FRUIT DROP PROBLEMS OF CITRUS

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INTRODUCTION

Fruit set percentage and severity of fruit drop vary considerably among the major fruit crops. Fruit set may be as high as 90% for blueberries, 10-20% for apples and peaches to a low of 1% for sweet oranges. Moreover, blueberries have a small percentage of fruit drop after the initial fruit set period, while apples, peaches and citrus have a pronounced and sometimes extensive June drop. The severity of postbloom drop is a function of cultivar, environment, and cultural practices. Nevertheless, some degree of fruit drop is not only desirable, but necessary. For example, a mature navel orange tree may produce 100,000 flowers. If even 10% of these produced mature fruit, yields would average about 125 boxes/tree!

Fruit drop may be divided into 3 major periods for citrus: postbloom drop, June drop, and preharvest drop. Navel oranges have 2 additional periods of drop, summer and summer-fall drop. The major fruit drop periods and types of fruit drop, their possible causes, and solutions to the problems will be discussed in this article.

POSTBLOOM DROP

Postbloom drop occurs during and within a few weeks of bloom, involving the abscission of flowers and small fruit. Postbloom fruit drop accounts for an 80-90% reduction in the total flower number. Lima counted 81,062 flowers on a mature navel orange tree of which 71,913 (88.7%) abscised during the postbloom period (Table 1). Erickson and Brannaman observed similar fruit set percentages for navels under California conditions.

The causes of postbloom drop include inadequate pollination, water or temperature stress, inadequate nitrogen levels, and natural abscission probably regulated by hormone imbalances in the fruit. Gibberellic acid sprays have been used to reduce postbloom drop and improve initial fruit set particularly for weakly parthenocarpic cultivars like 'Orlando' and 'Minneola' tangelos and navel oranges. The reduction in postbloom drop for navels, however, does not translate to improved yields due to extensive June drop.

A more detailed discussion of the initial fruit set period and postbloom drop is contained in a previous chapter by A. H. Krezdorn.

JUNE DROP

June drop is a common occurrence for many fruit crops. As the name implies, June drop occurs in June for many temperate crops, like apples and peaches, in the northern hemisphere and for some citrus cultivars in California and Arizona. This phenomenon generally occurs from April to June in Florida and December and January in the southern hemisphere. Fruit size generally ranges from 1 to 3 cm in diameter during this time. June drop accounts for ca. 10% of the total fruit drop of most citrus cultivars (Table 1).

Table 1. Major fruit drop periods for navel orange trees in Florida based on average catching frame counts taken under 25 trees.

Drop period	Fruit drop		
	Fruit No./tree	% of initial Fruit	% of remaining Fruit
Postbloom (3/24-4/18)	71,913	88.7	88.7
June drop (4/19-6/7)	8,411	10.4	91.90
Summer drop (6/8-8/11)	120	0.15	16.50
Summer-fall drop (8/12-10/24)	206	0.25	14.50
Total fruit drop	80,530	99.35	99.35
Total fruit borne	81,062	100.00	
No. of harvested fruit	532	0.65	

(From: Lima. 1980. MS Thesis, University of Florida, Gainesville.

June drop is most severe and troublesome to growers in arid climates where temperatures routinely reach 40°C. Hilgeman found the problem to be most acute during seasons where daytime temperatures remained above 40°C. Although many causes have been proposed for June drop, including water stress, hormone imbalances and competition among fruitlets, high temperature stress appears to be the most important cause. Brewer et al. in California and Costa in Florida found that application of intermittent overhead irrigation to citrus during the June drop period would reduce leaf temperatures by 22°C and thereby decrease drop and improve yields. The results were less impressive under Florida's humid conditions because June drop is usually less severe than in arid parts of California.

Spray applications of various growth regulators, including gibberellic acid and 2,4-D, have not reduced June drop. Currently, most growers in Florida are not concerned with fruit losses during June drop.

PREHARVEST DROP

Preharvest drop occurs after the fruit have reached legal maturity but prior to harvest. Since preharvest drop involves abscission of mature fruit, this problem is very disturbing to growers. The problem is most severe for 'Temples', 'Pineapple' oranges, and 'Murcotts', but also is a problem for navels, 'Minneolas' and grapefruit when held on the tree late into the season

Preharvest drop used in this sense is not caused by a specific organism or environmental factor but is simply due to natural aging and abscission.

'Pineapple' oranges, for example, are held less tightly on the tree than 'Hamlins' or 'Valencias' as evidenced by differences in the fruit removal force. Whereas 9-14 kg (20-30 lbs.) of force is needed to remove a mature 'Valencia', only 1.4-2.3 kg (3-5 lbs.) is needed to remove 'Pineapples'. Therefore, 'Pineapples' left on the tree into February are prone to preharvest drop.

Preharvest drop of 'Murcotts' is quite severe in some seasons. Fruit drop seems to be particularly severe when trees become stressed due to lack of water. Observations also suggest that overfertilization or excessive cropping may promote fruit drop. Crop thinning through the use of growth regulators may help to balance fruit load and possibly lessen the severity of preharvest drop.

Growth regulator applications have been used successfully for many years in California to reduce preharvest drop of navels and grapefruit. Spray applications of 2,4-D (10-16 ppm) to hold fruit and gibberellic acid (10-20 ppm) to prevent rind senescence during December and January are commonly used for late-season navels in California. Application of 20 ppm 2,4-D is effective in reducing preharvest drop of 'Pineapple' oranges in Florida. Unfortunately, this material is not currently cleared for use in Florida.

