



Effect of foliar application of urea, boron and 2,4-D in acid lime (*Citrus aurantifolia* Swingle) under Malwa Plateau conditions

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ABSTRACT

An experiment was conducted during 2015-2016 at the Instructional cum Research Fruit Orchard, Department of Fruit Science, K.N.K. College of Horticulture, Mandsaur (M.P) on well established Eight years old orchard of acid lime. The experiment was laid out in Randomized Block Design with three replication keeping each treatment on one plant. There were twelve treatments comprising of three levels of Urea (1%, 2% and 3%), Boron (0.4%, 0.6% and 0.8%) and 2,4-D (10, 20 and 30 ppm), and their combinations (Urea 1% + Boron 0.4% + 2,4-D 10 ppm, Urea 2% + Boron 0.6% + 2,4-D 20 ppm and Urea 3% + Boron 0.8% + 2,4-D 30 ppm) with control. Foliar application was done on first week of July and same spray was repeated after 30 days with the urea, boron, 2,4-D and their combinations at pea stage of fruit. It was found best that foliar application of urea 2% + boron 0.6% + 2,4-D 20 ppm. Physical parameters i.e fruit length (4.86cm), fruit diameter (4.68cm), fruit volume (50.15ml), fruit weight (50.88g), juice (52.82%), moisture in rag (87.40%) and moisture in peel (83.86%) and Bio-chemical parameters i.e TSS (8.2), TSS: Acid ratio (1.29), and ascorbic acid (32.03).

Keywords: Foliar application, Boron, Urea, 2,4-D, Acid Lime

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INTRODUCTION

Acid lime (*Citrus aurantifolia* Swingle), are one of the best fruit grown and used in India. It is appreciable not only its appearance and pleasing flavour, excellent fruit qualities. These acid lime are used as fresh fruit preparing the pickles and many beverages. The best part of it is having plenty of vitamin 'c' which can provide good antioxidants. Commercial cultivation of acid lime is defiantly a most successful and profitable business due to lime demand throughout the year. In India, acid lime is grown in a variety of agro-climates comprising from the northern plains and central highlands having hot semi arid eco-region with black and red soils. Acid lime are grown commercially in Andhra Pradesh, Tamil Nadu, Karnataka, Gujarat, Bihar and West Bengal. The total area and production under lime in India is estimated 269 thousand hectares and 3020 thousands tones. The total area and production of lime in Madhya Pradesh are 11.12 thousand hectares and 245.00 thousand tones, respectively [2]. In Madhya Pradesh, it is cultivated in Dhar, Badwani, Khargon, Khandwa, Ujjain, Ratlam, Mandsaur, Neemach, Shajapur, Gwalior, Burhanpur, Hoshangabad, Murena, and Guna Districts. Malwa is an important region in Madhya Pradesh, where acid lime is grown, respectively [2]. Fruits of acid lime flowers throughout the year in three distinct seasons known as "bahar" viz., ambia, mrig and hasta bahar. Due to the continuous flowering and heavy crop load on trees, the size of the fruits remains usually very small. Qualitative characters like juice per cent, ascorbic acid, acidity etc. also get affected resulting into harvest of poor quality and unmarketable fruits. Foliar sprays of plant growth regulators and nutrients not only improve the size but also enhance qualitative parameters of fruits.

MATERIALS AND METHODS

An experiment was conducted during 2015-2016 at the Instructional cum Research Fruit Orchard, Department of Fruit Science, K.N.K. College of Horticulture, Mandsaur (M.P) on well established Eight years old orchard of acid lime. The experiment was laid out in Randomized

