Int.J.Curr.Microbiol.App.Sci (2018) Special Issue-6: 940-944

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7692 **Special Issue-6 pp. 940-944**
Journal homepage: http://www.ijcmas.com

Original Research Article

Effect of Growth Regulators and Chemicals on Growth of Kagzi Lime (*Citrus aurantifolia* Swingle.) Seedlings

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Keywords

Kagzi lime, Growth regulator, GA_3, NAA, Thiourea

A B S T R A C T

The present investigation was carried out at Department of Horticulture, College of Agriculture, Badnapur, Jalna, VNMKV, Parbhani with the objective to study the effect of different growth regulators and chemicals on growth of Kagzi lime. The effect of different growth regulators and chemicals *viz.*, GA_3, NAA, KNO_3 and Thiourea were used to treat the seeds of Kagzi lime and further observation were taken for 180 DAS. The maximum plant height (30.02 cm) was produced under the treatment GA_3 80 ppm, while it was recorded the minimum (14.79 cm) in control. Significantly the maximum numbers of leaves per plant (28.62) were recorded in GA_3 80 ppm which was superior over control and rest of the treatments, except the treatment GA_3 60 ppm (26.76). The maximum number of branches per plant (1.83) was recorded under the treatment Thiourea 1.5 %. The treatment NAA 80 ppm registered the maximum circumference of stem (13.61 mm). The fresh and dry weight of shoots, were found maximum in GA_3 80 ppm (20.60 g and 10.04 g, respectively). Hence the GA_3 80 ppm was found more productive and the maximum induction in the physiological activities of seedlings than the other growth regulators and chemicals.

Introduction

Kagzi lime (*Citrus aurantifolia* Swingle.) belongs to family Rutaceae, originated in India. It is commercially grown in tropical and subtropical region of India. Acid lime is the third most important fruit after mandarin and sweet orange. India ranks fifth among major lime producing countries in the world (Chadha, 2010). Kagzi lime is one of the important citrus species, widely grown in India for various purposes. The fruits are extensively used for squashes, pickles, syrups and cordials, manufacture of citric acid and for table purpose in daily life of Indians (Cheema *et al.*, 1954). Lime is being acidic generally consumed as fresh but mostly used for flavouring vegetable dishes, fish, meat and salads. It also makes delicious and refreshing cold drinks. The fruits are valued not only for its nutritional qualities but also for medicinal purposes. Kagzi lime is commercially propagated through seeds in India (Naik, 1949) as it comes true to type, because of high degree (39-60%) of nucellar embryony. In seed propagated plants better and quicker germination of seeds and production of maximum number of seedlings are highly essential to meet the increasing demand of the cultivars in shortest possible time. In Kagzi lime germination percentage is low and it varies

between 27-58 per cent (Anandam and Singh, 1969) and Kagzi lime takes about 3 weeks to germinate (Naik, 1949 and Cheema *et al.*, 1954).

The most serious problem in Kagzi lime propagation is heavy mortality with the seedlings in primary nursery stage (Gupta, 1989). Evenary (1949) reported that, the seed coat of lime acts as a barrier because it interferes with early germination of seed due to presence of certain inhibitory substance. The growth of acid lime seedling is very slow in nursery as well as in the field, In fact many complaints from cultivators for slow growth of seedlings under field conditions are being reported (Shant and Rao, 1973). In view of the above specific problems of Kagzi lime and considering the importance of Kagzi lime, experiment was laid out to study the effect of growth regulators and chemicals on growth of Kagzi lime seedlings.

Materials and Methods

The experiment was carried out during the year 2015-2016 under the agro-climatic conditions of Badnapur, district Jalna in a Randomized Block Design with 13 treatments and three replications. The treatments were as follows: T_1 – GA_3 40 ppm, T_2 – GA_3 60 ppm, T_3 – GA_3 80 ppm, T_4 – NAA 40 ppm, T_5 – NAA 60 ppm, T_6 – NAA 80 ppm, T_7 – KNO_3 1.0 %, T_8 – KNO_3 2.0 %, T_9 – KNO_3 3.0 %, T_{10} – Thiourea 0.5 %, T_{11} – Thiourea 1.0 %, T_{12} – Thiourea 1.5 %, T_{13} – Control (Distilled water). Sixty seeds under each treatment were soaked for twelve hours and then sown after washing with distilled water in polythene bags which were properly filled, labeled with tags and placed as per layout. The intercultural operations like regular watering, weeding, and plant protection measures like spraying of insecticides against caterpillar and leaf miner were taken. For control of damping off disease drenching of copper fungicides (1.0 per cent) was done twice during the early period of investigation. The observations on height of plant and number of leaves per plant were recorded at monthly interval starting from 60 days after sowing up to 180 days after sowing. The observations on number of branches, circumference of stem, fresh and dry weight of shoot were recorded after 180 days of sowing of seeds at randomly selected five plants in each treatment. The data recorded on various observations, during the course of investigation were statistically analyzed by RBD as suggested by Panse and Sukhatme (1995).

