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Research Article

EFFECT OF GROWTH REGULATORS AND MACRONUTRIENTS ON SEEDLING GROWTH OF PUMMELO (*CITRUS MAXIMA* MERILL)

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ABSTRACT

An experiment was conducted during 2016-17 at College of Horticulture, Bengaluru to study the effect of plant growth regulators and macronutrients on seedling growth of pummelo. The treatment with GA_3 150 ppm + NAA 150 ppm has recorded the maximum seedling height (49.30 cm), seedling diameter (0.64 cm), number of leaves (42.90), leaf area (32.53 cm^2), fresh and dry weight of seedlings (48.67 and 12.87 g respectively), number of primary and secondary roots (52.07), Length of primary root (47.53 cm), Root volume (13.43 cm^3) and fresh and dry weight of root (13.07 and 5.37 g respectively) of pummelo seedlings.

INTRODUCTION

Pummelo (*Citrus maxima* Merill or *Citrus grandis* Osbeck) belongs to family Rutaceae and is probably originated in the region of Thailand and Malaysia. It is called by various names such as Chakotha, Sadaphal, Chinese grapefruit, Batavia lemon, Batabi lebu, Pomelo, Pomello, Pummelo, Pommelo, Pamplemousse, Jabong (Hawaii) and Shaddock.

The growth of pummelo seedlings is slow and the growers have to wait for one year to take up budding or grafting operation to market them or plant them. Chemical growth regulators like GA_3 (Gibberellic acid) and NAA (Naphthalene Acetic Acid) perform an important role in growth and development of plants by increase in cell enlargement and division, increase in cellular spaces in the mesocarpic cells and higher translocation of photosynthates and mineral nutrients in plants (Krishnamoorthy, 1993)

Similarly, there is a major role of macronutrients in plant. However some macronutrients, like nitrogen which helps in utilization of carbohydrates and components of proteins, protoplasm and cholorophyll. While phosphorus helps in development of roots and potassium is involved in standard stomatal regulation and increases disease resistance in plants (Singh, 2014)

Keeping in view of the role of growth regulators and macronutrients, the present study was conducted to see weather quick growth could be achieved with the use of these at different concentrations on pummelo seedlings. The present investigation was carried to get early marketable plants and there by reducing the cost of production.

MATERIAL AND METHODS

The trial "Effect of growth regulators and macronutrients on seedling growth of pummelo (*Citrus maxima* Merill)" was conducted at Regional Horticultural Research and Extension Centre, University of Horticultural sciences campus, GKVK, Bangalore 560 065, during the year 2016-17.

The experiment was laid out in completely randomized design with three replications. The experiment comprised of thirteen treatments with the combinations of plant growth regulators, namely Gibberellic acid (GA_3) and Naphthalene acetic acid (NAA). Macronutrients namely Urea, water soluble NPK and KNO_3 were used at different concentrations.

Seedlings were raised in the polybags. The polybags were prefilled with Red soil, FYM and sand (2:1:1). The germination period is about 45 days from sowing. The required quantities of plant growth regulators and macronutrients were prepared through stock solution with their different concentrations and were sprayed as per the treatment for seedlings. The first spray

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were taken up 30 days after germination and second spray was taken 60 days after germination and observation were recorded at 150 days after germination (DAG).

RESULTS AND DISCUSSION

The results in Table 1 revealed that the maximum seedling height, seedling diameter, number of leaves, leaf area, fresh and dry weight of seedling (49.30 cm, 0.64 cm, 42.90, 32.53 cm^2, 48.67 g and 12.87 g respectively) were recorded in the treatment GA_3 150 ppm + NAA 150 ppm (T_3) at 150 days after germination and minimum was recorded in control i.e., water spray (T_{13}). The application of growth promotive substances increased the plant height and seedling diameter, such effect was due to increased photosynthetic activity, enhancement in the mobilization of photosynthates and change in the membrane permeability (Shukla *et al.*, 1997). The vigorous growth induces more number of branches which in turn facilitates better harvest of sunshine by the plants to produce more number of leaves. These results obtained on this aspect are in agreement with Marler and Mickelbert (1992) in carambola and Kawthalkar and Kunte (1974) in rangpur lime. This also helps in invigoration of physiological process of plant and stimulatory effect of chemicals to form new leaves at faster rate (Sharma *et al.*, 1991). And mobilization of water and nutrients transported at higher rate which might have promoted more production of photosynthetic product and translocated them to various plant parts which might have resulted in better growth of the seedlings and hence more fresh and dry weight. The results are in conformity with the findings of Misra and Jaiswal (2001) in bael, Monselise and Halevy (1962) in citrus.

