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Effect of plant growth regulators and thiourea on seed germination and seedling growth of Jatti Khatti (*Citrus jambhiri* Lush.)

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Abstract
The present investigation was conducted at Fruit Nursery, Department of Fruit Science, College of Horticulture, Banda University of Agriculture & Technology, Banda 210001, (U.P.) during the year 2020-2021. The experiment was conducted in completely randomized design with nine treatments, replication thrice. The seed germination experiment was conducted in laboratory (in Petri dish). However, the physical growth parameters and root parameters were taken in shade net house. The various concentration of plant growth regulators and thiourea *viz*., T_1 (Control), T_2 (GA3 200 ppm), T3 (GA3 400 ppm), T_4 (IAA 30 ppm), T_5 (IAA 50 ppm), T_6 (Thiourea 500 ppm), T_7 (Thiourea 1000 ppm), T_8 (Kinetin 500 ppm) and T_9 (Kinetin 1000 ppm) were used to treat the seeds of Jatti Khatti and further observations were taken for 30 days for seed germination parameters.
The result indicated that minimum days taken to start seed germination in 8 days, maximum germination percentage 94.47%, earliness index 0.886 and also vigour index 511.760 in T3 (GA3 400 ppm) for 12 hours were recorded. However, the final observation was taken for 90 DAS for physical growth and root parameters. The results were indicated that maximum seedling height (15.400 cm), number of leaves (16.800), leaf area (7.003 cm2), stem diameter (0.323 cm), fresh weight of shoot (0.398 g) and dry weight of shoot (0.186 g), length of primary root (8.820 cm), number of secondary root (11.523), fresh weight of root (0.158 g) and dry weight of root (0.075 g) were recorded in seed treated with T_3 (GA3 400 ppm) for 12 hours. Therefore, it can be concluded that the GA3 at 400 ppm was found best for seed germination, physical growth and root parameters.

Keywords: Regulators, regulators, Jatti Khatti, *Citrus jambhiri*

Introduction
Citrus fruits (*Citrus* species.) belongs to family Rutaceae and sub-family Aurantoidae (Swingle and Reece, 1967) [41] comprising 140 genera and 1300 species distributed throughout the world and native place is South East Asia. Citrus fruit trees are evergreen, it has a prominent place among the popular fruit and extensively grown in tropical and sub-tropical region of India. North - East India is the native place of many Citrus species (Davies and Albrigo 2003) [10]. Citrus is third most important fruit crop after mango and banana in fruit cultivation. They are mostly grown in every country of the world; major Citrus fruit growing countries are China, India, Brazil, USA, Japan etc. In India *Citrus* fruit contribute about 14.03 MT. productions from 1.058 M.ha. Area (Anon 2018-19).
India is the second largest producer of Citrus in the world after China. Leading Citrus producing state in India is Andhra Pradesh followed by Maharashtra and Assam. It is mostly cultivated in Maharashtra, Andhra Pradesh, Karnataka, Madhya Pradesh, Punjab, Uttar Pradesh, Bihar, Gujarat, Tamil Nadu and North - Eastern part of the country in Assam, Meghalaya, Arunachal Pradesh, Manipur and Nagaland.
Rootstocks become a vital component of the budded/grafted plant and determined the success or failure of the orchard apart from the influence on the plant vigour, size, and long evity of the tree and early production of quality fruits. It is one of the techniques to counter the adverse effect of climate, soil and resistance/tolerance to certain disease/pest, thus make the scion adapted to wide range of climatic conditions.
Jatti Khatti (*Citrus jambhiri* Lush.) originated in Himalayan foothills region of India. It is most widely used rootstock of the country for the Kinnow mandarin and sweet orange. Jatti Khatti rootstock is more preferred due to its highly tolerance to Citrus *Tristeza* Virus (CTV), Exocortis and soil condition (Drought), they are highly vigorous shows good yield

performance with large size fruits in early years.