Results and Discussion

Height of plant (cm)

In kagzi lime it was observed that, at 60 and 90 DAS the treatment T_3 i.e. GA_3 80 ppm exhibited significantly increase in plant height (5.80 cm and 12.38 cm) over control (2.81 cm and 5.98 cm), respectively. Similar trend was observed at 120, 150 and 180 DAS. The treatment GA_3 80 ppm exhibited significantly increase in plant height (18.42 cm, 24.52 cm and 30.02 cm) while the lowest plant height in control (8.91 cm, 12.13 cm and 14.79 cm), respectively, remaining treatments showed intermediate effect on on producing plant height. More plant height in GA_3 might have occurred due to cell division (Stowe and Yamaki, 1957) and cell elongation (Shanmugavelu, 1970), which in turn would have increased the internodal length. The results are supported by the findings reported by various research workers. The increased height of Kagzi lime and Rangpur lime with GA was reported by Choudhary and Chakrawar (1980 and 1981) thus supporting the findings of present study. Results obtained in present study are

also supported by Sharma *et al.*, (1999) in Kagzi lime, Kalalbandi (2002) in Rangpur lime and Kagzi lime, Gurav (2004) in Rangpur lime and Kadam *et al.*, (2010, 2011) in Kagzi lime and Rangpur lime.

Number of leaves per plant

The data presented in Table 1 showed, at 60 and 90 DAS, the treatment T_3 i.e. GA_3 80 ppm produced significantly more number of leaves per plant (10.02 and 14.80, respectively), which was significantly superior over control (4.87 and 7.04, respectively). At 120, 150 and 180 DAS, the treatment GA_3 80 ppm produced significantly maximum number of leaves per plant (17.48, 23.85 and 28.62, respectively) over control (8.85, 13.06 and 15.67, respectively). Increase in number of leaves in GA_3 80 ppm might be due to maximum height of seedlings under this treatment. This also helps in invigoration of physiological process of plant stimulatory effect of chemicals to form new leaves at faster rate as suggested Sharma *et al.*, (1999) and Kadam *et al.*, (2010). Such type of findings also reported by Choudhary and Chakrawar (1980, 1981) in Kagzi lime and Rangpur lime which support the present findings. Similar results were obtained by Makne (2001) in Rangpur lime, Jadhav (2003) in Rangpur lime, Gurav (2004) in Rangpur lime and Kadam *et al.*, (2010, 2011) in Kagzi lime and Rangpur lime.

Number of branches per plant

The observations recorded in respect of number of branches per plant clearly indicated that more number of branches per plant (1.83) was produced in the treatment T_{12} i.e. Thiourea 1.5%, which was significantly superior over control (1.03) and rest of the treatments. The number of branches per plant was increased due to effect of thiourea because of its cytokinin like activity which suppresses the apical growth by stimulating lateral buds (Freez, 1978). The results obtained in the present investigation are in agreement with findings of Makne (2001) in Rangpur lime, Jadhav (2003) in Rangpur lime and Gurav (2004) in Rangpur lime.

Table.1 Effect of growth regulators and chemicals on growth of kagzi lime seedlings

