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Effect of different chemicals on pre-harvest fruit drop and fruit set of sweet orange (*Citrus sinensis* osbeck.) var. Nucellar

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Abstract
The present investigation was conducted on seven-years-old trees of sweet orange var. "Nucellar" growing at Sweet Orange Research Station Badnapur. The different chemicals *viz.,* Urea (0.5, 1.0 and 2.5%), GA3 (30, 50 and 70 ppm), NAA (15, 20, and 25 ppm), Urea (1%)+ GA3 (30,40 and 50 ppm) and CPPU (20, 40 and 60 ppm) were sprayed at prior to flowering, full bloom and pea stage along with a control. The minimum percentage of fruit drop was observed when NAA sprayed at 15 ppm (14.19%) which is followed by NAA (20 ppm), GA3 (50 ppm,) GA3 (30 ppm), and NAA (25 ppm) respectively. The maximum fruit set was observed in treatment Urea (1%) + GA3 (70 ppm) (67.67) which is followed by GA3 (50 ppm), NAA (25ppm), NAA (20ppm) and GA3 (70 ppm). Thus it proves that the application of plant growth regulators and chemicals most effective against the control of fruit drop and increasing fruit set.

Keywords: Sweet orange, fruit drop, fruit set, NAA, GA3, CPPU, Urea

Introduction

Sweet Orange is considered as most important fruit crop of citrus group with their wholesome nature multifold nutrition and medicinal value have made them so important. Sweet Orange (*Citrus sinensis* L.) belongs to family Rutaceae. Sweet Orange is native of Southern China. It is now widely distributed and naturalized in sub tropical zone of India. It is cultivated particularly in Brazil, China, Japan, Turkey and India. Andhra Pradesh, Karnataka, Maharashtra, Punjab, Rajasthan and Haryana are main Sweet Orange growing states. Sweet Orange need dry climate and arid weather with distinct summer and winter seasons with low rainfall. It is grown on wide range of soil ranging from clay to light sandy and sensitive to salt. Sweet Orange is well grown on medium black, red, alluvial river bank loamy soil of Maharashtra state and Goradu soil of Gujarat.

One of the main reasons for low Sweet Orange orchard productivity of Marathwada region is due to fruit drop. Fruit drop is the serious problem worldwide.

Fruit drop occurs from the abscission zone at the base of the fruit leaving the pedicel attached to the tree temporarily. Physiological drop is a disorder most probably related to competition among fruit lets for carbohydrates, water, hormones and other metabolites.

The problem, however, is greatly aggravated by stress, especially high temperatures or water deficit conditions. (Huchche., *et al* 1993) [5]. The present investigation was therefore planned with the objective to reduce the fruit drop and increase the fruit set of „Nucellar‟ variety of sweet orange. Plant growth regulators play a very vital role in plant growth and development. Although the naturally occurring (endogenous) growth substances normally control and guide planned growth and development, modification can be achieved by the application of the growth substances exogenously. Application of plant growth regulators can control the hormone balance at the abscission layer, reducing or retarding the early fruit fall and harvest losses (Modise *et al*., 2009) [8]. The application of auxin prevents the fruit falling by preventing the synthesis of hydrolytic enzymes, such as cellulose (Monselise, 1978) [9]. Urea and NAA sprays significantly increases fruit retention and fruit yield (Sharma *et al*., 1990) [13].

Material and Methods

The present investigation was undertaken during the year 2015-16 at the Sweet Orange Research Station, College of Agriculture, Badnapur.

The experiment was carried out with Randomized Block Design with sixteen treatments and three replications The experimental trees used were seven years old grafts of sweet orange (*Citrus Sinensis Osbeck.*) var. Nucellar spaced at 6.0 m × 6.0 m. The growth regulators and chemicals, Urea NAA, GA3 and CPPU sprayed at prior to flowering, at full bloom and at pea stage. The treatments comprised of Urea (0.5%), Urea (1%) and Urea (2.5%), GA3 30 ppm, GA3 50 ppm, GA3 70 ppm, NAA 15 ppm, NAA 20 ppm, NAA 25 ppm, CPPU 20 ppm, 40 ppm, 60 ppm and control (No spray). The observations on days required to initiation of 50 percent flowering, days required for fruit set from spraying, number of days from initiation of flower bud to fruit ser, fruit drop, fruit set percentage and number of days required from fruit set to fruit maturity were recorded as per standard procedure and statistically analyzed.

