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Research Article

INFLUENCE OF UREA AND PLANT GROWTH REGULATORS ON FRUIT RETENTION, FRUIT DROP AND FRUIT YIELD OF ACID LIME *VAR.* KAGZI (*Citrus aurantifolia* Swingle)

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Abstract: Experiment was conducted to studies on Influence of Urea and plant growth regulators on fruit retention, fruit drop and fruit yield of acid lime var. Kagzi. Foliar application of urea (1,2,3 percent), NAA (10,20,30 ppm), GA_3 (25,50,100 ppm) and 2,4-D (10,15,20 ppm) sprayed at full bloom and pea stage of fruit, significantly increased fruit retention percentage at various stages of fruit growth and development over control. Among various treatments, minimum fruit drop was noted with 20 ppm NAA followed by Urea 2 percent in all three waves of fruit drop. The maximum (62.59) fruit retention percentage was noted with the application of NAA 20 ppm at the time of harvest followed by Urea 2 percent (52.10).

Keywords: Acid lime, Foliar Application, Fruit Retention, Fruit Drop

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Introduction

Lime fruits are important as these find several uses in culinary, beverage, industry and medicine. Acid lime (*Citrus aurantifolia* Swingle) is the third important citrus fruit crop in India next to mandarins and sweet oranges. It is generally grown under both tropical and subtropical climatic condition. It is good source of vit- C and also contain vit- B, pectin organic acids, minerals and other nutritive substances, required for human health. Fruit drop is very common in the citrus family. Premature flowers and fruit drop is a nightmare for any gardener. The joy of seeing the plant laden with flowers and fruit in the initial stage is short lived when it is followed by fruit drop. The sight of a large number of half developed fallen fruits is painful. It starts with the flowering and continuous till the time of harvest. It is one of the most serious problems in citrus becoming limiting factor for increasing fruit production. Drop of fruits is said to be influenced by an abscission mechanism, which is controlled by a larger number of cells in the pedicel of the fruits. The formation and development of these layers of cells is held under check by a series of physiological processes. Growth regulators are known to control fruit drop by balancing the internal status of auxin responsible for inhibiting the formation of abscission layer in citrus fruits and improve the productivity as well as quality of acid lime. With increasing emphasis on increased production along with improved fruit quality compatible at international levels and subsequently keeping eye on global market for export in coming years. It is necessary to control fruit drop which is major constraint associated with citrus production in India. The present experiment was therefore, undertaken to study the influence of Urea and plant growth regulators on fruit retention, fruit drop and fruit yield of acid lime var. Kagzi (*Citrus aurantifolia* Swingle).

Material and Methods

The present experiment was carried out at the experimental orchard of Fruit Research Station, Imaliya, Department of Horticulture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, and Jabalpur during 2010-2011. Fourteen years old trees of Kagzi lime were selected for this study. Since the trees varied in blossom density, group of trees with same average blossom density were selected for each treatment. All the trees were subjected to identical standard cultural practices. There were Thirteen treatments *viz*., T_1- water spray (control), T_2- Urea (1%), T_3- Urea (2%), T_4- Urea (3%), T_5- NAA (10ppm), T_6- NAA (20ppm), T_7- NAA (30ppm), T_8- GA_3 (25ppm), T_9- GA_3 (50ppm), T_{10}- GA_3 (100ppm), T_{11}- 2,4-D (10ppm), T_{12}- 2,4-D (15ppm) and T_{13}- 2,4-D (20ppm). Aqueous solution of these chemicals were sprayed at full bloom and again repeated at pea stage of fruits. Spraying was done on the tree canopy as foliar feeding by the foot sprayer. The experiment was laid out in Randomized Block Design with three replications; one plant was taken for each treatment in each replication. Twelve tags were tied on the shoots of the tree. Tags were tagged soon after fruit set. Six shoots were selected randomly for recording observations. Observation on fruit set, fruit retention, fruit drop and fruit yield were recorded. Total numbers of fruit on the tagged shoots were counted soon after the fruit set and regularly at monthly intervals to determine initial fruit set and number of fruits retained after 30, 60, 90, 120 and 150 days of fruit set. The percentage of fruit retention and fruit drop was calculated on the basis of initial number of fruits and number of fruit retained after 30, 60, 90, 120, and 150 days of fruit set by using the following formula. The data was analyzed using standard statistical methods [1]

$$Fruit\ Drop\ \% = \frac{Fruit\ set - Fruit\ retained}{Fruit\ set} \times 100$$

$$Fruit\ Retention\ \% = \frac{Number\ of\ fruits\ retained}{Total\ number\ of\ fruit\ set} \times 100$$

Result and Discussion

Fruit Retention- Data presented in [Table-1] clearly indicate that all the growth promoting substances at various concentrations conferred significant impact on fruit retention percentage with more percentage of fruit retained at harvest. Application of NAA at 20 ppm concentration showed significantly higher fruit retention at all the stages as compared to the rest of the treatments and over control, followed by Urea 2%.