Especially in North Indian condition the commercial crop is Kinnow Mandarin, which is mostly propagated on Jatti Khatti (*Citrus jambhiri* Lush.) rootstock, so to fulfil the demand of quality planting materials of Kinnow Mandarin, the most important step is to produce good and healthy planting material or rootstock, but in most of the citrus species the rate and extent of seed germination and seedling growth is not satisfactory, seed take about 30-40 days to germinate and the seedling growth in the nursery stage is also very slow, therefore it takes 18-24 months to attain buddable size. It is highly essential to accelerate the seed germination and growth rate of citrus seedling by treating with growth regulators and thiourea to attain buddable size earlier. Recently different plant growth regulators and chemicals have gain much attention for their role in seed germination and physical growth. Plant growth regulators have most important functions to controlling and coordinating cell division, cell growth and differentiation (Hooley 1994) [15].

The use of growth regulators in overcoming the delay of germination also has been reported by (Abohassan *et al*. 1979) [2] in kagzi lime and apricot. The research on seeds scarification treatments to attained early buddable thickness in Jatti Khatti and rootstock.

Materials and Methods

The main experimental site at the Fruit nursery, Department of Fruit Science, College of Horticulture, Banda university of Agriculture & Technology, which is located 6 km away from Banda city on Kanpur Road. The geographically, university is situated at 25.48° N latitude, 80.32° E longitude and at altitude of 214.96 meters from sea level in the southern Uttar Pradesh of India. The climate of main experimental site is predominantly characterized by typical Sub-tropical penetrated by long and intense summers. The soil is loose sediments as well as black cotton. Average annual rainfall is 90 cm and most of it about 88-90% received during only in three months i.e. July, August and September. However, June and October receive only 7-9% of total rainfall. The annual temperature is comparatively high and it ranges in between 35-48 ℃, 23-28 ℃ and 12-20 ℃ for summer, rainy and winter season respectively. The April, May and June are the hottest months and most time temperature goes beyond 45-48 ℃.

The seed of Jatti Khatti rootstock was selected for the study. Therefore, seed were treated with different concentration of Gibberellic acid, Indole acetic acid, Thiourea and Kinetin. The seed germination experiment was laid under the laboratory condition in which after treatment of the seed with plant growth regulators and thiourea were kept with germination paper in petri dish and Petri dishes were kept in germination incubators and incubators temperature was maintain at 25 0C. However, seedling growth experiment was laid in the experimental field under shade net house of (60% shade) for making of 200 and 400 ppm of GA3 solutions 200 mg, 400 mg of Gibberellic acid were weighed separately using electronic balance and dissolved separately in ethyl alcohol of 10 ml of 99% in different beakers the distilled water added to make up the volume equal to 1 litre to obtain desired concentration of solution, similarly for 30 and 50 ppm IAA 30 mg, 50 mg of Indole Acetic Acid (IAA) were dissolved in ethyl alcohol and finally added to distilled water to make 1 litre of solution, and for 500 and 1000 ppm of Kinetin, 500 mg,1000 mg of Kinetin was taken and dissolved in NaoH (normal solution 40 mg of NaoH/litre), while for 500 and 1000 ppm of Thiourea, 500 mg, 1000 mg Thiourea was directly dissolved in distilled water.

Fully ripened, uniform size and free from disease fruits of Jatti Khatti were selected for seed extraction. after the extraction of seed were washed in water and remove non-viable and damaged seeds, during the seed kept in water the light weight and non-viable seed were floated on upper surface of water while, viable seed were settle down to the bottom surface. After washing of the seeds, the viable seed were kept for drying in shade for one hour.

Before the sowing of seed, solution of desired concentration of GA3, IAA, Kinetin, Thiourea was kept in beaker and seed were soaked with in for 12 hours while, in control treatment seed were soaked in distilled water.. Each treatment contains 75 seeds and 25 number of seed placed at one replication, total 3 replications was taken. After the complete germination of seed, sprouted seeds were sowed in field under shade net house conditions for further observation like seedling growth and root parameters.

