causes, fruit drop is also caused by diseases (pathological fruit drop) and insect-pests (entomological fruit drop).

Pathological Fruit Drop

Pathological fruit drop is a significant obstacle that can lower the yield and quality of harvested fruits. This type of fruit drop usually begins in August and persists until harvest time, with the highest occurrence observed in mid-September to mid-October. The drop during September and October is particularly harmful as the fruits are close to maturity and have already obtained nutrients from the tree. Various plant pathogens, including *Colletotrichum gloeosporioides*, *Diplodianatalensis*, and *Alternaria citri*, can cause pathological fruit drop(Lima et al., 2011).

Symptoms

The mentioned pathogens not only cause fruit drop but also lead to twig die-back. The disease starts on the tree as the drying of twigs from the tip downwards, and dead twigs show numerous black dot-like fruiting bodies of the fungus. Pathological fruit drop or stalk-end infection of immature fruits is identified by the emergence of small, circular, light brown lesions around the stalk end of the fruit. As the area grows larger, it results in the development of a soft dark brown pliable rot, causing premature fruit drop due to the rotting of the affected area. Some fruits exhibit lesions on both stalk-end and stylar-end, leading to premature fruit drop due to the rotting of the affected area(Dutta et al., 2022).

Alternaria citri, which causes stylar-end rot, infects the fruit in its early development stages and remains dormant as a weak parasite, showing symptoms later. When the fruit matures, the fungus becomes active, stimulating abscission. In some cases, late infection may cause the diseased fruits to shrink, turn black, become light in weight, mummify, and remain hanging on the stalks for a more extended period. The stalks of the diseased fruits turn grey, and numerous black dot-like fruiting bodies of the fungus appear on them.

Factors favouring disease development

The primary cause of fruit drop in Kinnow is the presence of dead wood on the tree, which provides a favourable environment for the disease. The fungus responsible for the

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disease survives on dead twigs, leaves, and fruit stalks in the form of black dot-like fruiting bodies, which serve as the primary source of infection for the upcoming fruiting season. The disease starts in diseased twigs during the spring season (February-March) and remains dormant during the hot summer months of April-June. However, frequent rains from July onwards, combined with high temperature and humidity create ideal conditions for disease development and rapid spread, resulting in maximum fruit drop between mid-September and mid-October.

Control of pathological fruit drop

Pathological fruit drop of citrus can be managed by adopting the following integrated management strategies:

During the months of January-February, after harvesting citrus fruit, it is recommended to prune the trees and remove any diseased, dead or decaying twigs. This will help to reduce the primary source of inoculums. After pruning, it is advisable to spray the trees with Bordeaux mixture (2:2:250) or copper oxychloride 50 WP (3 g/litre of water) in March, July, and September(Yasin Ashraf et al., 2012). Any pruned wood should be collected and destroyed by burning. To prevent further spread of the disease, it is essential to collect and dispose of any mummified fruits on the trees as well as any fallen fruits by deep burying.

Entomological Fruit Drop

Fruits flies and fruit sucking moths are most important insect pests responsible for fruit drop in citrus.

Fruit Flies

Oriental fruit fly, *Bactrocera dorsalis* (Hendel), and peach fruit fly, *Bactrocera zonata* (Saunders), are significant pests in citrus fruits in Haryana. These flies cause damage to fruits through the female flies and maggots. The female adult fruit fly uses its needle-like ovipositor to puncture ripening fruits and lay eggs inside. Upon hatching, the maggots feed on the pulp of the fruit. Infested fruit exhibits dark green depressions due to the punctures caused by the female fly's ovipositor. When squeezed, the infested fruit produces numerous jets of juice, as there are several holes on a single fruit. The fruit may rot due to fungal and bacterial infections entering through the puncture hole and feeding by maggots, resulting in premature fruit drop. Fruit flies have been observed to damage not only Kinnow but also the

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fruits of other citrus species, such as grapefruits, sweet oranges, and lemons. The peak activity period of fruit flies is from August to November.

Management of fruit flies

Managing fruit flies is a challenging task due to their ability to infest a vast range of host plants, multiple generations in a year, high mobility of adult flies, and a long lifespan of more than three months. Additionally, a single female fruit fly can lay over 1000 eggs, and all developmental stages occur in hidden locations, such as inside fruits for eggs and maggots, in soil for pupae, and flying for adults.

Orchard sanitation

Effective management of fruit flies can be achieved through measures such as clean culture, orchard sanitation, and the removal and destruction of infested fruits by burning or deep burying. Burying the fruits in pits that are 60cm deep has been proven to prevent fruit fly emergence from the soil. This practice should be conducted annually in all orchards and fruit crops that are host to fruit flies. To further reduce the fly population during the off-season, fruit growers should ensure that all undersized fruits remaining on trees after harvesting are collected and destroyed. Additionally, to manage fruit flies on a larger scale, it is recommended to install 16 PAU fruit fly traps per acre in the second week of August and recharge them every 30 days as needed.

Fruit sucking moths

Kinnow fruits are commonly damaged by fruit-sucking moths, including *Eudocimamaterna*, *Eudocimafullonia*, and *Acanthodeltajanata*. The larvae of these moths are semiloopers that feed on leaves of various host plants, such as *Tinosporacardifolia*. However, it is only the adult moth that causes damage to Kinnow fruits. During the rainy season, after dusk, the moths use their strong proboscis with sharp spines to pierce the ripening fruits and suck out their juice. These results in a circular pinhole-like spot at the feeding site, which later turns yellowish-brown. Some Kinnow fruits can have up to 16 holes caused by these moths. When such fruits are squeezed, fermented juice comes out from each hole, making them easily susceptible to bacterial and fungal infections. This causes the fruit to rot and fall prematurely. The peak activity period of these moths is from July to October(Dutta et al., 2022).

Management

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Controlling this insect is challenging because its caterpillar feeds on weeds and other plants surrounding the orchards. Additionally, moths inflict damage during the night-time hours. To manage the insect effectively, it is crucial to eliminate other hosts, such as wild weeds and creepers, particularly *T. cardifolia*, in the vicinity of citrus orchards. Proper disposal of fallen fruits is also necessary as they attract moths to the area. To repel insects, smoke can be created in the orchards after sunset. Bagging of fruits is an effective method.

Refrences

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