The results (Table 2) revealed that the maximum number of primary and secondary roots, length of primary root, root volume, fresh and dry weight of root (52.07, 47.53 cm, 13.43cm^3, 13.07 g and 5.37 g respectively). were recorded in the treatment GA_3 150 ppm + NAA 150 ppm (T_3) at 150 days after germination and minimum was recorded in control i.e., water spray (T_{13}). The restorer effect of NAA on apical dominance which promote root initiation, more nutrient uptake and root cell elongation and good growth of the roots. GA_3 increases somatic uptake of nutrients, causing cell elongation and enhanced hydrolysis of carbohydrates caused by auxins. The results obtained in the present studies are in agreement with that reported by, Misra and Jaiswal (2001) in bael, Singh and Sheo (2000) and Karunakaran *et al.* (2007) in citrus species and Virendra and Shafaat (1996) and Wagh *et al.* (1998) in aonla.

The maximum fresh and dry weight in this treatment was due the favorable effect of NAA which increases auxin level in the roots that stimulated more root initiation, more nutrient uptake and root cell elongation, thus resulting into increased tap root length resulted in increasing dry weight.

Table 1 Effect of foliar spray of growth regulators and macronutrients on seedling height, seedling diameter, number of leaves, leaf area, fresh and dry weight of seedling at 150 DAG

Treatments	Seedling height (cm)	Seedling diameter (cm)	Number of leaves	Leaf area (cm^2)	Fresh weight (g)	Dry weight (g)
T_1- GA_3 50ppm + NAA 50ppm	47.00	0.61	39.13	29.48	43.33	11.13
T_2- GA_3 100ppm + NAA 100ppm	46.40	0.63	39.83	30.98	45.33	11.70
T_3- GA_3 150ppm + NAA 150ppm	49.30	0.64	42.90	32.53	48.67	12.87
T_4- Urea 1%	42.90	0.58	37.20	29.18	44.13	11.17
T_5- Urea 2%	42.23	0.59	39.03	26.46	39.77	10.90
T_6- Urea 3%	42.57	0.62	41.80	28.75	38.97	10.93
T_7- Water soluble NPK 1% (19:19:19)	43.17	0.57	35.87	28.94	36.53	10.47
T_8- Water soluble NPK 2% (19:19:19)	45.17	0.57	37.17	27.94	42.97	10.80
T_9- Water soluble NPK 3% (19:19:19)	42.93	0.60	39.23	30.78	39.93	10.90
T_{10}- KNO_3 1%	46.20	0.59	36.13	27.58	42.43	10.90
T_{11}- KNO_3 2%	42.33	0.58	38.53	27.64	37.13	10.63
T_{12}- KNO_3 3%	43.30	0.61	40.97	29.76	43.00	11.23
T_{13}- Water spray (control)	38.53	0.52	34.83	25.69	29.23	7.60
SE.m±	1.65	0.01	1.46	1.17	1.65	0.48
CD at 5%	4.79	0.03	4.24	3.39	4.79	1.40

Table 2 Effect of foliar spray of growth regulators and macronutrients on number of primary and secondary roots, length of primary root, root volume, fresh and dry weight of root of pummelo seedlings at 150 DAG

Treatments	Number of primary and secondary roots	Length of primary root (cm)	Root volume (cm^3)	Fresh weight (g)	Dry weight (g)
T_1- GA_3 50ppm + NAA 50ppm	51.23	44.30	11.02	11.80	4.87
T_2- GA_3 100ppm + NAA 100ppm	51.93	44.80	12.00	12.13	4.93
T_3- GA_3 150ppm + NAA 150ppm	52.07	47.53	13.43	13.07	5.37
T_4- Urea 1%	46.73	37.30	9.90	10.60	4.47
T_5- Urea 2%	50.07	38.70	11.10	10.03	4.23
T_6- Urea 3%	43.90	38.53	11.40	10.40	4.20
T_7- Water soluble NPK 1% (19:19:19)	46.40	43.43	11.47	11.03	4.27
T_8- Water soluble NPK 2% (19:19:19)	45.47	40.80	10.97	12.10	4.87
T_9- Water soluble NPK 3% (19:19:19)	46.77	38.40	11.40	9.57	3.93
T_{10}- KNO_3 1%	45.77	40.53	11.43	11.37	4.10
T_{11}- KNO_3 2%	47.10	40.90	11.20	11.20	3.83
T_{12}- KNO_3 3%	45.00	41.40	11.73	11.87	4.83
T_{13}- Water spray (control)	40.27	36.67	9.37	9.23	3.17
SE.m±	1.85	1.99	0.53	0.55	0.20
CD at 5%	5.38	5.80	1.55	1.60	0.58

The results are in conformity with the findings of Anjanawe *et al.* (2013) in papaya and Panchal *et al.* (2015) in khirni.

CONCLUSION

From the above results we can conclude that the spray of growth regulators GA_3 150 ppm + NAA 150 ppm can be sprayed to get good growth of the seedling, so that early marketable size seedling can be produced and their by reducing the cost of production.

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