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Effect of PGR on Leaf Nutrients Content and Root Growth in Rough Lemon (*Citrus jambhiri*) Seedling

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ABSTRACT

A field experiment was carried out to find the effect of plant growth regulators on leaf nutrients content and root growth in rough lemon (Citrus jambhiri) seedling. More number of secondary and tertiary roots was counted in treatment T_8 43.00, 87.67 respectively. Highest root fresh & dry weight and root volume was recorded in treatment T_4 16.83 g, 7.65 g, and 14.57 ml respectively. The thickest root diameter (12.93 mm) was observed in treatment T_{11}. Highest nitrogen content (1.12 %) and potassium content (1.11 %) was estimated in treatment T_4.

Key words: *Plant growth regulator, Foliar spray, Rough lemon, Leaf nutrients, Root growth.*

INTRODUCTION

Citrus occupy third rank after mango and banana. India, with 1.03 million ha area and an annual production of 10.39 million ton is the third largest citrus-producing country after China and Brazil[4]. Among the citrus cultivars, sweet orange, mandarin, limes, lemon and grapefruit are important and occupy a major acreage in the state. They are propagated by budding mainly on rough lemon *(Citrus jambhiri*, Lush) rootstock. The major problem in citrus raising is the non-availability of quality planting material. Availability of sufficient, superior quality planting material and its effective distribution to the orchardists is likely to improve orchard efficiency. Under sub-tropical conditions of Haryana and surrounding states, the time required to grow citrus rootstock seedlings to a size suitable for budding may be as long as one to two years. The entire process is time consuming and labour intensive as, irrigations, fertilization and plant protection measures are to be taken up at regular intervals at all nursery stages thereby increasing cost of production. Therefore, from sowing of rough lemon seed until the planting of budded plants in the field it can take 1.5–2 years. Shortening this time would be beneficial for nurserymen by reducing the cost of production and increasing the supply of citrus plants to meet the huge demand of quality planting material. To shorten the time required for the production of citrus plants and to make them buddable early in the season, rapid growth and development of citrus rootstocks have been the primary concerns of nurserymen and research workers[1].

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Use of plant growth regulators and chemicals is a boon to horticulture and is being used for various purposes with an ultimate aim to increase production. Plant growth retardants are applied in agronomic and horticultural crops to reduce unwanted longitudinal shoot growth without lowering plant productivity[11].

MATERIALS AND METHODS

The experiment was carried out at the CCS Haryana Agricultural University, Hisar during 2016- 2017 by following Randomized Block Design (RBD) with thirteen treatments and three replication comprising foliar application of T_1 (GA_3 50 ppm + Urea 0.5%), T_2 (GA_3 50 ppm + Urea 1%), T_3 (GA_3 100 ppm + Urea 0.5%), T_4 (GA_3 100 ppm + Urea 1 %), T_5 (NAA 50 ppm + Urea 0.5%), T_6 (NAA 50 ppm + Urea 1%), T_7 (NAA 100 ppm + Urea 0.5%), T_8 (NAA 100 ppm + Urea 1%), T_9 (ABA 50 ppm + Urea 0.5%), T_{10} (ABA 50 ppm + Urea 1%), T_{11} (ABA 100 ppm + Urea 0.5%), T_{12} (ABA 100 ppm + Urea 1%) and T_{13} (Control, Water spray) twice after 30 and 60 days after transplanting on the same seedlings**.** Observations recorded on rough lemon seedling were root fresh and dry weight, root diameter, root volumes, root/shoot ratio, number of secondary and tertiary roots. The leaf sampling for the determination of nitrogen, phosphorus and potassium samples were collected from 4^{th}, 5^{th} pair of leaves from the top of the shoot of rough lemon at budding time. After collection, cleaning, drying and grinding of samples were carried out as per procedure suggested by Chapman[2]. Nitrogen was estimated by Nessler's reagent method as per standard procedure Jackson[6] and expressed in per cent.The phosphorus and potassium were estimated by vanodomolybdate phosphoric yellow colour method and flame photometer method, respectively[6] and expressed as percentage. The nutrient levels were expressed on a percent dry weight basis.