Table 1: Days required for initiation of 50 % Flowering, days require for fruit set from spraying, number of days from initiation of flower bud to fruit set influenced by various treatments of plant growth regulators and chemicals.

Tr. no.	Treatments	Days required initiation of 50% Flowering	Days require for fruit set from spraying	Number of days from initiation of flower bud to fruit set
T1	Urea (0.5%)	15.00	40.33	11.00
T2	Urea (1%)	15.33	39.67	10.67
T3	Urea (2.5%)	16.00	39.33	10.00
T4	GA3 (30 ppm)	18.33	42.67	9.67
T5	GA3 (50 ppm)	17.00	43.00	8.67
T6	GA3 (70 ppm)	18.00	41.33	10.00
T7	NAA (15ppm)	19.33	38.00	9.00
T8	NAA (20ppm)	18.00	39.33	9.67
T9	NAA (25ppm)	18.00	39.67	9.33
T10	Urea (1%)+ GA3 (30 ppm)	19.67	40.33	9.33
T11	Urea (1%)+ GA3 (50ppm)	19.33	41.33	9.67
T12	Urea (1%)+ GA3 (70 ppm)	18.33	40.67	8.00
T13	CPPU(20 ppm)	18.00	42.00	10.67
T14	CPPU(40 ppm)	19.67	41.33	11.33
T15	CPPU(60 ppm)	17.67	40.00	11.67
T16	Control	21.00	46.00	13.33
SE		0.80	1.42	0.87
CD at 5 %		2.28	4.13	2.53

Table 2: Fruit set, Number of days from fruit set to fruit maturity and Fruit Drop as influenced by various plant growth regulators and chemicals are presented below

Tr. no.	Treatments	Fruit set %	Number of days from fruit set to fruit maturity	Fruit drop%
T1	Urea (0.5%)	60.56	241.33	24.33
T2	Urea (1%)	61.90	239.67	24.18
T3	Urea (2.5%)	61.90	240.00	24.89
T4	GA3 (30 ppm)	63.07	237.00	15.11
T5	GA3 (50 ppm)	65.56	238.67	16.93
T6	GA3 (70 ppm)	63.81	239.33	21.24
T7	NAA (15ppm)	62.43	242.33	14.19
T8	NAA (20ppm)	64.13	245.00	15.10
T9	NAA (25ppm)	64.57	248.67	19.71
T10	Urea (1%)+ GA3 (30 ppm)	62.13	237.00	20.57
T11	Urea (1%)+ GA3 (50ppm)	63.13	240.00	20.68
T12	Urea (1%)+ GA3 (70 ppm)	66.67	239.67	21.61
T13	CPPU(20 ppm)	62.60	240.00	22.67
T14	CPPU(40 ppm)	62.50	239.67	22.33
T15	CPPU(60 ppm)	62.33	240.67	21.85
T16	Control	58.35	230.00	28.56
SE ±		1.37	2.20	1.19
CD at 5 %		4.00	6.25	3.48

Result and Discussion

The data showed the significant difference with the application of plant growth regulators and chemicals combination. The minimum days required for 50 % flowering was recorded in treatment T1 (15.00 days).This was followed by treatment T2, T3, T5, and T6 (15.33, 16.00,17.00 and 18.00 days) respectively, which were statistically at par with treatment T1. The maximum number of days required for 50% flowering was recorded in treatment T16 (21.00 days), followed by treatment T7, T11, and T14 (19.33, 19.33, and 19.67 days) respectively, which were statistically at par with treatment T16.

The minimum days required for fruit set from spraying was recorded in treatment T7 (38.00) and followed by T8, T9, T15 and T1 (39.33, 39.67, 40.00 and 40.33 days) respectively, which were statistically at par with the treatment T7. The maximum number of days required for fruit set from spraying was recorded in treatment T16 (46.00) followed by treatment T5, T4, and T13 (43, 42.67, and 42.00 days) respectively, which were statistically at par with the treatment T16.

The minimum days required from initiation of flower bud to fruit set was recorded in treatment T12 (8.00 days).This was followed by treatment T5, T7, T8 and T9 (8.67, 9.00, 9.67, and 9.33 days) respectively, which were statistically at par with treatment T12. The maximum number of days required for initiation of flower bud to fruit set was recorded in treatment T16 (13.33 days). This was followed by treatment T1, T14, and T15 (11.00, 11.33, and 11.67 days) respectively, which were statistically at par with treatment T16.