SUMMER AND SUMMER-FALL DROP

Summer and summer-fall drop are primarily problems for navel oranges in Florida. Summer drop occurs during June and July when fruit are ca. 5-6 cm in diameter. Summer drop, like June drop, is induced by physiological rather than pathological causes. The navel (secondary fruit) abscises from the main fruit causing the production of ethylene that leads to fruit abscission. The navel generally becomes yellowish and necrotic prior to fruit drop. Insects and pathogens then invade the weakened areas as secondary problems. Summer drop may reduce yields by 15% in some years and varies in severity from year to year.

Summer-fall drop of navels occurs from September to October as fruit near maturity and is particularly troubling to growers. This drop period involves a multitude of causes including splitting, stylar-end decay and natural abscission. Stylar-end decay is caused by a weakening of the peel due to formation of abnormal structures under it. The weakened area then becomes necrotic and is predisposed to secondary invasion by insects (particularly sap beetles) and diseases. Stylar-end decay appears to be induced by physiological and morphological causes.

Splitting is also a physiological disorder of unknown causes. Observations suggest that uneven growth of the peel may produce structurally weak areas. Periods of dry weather followed by heavy rains or irrigation then cause uneven growth of the fruit and splitting. Severity of splitting, however, varies considerably from grove to grove independent of rainfall or irrigation and, therefore, cannot be explained solely on the basis of water relations. Some observers believe that potassium or copper imbalances may also increase the incidence of splitting. Considerable fruit drop due to splitting also occurs for 'Hamlins' and particularly 'Valencias' in some years.

Severity of summer drop of navels can be reduced significantly by dilute application of 2,4-D 6-8 weeks after full bloom (Table 2). 2,4-D prevents the abscission of the secondary fruit and prevents fruit drop. It should not be

applied to new growth flushes. Preliminary data indicate that 2,4-D applied in mid-August may also reduce summer-fall drop. However, this material has not been thoroughly tested under commercial conditions and is not currently recommended.

Table 2. Effect of 2,4-D and gibberellic acid (GA) spray applications on summer fruit drop of navel oranges in Florida.

Treatment[z]	Fruit drop (no./tree)
No spray	101
Midbloom	
GA (20 ppm)	123
2,4-D (10 ppm)	19
GA (20 ppm) + 2,4-D (20 ppm)	27
Midbloom + 5 weeks	
GA (20 ppm)	93
2,4-D (20 ppm)	18
GA (20 ppm) + 2,4-D (20 ppm)	
Midbloom + 12 weeks	
GA (20 ppm)	131
2,4-D (20 ppm)	59
GA (20 ppm) + 2,4-D (20 ppm)	54

[z]Note that 2,4-D is currently not labeled for use on Florida citrus (From: Lima and Davies. 1984. J. Amer. Soc. Hort. Sci. 109:81-84.).

OTHER FRUIT DROP CAUSES

Many other factors in addition to those mentioned can cause fruit drop of citrus. These can be divided into 3 major categories: insects and pathogens, environmental factors, and mechanical causes. High populations of purple scale are known to cause fruit drop but this problem has not been severe in recent years. Also, plant and mealy bugs cause peel damage and ethylene production which leads to fruit drop. For example, plant bug damage caused considerable fruit losses to 'Orlando' tangelos in one year. During the past few years Alternaria has caused extensive fruit losses for 'Dancy' tangerines and 'Minneola' tangelos. Brown rot also causes fruit drop in the lower canopy and is most severe in very wet seasons. Fortunately, control measures exist for most insect and disease problems.

The major environmental factors causing fruit drop are temperature and water stress. High temperature effects on June drop have already been discussed. Low temperatures (freezes) also cause extensive fruit drop. Water stress can accelerate fruit drop particularly for late-season fruit and weakly parthenocarpic cultivars like navels, 'Orlandos' and 'Minneolas' during the postbloom drop period.

Mechanical damage is a cause of fruit drop that is often overlooked by growers. Movement of grove equipment particularly discs or mowers may damage

or remove considerable fruit from the lower canopy. We observed that 2-directional discing of mature navel groves removed as much as one half box of fruit/tree.

The major causes of citrus fruit drop and possible solutions are summarized in Table 3.

Table 3. Major fruit drop problems in Florida citrus.

Type of fruit drop	Causes	Solutions
Physiological		
Postbloom	Hormonal, stress	Limit water stress.
June drop	Hormonal, heat stress	Reduce heat and water stress with irrigation
Secondary fruit yellowing (navels only)	Hormonal?	Apply 2,4-D 6-8 weeks after midbloom.
Stylar-end decay (navels only)	Morphological	No cure.
Splitting (navels, Murcotts; Hamlins, Valencias less severe)	Water and nutritional imbalance	Maintain adequate potassium. Limit fluctuations in soil moisture content.
Pathological		
Brown rot	*Phytophthora*	Fungicidal sprays.
Alternaria rot (severe with Dancy and Murcotts)	*Alternaria*	Fungicidal sprays.
Insects		
Purple scale	Organisms indicated	Scalicide sprays.
Plant bugs		Insecticide sprays.
Mealy bugs		Insecticide sprays.
Mechanical		
	Physical damage to fruit caused by machinery in the grove	Limit and supervise mowing and cultivation.

Environmental

Low temperature	Freezes	Site selection, or use of grove heaters.
Water stress	Drought, shallow rooting	Irrigation.
Flooding stress	Poor drainage	Proper design of drainage systems.

CONCLUSIONS

1. Fruit drop during postbloom and June drop periods is necessary to balance crop load and improve fruit size. Most of the fruit and flowers on the tree abscise at this time.

2. Fruit drop after June drop varies with cultivar ('Pineapples', navels, 'Murcotts' are most susceptible.), environmental factors particularly temperature and water, and cultural practices (nutrition, type of insect and disease control and use of discing and mowing).

3. Fruit drop problems may be lessened by managing water and nutrition for susceptible cultivars and use of approved growth regulators.

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