Tr. No.	Treatments	Height of plant (cm)					Number of leaves per plant				
		60 DAS	90 DAS	120 DAS	150 DAS	180 DAS	60 DAS	90 DAS	120 DAS	150 DAS	180 DAS
T_1	GA_3 40 ppm	4.24	11.00	14.11	19.13	23.55	6.79	10.62	14.17	19.71	23.65
T_2	GA_3 60 ppm	4.58	11.70	15.22	20.42	25.10	9.27	12.26	16.24	22.30	26.76
T_3	GA_3 80 ppm	5.80	12.38	18.42	24.52	30.02	10.02	14.80	17.48	23.85	28.62
T_4	NAA 40 ppm	4.20	8.22	12.19	16.73	20.67	6.53	10.29	12.58	17.72	21.26
T_5	NAA 60 ppm	4.26	10.12	15.16	20.45	25.14	6.74	11.56	14.52	20.15	24.18
T_6	NAA 80 ppm	4.50	11.40	16.20	21.75	26.70	8.64	11.86	14.88	20.60	24.72
T_7	KNO_3 1.0 %	4.20	7.88	13.69	18.61	22.93	5.65	8.87	11.73	16.66	19.92
T_8	KNO_3 2.0 %	4.22	8.59	13.96	18.95	23.34	5.97	9.27	12.92	18.15	21.78
T_9	KNO_3 3.0 %	4.64	9.88	14.78	19.97	24.56	7.28	10.61	13.29	18.61	22.33
T_{10}	Thiourea 0.5 %	3.29	7.26	11.21	15.51	19.21	5.79	7.51	10.08	14.60	17.52
T_{11}	Thiourea 1.0 %	3.65	7.38	11.99	16.48	20.39	6.17	8.57	11.24	16.05	19.26
T_{12}	Thiourea 1.5 %	3.77	7.98	12.13	16.66	20.66	6.31	9.02	12.30	17.37	20.84
T_{13}	Control	2.81	5.98	8.91	12.13	14.79	4.87	7.04	8.85	13.06	15.67
SE±		0.25	0.39	0.75	0.68	1.04	0.44	0.65	0.75	0.74	0.95
CD @ 5%		0.74	1.13	2.18	2.00	3.05	1.28	1.90	2.19	2.15	2.77

Table.2 Effect of growth regulators and chemicals on growth of kagzi lime seedlings

Tr. No.	Treatments	Number of branches per plant	Circumference of stem (mm)	Fresh weight of shoot (g)	Dry weight of shoot (g)
T_1	GA_3 40 ppm	1.14	10.88	18.11	8.08
T_2	GA_3 60 ppm	1.18	10.93	19.26	9.33
T_3	GA_3 80 ppm	1.22	12.83	20.60	10.04
T_4	NAA 40 ppm	1.17	12.11	18.48	8.80
T_5	NAA 60 ppm	1.38	12.90	19.07	8.90
T_6	NAA 80 ppm	1.47	13.61	19.69	9.21
T_7	KNO_3 1.0 %	1.36	11.10	17.10	8.32
T_8	KNO_3 2.0 %	1.44	11.41	17.52	8.65
T_9	KNO_3 3.0 %	1.62	11.71	17.83	8.94
T_{10}	Thiourea 0.5 %	1.51	8.25	16.29	7.66
T_{11}	Thiourea 1.0 %	1.59	8.83	16.75	7.80
T_{12}	Thiourea 1.5 %	1.83	9.61	16.79	7.85
T_{13}	Control	1.03	7.30	13.91	6.73
SE±		0.07	0.44	0.49	0.31
CD @ 5%		0.19	1.30	1.42	0.89

Circumference of stem (mm)

The results obtained regarding circumference of stem revealed that significantly more circumference of stem (13.61 mm) was recorded over control (7.30 mm) in kagzi lime under the treatment NAA 80 ppm. The increase in circumference of stem with NAA may be due to cell expansion rather than cell division (Mishra and Verma, 1980). The results obtained under present study are in accordance with Choudhary and Chakrawar (1980 & 1981) in Kagzi lime and Rangpur lime. The present findings are supported by Makne (2001) in Rangpur lime. Kalalbandi *et al.,* (2003) in Kagzi lime, Jadhav (2003) in Rangpur lime and Gurav (2004) in Rangpur lime

Fresh and dry weight of shoots (g)

The treatment GA_3 80 ppm produced more fresh and dry weight of shoots (20.60 g and 10.04 g, respectively), which was significantly superior over control. Significantly less fresh and dry weight of shoots (13.91 g and 6.73 g, respectively) was observed under the treatment control. This seems to be the effect of 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 have resulted in better growth of the seedlings and hence, more fresh and dry weight (Brain *et al.,* 1954 and Shanmugavelu, 1966). The result of present study was supported by the findings reported by various research workers viz. Choudhari and Chakrawar (1981) in Rangpur lime, Sharma *et al.,* (1999) in Kagzi lime and Makne (2001) in Rangpur lime. Similar results were obtained by Kalalbandi *et al.,* (2003) in Kagzi lime, Jadhav (2003) in Rangpur lime, Gurav (2004) in Rangpur lime and Kadam *et al.,* (2010, 2011) in Kagzi lime and Rangpur lime. The growth attributes like height of plant, number of leaves per plant, fresh and dry weight of shoots was found maximum in treatment GA_3 at 80 ppm. The circumference of stem was maximum in treatment NAA 80 ppm and the maximum number of branches were observed under the treatment Thiourea 1.5 %. Hence, for better as well as faster vegetative growth of kagzi lime seedlings the seeds of kagzi lime should be soaked in GA_3 80 ppm for 12 hours.

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