The maximum number of days from fruit set to fruit maturity was recorded in treatment T9 (248.67 days) followed by T8, T7, T2 and T6 (245, 242, 239.67 and 239.33 days) respectively, which were statistically at par with the treatment T9. The Minimum days was recorded with treatment T16 (230 days).

The role of nitrogen metabolism in regulating the induction of flowering has been claimed as one of the valid hypotheses to explain the phenomenon of flowering. The two hypotheses were proposed for induction of flowering which are 1) The accumulation of ammonia during stress resulted in a increased biosynthesis of arginnie, polyamines and subsequently an increased the rate of cell division following the release of citrus plants from stress. 2) These physiological changes and the subsequent rapid increase in cell division are pre-requisites to flower initiation in citrus (Shrivastava *et al.*, 1997) [14].

The data indicated that the application of growth regulators significantly reduced the fruit drop in sweet orange var. Nucellar compared to untreated control. The various treatments NAA 15 ppm treatment proved the most effective against the reduced the fruit drop than control treatment followed by NAA (20ppm), GA3 (50 ppm),GA3 (30 ppm) and NAA (25ppm) and treatments The data presented in Table-1 revealed that the maximum fruit set was recorded in treatment Urea (1%)+ GA3 (70 ppm), followed by treatments GA3 (50 ppm), NAA (25ppm), NAA (20ppm) and GA3 (70 ppm) respectively which were statistically at par with treatment control. Same results observed by The application of (GA3 50 ppm + Urea 0.5%) gaves the significantly highest fruit set per cent (Rahman *et al.*, 2012) [11]. Gibberellins have been used in citrus production with several objectives including bloom reduction, increased fruit setting (Agusti and Almela, 1991) [1]. GA3 application increased the fruit set in Clementine Mandarin due to an increased availability of nutrients from the leaves. The application of GA3 alone increases the fruit set in pear (Marcelle, 1984) [7]. (Saleem *et al.*, 2008) [12] reported that the final fruit set was significantly affected by GA3 individually as well as in combination observed the maximum fruit set in „Blood Red‟ Sweet Orange. The use of growth substances and some chemical compound may regulate the fruit set in many fruit crops. Many investigators found that the spraying of mango trees with NAA at different concentration (20, 25, and 40 ppm) increased the fruit set percentages and fruit retention (Oksher *et al.*, 1980) [10].

The NAA treatment significantly decreased fruit drop by the suppressing the formation of abscission layer. (Frolov, 1967) [4]. The beneficial role of Sweet Orange for reducing fruit drop may be explained from the fact that it maintains the on going physiological and biological process of inhibition of abscission (Tomaszewska. E and Tomaszewska. M, 1970) [15]. It has been reported that fruit drop synchronizes with the period of low auxin production in the fruit and suggested for application of auxin which would be helpful in increasing auxin level and thereby resulted in reduce fruit drop (Luckwill, 1957) [6]. NAA is auxin type growth regulator that primarily is used to reduce preharvest drop.NAA does not strengthen up the fruit attachment, but only prevents further loosening from the fruit stem. When it is used to reduce the fruit drop, it is not delay the ripening (Curry, 2006) [3]. Foliar spray of growth regulators (NAA and GA3) could be used as one of these horticultural practices that reduce the fruit drop of mango (Anila and Radha, 2003) [2]