Block Design (RBD) with three replication keeping each treatment on one plant. There were twelve treatments comprising of three levels of urea (1%, 2% and 3%), boron (0.4%, 0.6% and 0.8%) and 2,4-D (10, 20 and 30 ppm), and their combinations (Urea 1% + Boron 0.4% + 2,4-D 10 ppm, Urea 2% + Boron 0.6% + 2,4-D 20 ppm and Urea 3% + Boron 0.8% + 2,4-D 30 ppm) with control. Foliar spray was done on first week of July and same spray was repeated after 30 days with the urea, boron, 2,4-D and their combinations at pea stage of fruit. The brief description of materials used and techniques employed in carrying out the investigation are given as the physical parameter *i.e.* fruit length, fruit diameter, fruit volume, fruit weight, number of seed per fruit, total seed weight per fruit, moisture percent in peel, moisture per cent in Rag, while bio chemical parameters like TSS, Acidity, TSS: acid ratio, ascorbic acid and chlorophyll content were calculated with following formula.

Specific gravity = weight of fruits (g) / volume of fruits (ml)

Average fruit weight = Total weight of fruits (g) / Number of fruits

RESULT AND DISCUSSION

Physical Parameters:- The minimum number of seed per fruit (8.33 g), total seed weight per fruit (2.67 g) and maximum fruit length (4.86 cm), fruit diameter (4.68 cm), fruit volume (50.15 ml), fruit weight (50.88 g), specific gravity (1.01), juice (52.82 %), moisture in rag (albedo) (87.40%) and moisture in peel (flavido) (83.86%). with the application of urea 2% + boron 0.6% + 2,4-D 20 ppm which was significantly superior than all over treatment. The increase in fruit length and diameter by the application of the response of exogenous application of urea, boron and 2, 4-D treatments might be due to optimum supply of proper plant nutrients and growth hormones in right amount during the entire crop period causing vigorous vegetative development of the plants and ultimately production of more photosynthesis. The higher fruit length and diameter due to combined application of zinc and boron might be attributed to their stimulatory effect of plant metabolism. The results are inconformity with the observations recorded by fruit length Gurjar *et al* [6] in citrus. The increase in fruit weight and volume might be due to increased rate of cell division and cell enlargement leading to more accumulation of metabolites in the fruit. Similar results have also been reported by Gurjar *et al* [6] and Khan *et al*. [9] in citrus. The rapid growth of the fruit synchronized with the maximum amount of auxin present therein. The results regarding weight and volume of the fruit is increased due to augmentation of the native supply of hormones. Similar results were obtained Jagtap *et al*. [8], Debaje *et al*. [4], Shinde *et al*. [10], in acid lime and Choudhary *et al*. [3] in Nagpur mandarin.

The increase in juice volume higher than that obtained by 2,4-D. Such increase could be explained on increase in the sink strength leading to greater flux of water and solutes to treated cell. The explanation for the present experimental results is the auxin treatment significantly enhanced the growth of fruit then control. Similarly the boron also accelerated the fruit development. Due to the accelerated rate of fruit growth more metabolites might have been diverted from leaves to fruits. Similar results were also obtained by Jagtap *et al*. [8], Debaje *et al*. [4], Shinde *et al*. [10] in acid lime. Jain *et al*. [7], Ashraf *et al*. [1] in Nagpur mandarin and Dixit *et al*. [5] in litchi.

Bio-chemical parameters: - The minimum acidity (6.35 %) and maximum Total Soluble Solids (8.2 °Brix), TSS: acid ratio (1.29) ascorbic acid (32.03 mg/100 g) were recorded in foliar application of treatment urea 2% + boron 0.6% + 2, 4-D 20 ppm which were significantly superior than all over the treatment and maximum chlorophyll content in leaves (70.96) was observed in urea 3% + boron 0.8% + 2,4-D 30 ppm.

Decrease in acidity of fruits, It appears that acids under the influence of growth regulators might have either fastest been converted into sugars and their derivatives by reactions involving reverse glycolytic pathways or might have been used in respiration or both. Similar results were also obtained by Shinde *et al*. [10] and Ashraf *et al*. [1] in citrus. Increase in ascorbic acid content might be due to the fact that growth regulators increased the osmotic pressure by cell expansion which led to the accumulation of organic acid observations recorded by Ashraf *et al*. [1] in citrus. This has reported to divert more solids toward developing fruits and might also enhance the conversion of complex polysaccharide into simple sugars. These results are in conformity with the results reported by Shinde *et al*. [10] in acid lime.