Table-1 *Influence of Urea, NAA, GA_3 and 2,4-D on Fruit Retention Percentage at Various Stages*

Fruit retention percentage after					
Treatment	30 days of fruit set	60 days of fruit set	90 days of fruit set	120 days of fruit set	150 days of fruit set (at harvest)
Control (water spray)	68.26	55.31	34.58	22.65	18.15
Urea (1%)	90.25	74.13	59.52	51.55	42.43
Urea (2%)	91.09	85.03	67.25	59.26	52.1
Urea (3%)	87.47	70.47	48.13	32.64	28.35
NAA (10 ppm)	88.15	74.11	48.51	39.39	32.57
NAA (20 ppm)	93.25	88.45	77.66	71.33	62.59
NAA (30 ppm)	86.05	76.43	47.35	40.19	33.41
GA_3 (25 ppm)	88.3	79.21	49.09	39.37	33.05
GA_3 (50 ppm)	89.19	80.49	61.22	53.17	44.53
GA_3 (100 ppm)	85.65	68.65	47.05	37.62	30.41
2,4-D (10 ppm)	90.15	85.05	64.1	57	51.03
2,4-D (15 ppm)	87.07	78.09	55.51	46.06	38.49
2,4-D (20 ppm)	89.17	73.49	53.21	41.15	34.33
S.Em±	0.08	0.1	0.11	0.11	0.11
CD at 5%	0.24	0.3	0.31	0.33	0.32

Table-2 *Influence of Urea, NAA, GA_3 and 2,4-D on Fruit Drop Percentage and Yield*

Fruit drop percentage				
Treatment	Pin head size	Pea size	Pre-harvest	Yield per tree (kg)
Control (water spray)	29.4	39.43	28.29	13.22
Urea (1%)	7.14	23.07	13.25	22.22
Urea (2%)	5.19	17.65	9.14	29.22
Urea (3%)	13.66	29.23	14.47	18.22
NAA (10 ppm)	9.52	27.22	12.47	25
NAA (20 ppm)	4.5	10.47	7.33	33
NAA (30 ppm)	11.6	26.62	14.23	25.22
GA_3 (25 ppm)	10.3	29.51	15.4	22.22
GA_3 (50 ppm)	8.46	24.61	12.36	28
GA_3 (100 ppm)	12.01	28.27	14.58	23
2,4-D (10 ppm)	6.28	19.33	11.14	28.44
2,4-D (15 ppm)	9.36	27.49	12.46	23.44
2,4-D (20 ppm)	10.41	28.49	13.48	18.44
S.Em.±	0.07	0.09	0.07	0.08
CD at 5% level	0.2	0.26	0.2	0.24

It was also in conformity with results as noted by Yadav *et al*. in ber and Singh *et al*. in Aonla [2,3]. Auxin content in fruits during 2-3 weeks after pollination is low and the ability of fruits to mobilize food material is poor due to low auxin level which results fruit drop. As the fruit develops the amount of auxin rises rapidly which is helpful in mobilization of food material. At this stage the competition among developing fruits starts and the fruits which compete less successfully are forced to drop. Foliar application of NAA at this stage proved beneficial to encourage fruit retention. Plant regulators seem to have many fold function *e.g.* increasing the number of flowers, provision of growth factors for the ovary development and inhibiting the shedding of flowers which are finally responsible for fruit retention. Urea increases the auxin synthesis and reduces the formation of abscission layer which helps in strong attachment of fruit with the stalk. Fruit drop- All the growth promoting substances significantly decreased the percentage of fruit drop in all the three stages *i.e.* Pin-head size, pea size and pre harvest fruit drop. Minimum fruit drop was noted with 20 ppm NAA followed by Urea 2 percent in all the three stages of fruit drop and maximum drop in control. Reduction in fruit drop due to NAA application may be because of the fact that NAA maintains the on-going physiological and bio-chemical process of inhibition of abscission [4]. Similar inferences were made by Rajpal *et al*. in ber [5]. NAA improved the internal physiology of developing fruits in terms of better supply of water, nutrients and other bio-compounds vital for their proper growth and development which resulted in more fruit retention and reduce fruit drop as compared to control. Application of NAA 20 ppm concentration highly minimized the fruit drop at all the stages of development and gave maximum fruit retention at maturity has been reported by Haidry *et al*. in mango support the results. Fruit Yield- Maximum fruit yield was noted with 20 ppm NAA followed 2% Urea [6]. Increasing number of fruit, inhibiting the shedding of fruits, increasing fruit retention percentage, decreasing fruit drop percentage ultimately resulted into higher yield as compared rest of treatments. Similar results were also obtained by Singh and Rethy in Kagzi lime and Bal *et al*. in Ber [7,8]. Since nitrogen is an important constituent of protoplasm and is helpful in chlorophyll synthesis, the increased photosynthetic activity of leaves and consequently the yield as a result of urea application. Moreover, increased fruit set reduced fruit drop as a result of urea spray could give higher number of fruits consequently the yield. The present findings are in conformity with Shinde *et al*. and Singh *et al*. in mango [9-11].

Conclusion

Based on above fact, it can be concluded that foliar application of NAA@20ppm was found best treatment in respect to minimizing fruit drop, maximizing fruit retention percent and yield followed by Urea 2%.

Application of research: The research will be very useful to citrus growing community by getting higher fruit yield as well as income through overcome of fruit drop problem in citrus.

Research Category: Production Technology

Abbreviations: GA- Gibberellic Acid, NAA- Nephthalene Acetic Acid

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