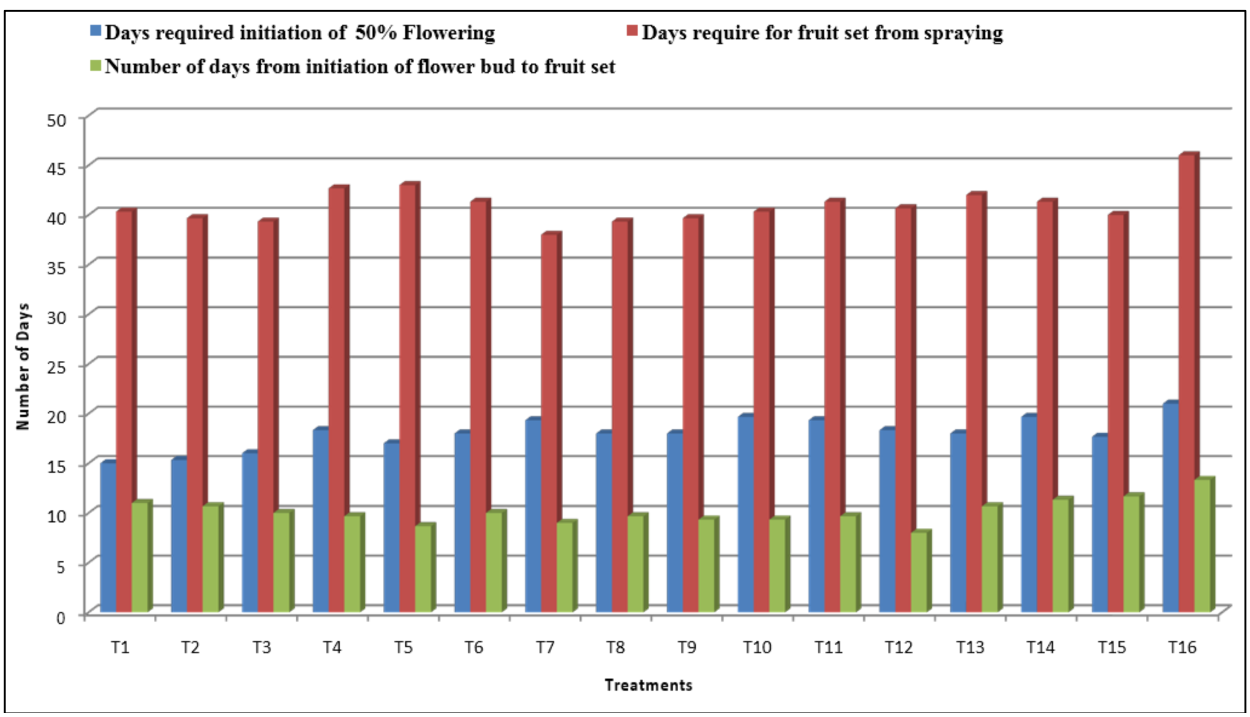

Fig 1: Number of days Flowering 50%, fruit set from spraying, flowering bud to fruit set

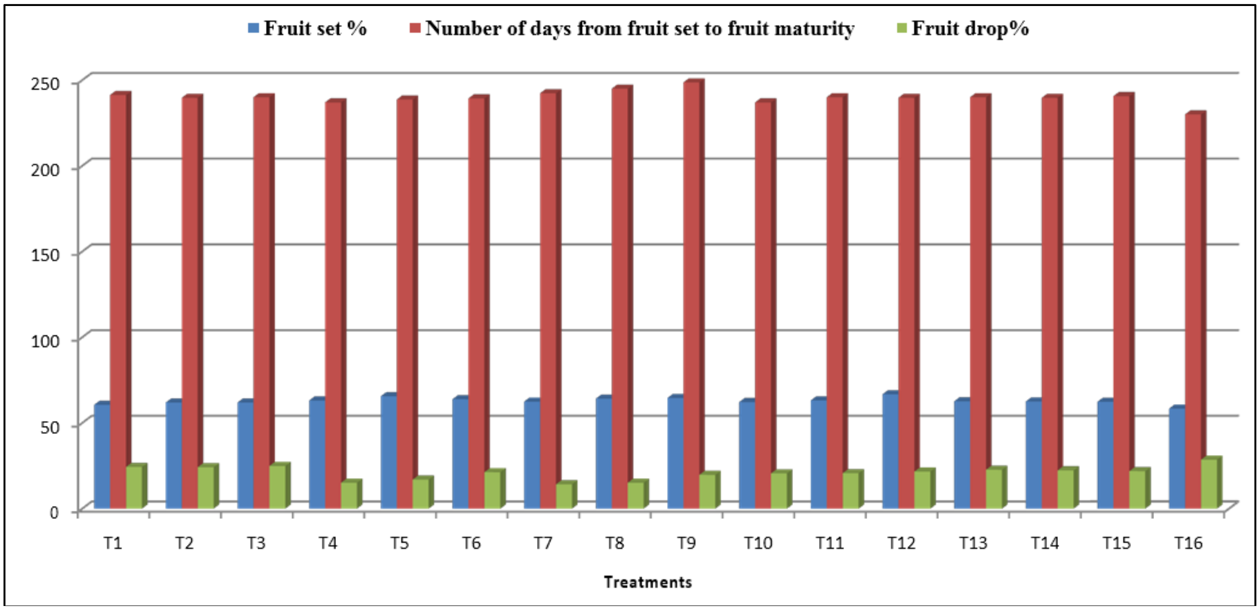

Fig 2: Fruit set %, Fruit drop%, Days required for fruit set maturity.

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