RESULTS AND DISCUSSION

Number of secondary & tertiary roots and root/shoot ratio of rough lemon seedlings

The data presented in Table 1 indicated that numbers of secondary roots were influenced significantly by the various treatments. Maximum number of secondary roots (43.00) were counted in treatment T_8 closely followed by T_4 (40.83) whereas, minimum number of secondary roots (31.17) was observed in treatment T_{11} which was at par with T_9 (32.67), T_{10} (34.50) and T_{12} (33.83). Numbers of tertiary roots were influenced significantly by various growth regulators in combination of urea. Comparing the various treatments, maximum number of tertiary roots (87.67) was observed in treatment T_8 closely followed by T_7 (87.67) whereas minimum number of tertiary roots (60.50) was counted in treatment T_9 followed by T_{11} (63.83). In general maximum root to shoot ratio (0.31) was calculated in treatment T_1, T_2 and T_6 whereas minimum values (0.26) was calculated followed by T_{10} (0.27), T_3 and T_{11} (0.28) in control value was recorded (0.29). The promotive effect of GA_3 and urea on secondary and fibrous roots was because of more root cell elongation, cell division, auxin metabolism due to GA_3 and more vegetative growth due to nitrogen. The application of GA_3 accelerates the translocation and assimilation of auxins, reasons for better root growth and vegetative characters are due to the overall assimilation and redistribution of materials with in plants enhance the growth attributes[10]. The more length of tap root in NAA might be due to restorer of apical dominance which promotes root initiation, more nutrient uptake and root cell elongation as suggested by Shanmugavelu[12].

Table 1: Effect of different chemicals on number of secondary and tertiary roots per seedling and root/shoot ratio of rough lemon seedlings

Treatment	Number of Secondary root/seedling	Number of Tertiary root/seedling	Root/shoot ratio
T_1: GA_3 50 ppm +Urea 0.5%	38.33	76.67	0.31
T_2: GA_3 50 ppm +Urea 1%	40.17	79.50	0.31
T_3: GA_3 100 ppm +Urea 0.5%	39.00	77.33	0.28
T_4: GA_3 100 ppm +Urea 1%	40.83	80.50	0.30
T_5: NAA 50 ppm +Urea 0.5%	38.17	76.83	0.30
T_6: NAA 50 ppm +Urea 1%	39.67	78.67	0.31
T_7: NAA 100 ppm +Urea 0.5%	40.17	86.67	0.29
T_8: NAA 100 ppm +Urea 1%	43.00	87.67	0.30
T_9: ABA 50 ppm +Urea 0.5%	32.67	60.50	0.26
T_{10}: ABA 50 ppm +Urea 1%	34.50	64.33	0.27
T_{11}: ABA 100 ppm +Urea 0.5%	31.17	63.83	0.28
T_{12}: ABA 100 ppm +Urea 1%	33.83	64.67	0.29
T_{13}: Control	37.50	70.00	0.29
C.D. at 5 %	**2.83**	**4.43**	-

Root fresh & dry weight, root diameter and root volume of rough lemon seedlings

A perusal of data presented in Table 2 indicated that root fresh weight was significantly influenced by various treatments. Maximum root fresh weight (16.83 g) was recorded in treatment T_4 which was at par with treatment T_2, T_6, T_7 and T_8 with values 16.20, 15.12, 16.14 and 16.48 g, respectively. Minimum root fresh weight (11.32 g) was observed in treatment T_9, which was at par with treatment T_{10} (11.51g). Maximum root dry weight (7.65 g) was observed in treatment T_4 closely followed (7.60 g) in $T_8$and T_2 (7.30 g). Minimum root dry weight (5.45 g) was recorded in treatment T_9 which was at par with T_{10} (5.69 g) and T_{11} (5.63 g). Maximum root diameter (12.93 mm) was observed in treatment T_{11}, which was at par with T_{12}(12.67 mm) T_{10} (12.47 mm). Minimum root diameter (10.44 mm) was recorded in treatment T_4 which was at par with T_2 (10.84). Maximum root volume (14.57 ml) was recorded in treatment T_4 closely followed by T_2 and T_8 (14.50 ml) whereas, minimum root volume (10.17 ml) was recorded in treatment T_9 followed by (10.83 ml) in T_{10} and T_{11} (11.07 ml). Singh and Sheo-Govind (2000) application of one per cent urea and 50 ppm GA_3 singly or in combination gave the highest root length and root diameter in *C. volkameriana*. This may be due to reduction vegetative growth by ABA treatment which help increasing the root diameter due to decrease in the linear growth whereas in GA_3 and NAA applications less diameter was recorded due to more increase in the roots. Similar results have been reported by Vasantha *et al.*[15] that foliar spray of GA_3 300 ppm on tamarind seedling recorded the maximum fresh weight and dry weight of roots. Kadam *et al.*[7] reported application of NAA 150 ppm produce significantly maximum fresh as well as dry weight of roots in rangpur lime. The favourable effect of NAA might be due to increased auxin level in the roots uptake and root cell elongation, thus resulting into increased tap root length and secondary and tertiary roots and in return increased the fresh and dry weight of roots.