The number of germinated seed was counted everyday over a period of 30 days. The final germination percentage under each replication was calculated from total number of seed germinated in each treatment divided by the total number of seed sowed in a treatment. The earliness index was determined by giving numerical value to each observation during the experiment (if 'n' observations were made, the first observation was given a numerical value of (n), second observation (n-1), third observation (n-2), …… final observation n-(n-1). This was multiplied by number of seed germinated at respective observations and its summation was taken. This sum was divided by the number of observations and the total number of seed germinated finally, to arrive at earliness index (Bavappa *et al*., 1964).

$$\text{Earliness index} = \frac{n.x1 + (n-1).\ X2 + (n-2).\ X3\ \ldots\ldots\ldots\ldots\ n - (n-1)x.k}{n.x}$$

Where

n = number of observation made till the completion of germination

X1. k = number of seed germinated during respective observations

X = number of seed germinated finally.

Vigour index of seed was estimated by multiplying percent normal seed germination by length of epicotyl (mm). This method suggested by (Abdul-Baki and Anderson 1973) [1].

Height of Jatti Khatti seedling was measured with the help of meter scale from the ground level to the top of seedling at 30, 60 and 90 days after sowing and average value expressed in cm. The number of leaves per plant was counted at 30, 60 and 90 days after sowing of seed and average value expressed in number. Leaf area is a measurement of leaf length and width it can be done with the help of measuring scale measurement was taken at 90 days after sowing. Stem diameter was recorded with the help of Vernier Callipers at 90 days after sowing and average value expressed in cm. The fresh and dry weight of shoot was determined with the help of balance and then sample were dried in oven till constant weight. Observation was recorded at 90 days after sowing and average number was recorded and average value expressed in g. The length of primary root from the collar region to the tip was measured for 3 randomly uprooted plants in each

treatment at 90 days after sowing with the help of measure scale and expressed the length of root in cm. The three seedling selected randomly from each treatments and were uprooted and washed carefully and observation will be recorded at 30, 60 and 90 days after sowing. The average value was computed.

The three seedlings selected randomly from each treatment and were uprooted and washed carefully and observation will be recorded at 90 days after sowing. The fresh weight was taken just after uprooting and dry weight was taken after the root were dried at 60 ℃ to 75 ℃ for about 10-20 hours and average number of dry weight were recorded and expressed in (g). The data obtained during experimentation was statistically analyzed as per method given by Panse and Sukhatme (1985) and C.D. will be evaluating at 5% level of significance. Where MSE = Mean sum of squares due to error. The calculation of C.D. at 5% of table value will be carry out with the help of following formula. C.D. = Critical difference S.E. m± = Standard error of mean.

Results and Discussion

The results obtained during the course of investigation are discussed with the help of relevant information available on Jatti khatti and other fruit crops under the following heads.

The Effect of plant growth regulators and thiourea on seed germination and roots growth

Days taken to start seed germination

Among all the treatments the seed treated with T_3 GA3 400 ppm for 12 hours were taken minimum days to start seed germination (8.000 days) followed by T_2 GA3 200 ppm (9.700 days) and T_7 Thiourea 1000 ppm (11.300 days). Whereas, start the late of seed germination (18.00 days) was recorded in the seed soaked in distilled water T_1 Control. The promotion of seed germination due to antagonistic effect of GA3 against influence of inhibitors of seeds germination (Brain and Hemming, 1958 and Wareing *et al*., 1968). GA3 break down the dormancy in many seed and activate the enzyme, which has most important roles for seed germination. These result are closely confirmed by findings obtained by Chaudhary *et al*. (2019) [7] in Kagzi lime, Prabha *et al*. (2015) [33] in papaya reported that early start of germination would be induced by treatment of seed with GA3 solution, Patil *et al*. (2012) [32] in Rangpur lime, Shukla *et al*. (2012) [38] in Kagzi lime, Dhaka and Pal (2009) [11] in Kagzi lime, Shinde *et al*. (2008) [37] in Rangpue lime. The common delay of germination might be associated to the environmental factor like winter season of a cool period and short day length. According to the Hills *et al*. (2001) [14] the speed and percentage of germination are reduced by low and high temperature.