CONCLUSION

On the basis of results obtained in present investigation it is concluded that foliar application of urea 2% + boron 0.6% + 2, 4-D 20 ppm proved best for physical parameters of fruits fruit length (cm), fruit diameter (cm), fruit volume (ml), fruit weight, juice, moisture percent in rag and moisture percent in peel and **Bio-Chemical** parameters of fruits TSS, TSS: Acid ratio, ascorbic acid.

Table 1 : Effect of foliar application of urea, boron and 2, 4-D on Physical and Bio- chemical parameter of acid lime.

Treatments	Fruit length (cm)	Fruit diameter (cm)	Fruit volume (ml)	Fruit weight (g)	Specific gravity	Juice (%)	Number of seed(s) per fruit	Total seed weight (g)	Moisture percent in peel	Moisture percent in Rag	TSS (°Brix)	Acidity (%)	TSS: acid ratio	Ascorbic acid (mg/100g)	Chlorophyll content (SPAD value)
Control (Water spray)	3.35	3.03	28.48	28.38	1.00	36.38	9.00	3.00	62.52	67.16	7.1	6.99	1.00	25.32	59.61
Urea (1%)	3.82	3.74	33.97	34.66	1.02	40.30	6.67	1.33	76.73	80.39	7.3	6.75	1.08	27.07	62.18
Urea (2%)	4.17	4.14	39.12	39.28	1.02	43.65	7.00	1.67	79.83	82.98	7.6	6.85	1.11	29.02	63.45
Urea (3%)	4.05	3.90	35.67	37.37	1.05	41.47	7.67	2.00	78.19	82.03	7.5	6.96	1.07	28.20	65.43
Boron (0.4%)	3.63	3.50	33.06	33.73	1.02	42.66	7.33	1.33	69.71	77.39	7.5	6.70	1.12	28.82	60.09
Boron (0.6%)	3.72	3.73	35.67	35.66	1.00	44.86	7.67	1.67	72.07	79.61	7.7	6.81	1.13	29.59	61.11
Boron (0.8%)	3.97	3.96	37.78	37.59	1.01	46.70	8.00	2.33	74.17	80.74	7.8	6.90	1.12	29.83	62.93
2,4-D (10 ppm)	3.77	3.60	33.22	33.45	1.01	42.77	6.33	1.33	74.85	78.89	7.5	6.40	1.17	27.65	61.52
2,4-D (20 ppm)	3.93	3.96	36.17	36.37	1.01	44.92	6.67	1.33	76.83	80.78	7.6	6.50	1.17	28.72	62.70
2,4-D (30 ppm)	4.07	4.04	39.03	39.03	1.00	48.60	7.00	1.67	77.16	82.69	7.7	6.62	1.17	29.50	64.56
Urea (1%) + Boron (0.4%) + 2,4-D (10ppm)	4.20	4.17	42.28	42.33	1.00	50.06	7.67	1.67	80.57	83.58	7.8	6.55	1.19	30.26	66.46
Urea (2%) + Boron (0.6%) + 2,4-D (20ppm)	4.86	4.68	50.15	50.88	1.01	52.82	8.33	2.67	83.86	87.40	8.2	6.35	1.29	32.03	68.04
Urea (3%) + Boron (0.8%) + 2,4-D (30ppm)	4.49	4.30	46.03	46.32	1.01	51.73	8.00	2.33	82.69	85.26	8.0	6.45	1.24	30.95	70.97
S.Em.±	0.09	0.08	0.98	0.63	0.30	1.12	0.46	0.31	1.5	1.27	0.20	0.06	0.03	0.78	1.8
C.D. at 5%	0.27	0.23	2.88	1.86	NS	3.3	1.34	0.92	4.4	3.7	0.60	0.20	0.10	2.28	5.2

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