Table 2: Effect of different chemicals on fresh and dry weight of root, root diameter and root volume of rough lemon seedlings

Treatment	Root fresh weight (g)	Root dry weight (g)	Root diameter (mm)	Root volume (ml)
T_1: GA_3 50 ppm +Urea 0.5%	14.19	6.57	11.71	12.67
T_2: GA_3 50 ppm +Urea 1%	16.20	7.30	10.84	14.50
T_3: GA_3 100 ppm +Urea 0.5%	14.85	6.61	11.58	13.33
T_4: GA_3 100 ppm +Urea 1%	16.83	7.65	10.44	14.57
T_5: NAA 50 ppm +Urea 0.5%	14.74	6.45	12.29	12.33
T_6: NAA 50 ppm +Urea 1%	15.12	6.73	12.08	13.67
T_7: NAA 100 ppm +Urea 0.5%	16.14	6.89	11.50	13.97
T_8: NAA 100 ppm +Urea 1%	16.48	7.60	11.24	14.50
T_9: ABA 50 ppm +Urea 0.5%	11.32	5.45	12.37	10.17
T_{10}: ABA 50 ppm +Urea 1%	11.51	5.69	12.47	10.83
T_{11}: ABA 100 ppm +Urea 0.5%	11.79	5.63	12.93	11.07
T_{12}: ABA 100 ppm +Urea 1%	11.99	5.92	12.67	11.67
T_{13}: Control	13.09	6.05	11.24	11.50
C.D. at 5 %	**1.06**	**0.37**	**0.47**	**1.04**

Leaf nutrients content of rough lemon seedlings

The data on leaf nutrients content was presented in Table 3. Maximum nitrogen content (1.12 %) was estimated in treatment T_3 and T_4 which was at par with other remaining treatments except control (0.92 %). Phosphorus was not influenced significantly by any of the treatment. However the value varies between 0.08 to 0.10 per cent. Generallly more phosphorus content (0.10 %) was estimated in treatment $T_{8.}$ Leaf potassium content was effected significantly by various treatments. All the treatments except T_9 (0.79 %) and T_{11} (0.89 %) increased the leaf potassium content over control (0.84 %).

Table 3: Effect of different chemicals on leaf nitrogen, phosphorus and potassium contents of rough lemon seedlings

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Treatment	Nitrogen (%)	Phosphorus (%)	Potassium (%)
T_1: GA_3 50 ppm +Urea 0.5%	1.00	0.08	0.96
T_2: GA_3 50 ppm +Urea 1%	1.08	0.08	1.08
T_3: GA_3 100 ppm +Urea 0.5%	1.12	0.09	1.07
T_4: GA_3 100 ppm +Urea 1%	1.12	0.09	1.11
T_5: NAA 50 ppm +Urea 0.5%	1.00	0.08	0.98
T_6: NAA 50 ppm +Urea 1%	1.04	0.08	0.98
T_7: NAA 100 ppm +Urea 0.5%	1.10	0.09	1.04
T_8: NAA 100 ppm +Urea 1%	1.10	0.10	1.08
T_9: ABA 50 ppm +Urea 0.5%	0.98	0.08	0.79
T_{10}: ABA 50 ppm +Urea 1%	1.00	0.08	0.91
T_{11}: ABA 100 ppm +Urea 0.5%	1.00	0.08	0.89
T_{12}: ABA 100 ppm +Urea 1%	1.04	0.08	0.97
T_{13}: Control	0.92	0.08	0.84
C.D. at 5 %	**0.16**	**NS**	**0.10**

Maximum potassium content (1.11 %) was estimated in treatment T_4 closely followed (1.08 %) in treatment T_5 and T_8. Minimum leaf potassium content (0.79 %) was estimated in treatment T_9 which was at par with treatment T_{11} (0.89 %). It may be due to that urea is a direct source of nitrogen; therefore it increased the nitrogen content in the leaves while leaf potassium content increased as a result of spray of GA_3. These results are in agreement with the finding of Mougheith *et al.*[8] they observed treatment GA_3 at 100 ppm + urea 0.5 per cent most effective in increased leaf nitrogen content in citrus. Singh and Singh[13] revealed that 100 ppm GA_3 application resulted in maximum nitrogen content in strawberry cv. Sweet Charlie. These results are in harmony with those obtained by Monge *et al*.[9], Hassan *et al.*[5] in plum and Desouky *et al*.[3] in olive.

CONCLUSION

It has been concluded from the present investigation that more number of secondary and tertiary roots was counted in treatment T_8 43.00, 87.67 respectively. Highest root fresh & dry weight and root volume was recorded in treatment T_4 16.83 g, 7.65 g, and 14.57 ml respectively. The thickest root diameter (12.93 mm) was observed in treatment T_{11}. Highest nitrogen content (1.12 %) and potassium content (1.11 %) was estimated in treatment T_4.

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