Germination percentage

The data have been presented in (Table No. 1) revealed that the seed treated with T_3 GA3 400 ppm for 12 hours was obtained maximum seed germination percentage (94.473%) followed by T_2 GA3 200 ppm (88.223%), T_7 Thiourea 1000 ppm (82.667%) and T_6 Thiourea 500 ppm (77.843%). However, minimum seed germination percentage were recorded under T_1 Control (49.167%). The increasing of seed germination percentage with GA_3 may be either due to diffusion of endogenous auxin and gibberellin like substances or due to antagonistic effect of GA3 against influence of inhibitors. The results are in accordance with the findings obtained by Affric and Tagelsir (2018) [3] in lime, Khpkar *et al*. (2017) in pummels, Singh *et al*. (2017) [39] in Kagzi lime, Khatana *et al*. (2015) [23] in Acid lime cv. Kagzi lime, Samir *et al*. (2015) in Khirni, Kalyani *et al*. (2014) in Guava, Chaudhary and Chakrawar (1980) [8] in kagzi lime and Rawash *et al*. (1980) [34] in sour orange and mandarin. Moreover, the germination percentage was probably affected by environmental factors such as high humidity causes fungus attack during the course of seed germination which causes rotting of seed.

Earliness index

Data on earliness index of seed germination have been presented in (Table No. 1). The earliness index among various treatment was found to be vary ranged between (0.641-0.886). The maximum earliness index was recorded in treatment T_3 GA3 400 ppm (0.886) followed by T2 GA3 200 ppm (0.878), T_7 Thiourea 1000 ppm (0.766) and T_6 Thiourea 500 ppm (0.756) respectively. However, minimum earliness index was recorded under T_1 Control (0.641). These findings also supported by Reddy and Murthy (1990) in seed germination of Ber, reported that the earliness index was varied from (0.799 to 0.641).

Vigour index

The vigour index was recorded at 30 DAS when all the seed germinated. The data have been presented in (Table No. 1). Data revealed that the vigour index was recorded highest in treatment T_3 GA3 400 ppm (511.76) followed by T_2 GA3 200 ppm (423.47), T_7 Thiourea 1000 ppm (324.05) and T_6 Thiourea 500 ppm (251.98) respectively. The increased growth might be due to stimulatory effect of harmone and thiourea. Similar findings also have been reported in Ber by Murthy and Reddy (1989) [28], Patil *et al*. (2012) [32] in Rangpur lime, Smet *et al*. (1999) in cherimoya, Dhankar and Kumar (1996) reported that application of GA3 250 ppm caused longest growth of plumule and radicle in Aonla.

Length of primary root

Length of primary root under shade net house condition was recorded at 90 DAS. The data have been presented in (Table No. 1). The primary root length range 5.200-8.820 cm. The maximum root length (8,820 cm) was recorded in the treatment T_3 GA3 400 followed by T_7 Thiourea 1000 ppm (7.120 cm), T_2 GA3 200 ppm (6.970 cm) and T_6 Thiourea 500 ppm (6.140 cm) respectively. However, the minimum length of primary root was observed in treatment T_1 Control (5.200 cm). These findings are also supported by Dilip *et al*. (2017) [12] in Rangpur lime, Singh *et al*. (2017) [39] in Kagzi lime, Patil *et al*. (2012) [32] in Rangpur lime.

Number of secondary roots

Observation were recorded on account of number of secondary roots have been presented in (Table No. 1). The data on number of secondary roots was recorded at 30, 60 and 90 DAS. The treatment T_3 GA_3 400 ppm for 12 hours was recorded significantly increase maximum number of secondary roots (3.120, 6.210 and 11.523) followed by treatment T_2 GA3 200 ppm (2.270, 4.657 and 8.573) and T_7 Thiourea 1000 ppm (1.957, 3.083 and 7.237). However, the minimum number of secondary roots was recorded in the treatment T_1 Control (1.680, 2.270 and 3.800). The

improvement in number of roots per seedling due to more photosynthetic produce resulting in better vegetative growth and more number of secondary roots per seedling was produce. These findings are also supported by Dilip *et al.* (2017) [12] in Rangpur lime, Jain *et al.* (2017) in Custard apple, Parab *et al.* (2017) [30] in Papaya, Anjanawe *et al.* (2013) [5] in Papaya.

Fresh weight of root

Fresh weight of roots under shade net house condition was recorded at 90 DAS. The data presented in (Table No. 1). Fresh weight ranged between 0.050-0.158 g. The Maximum fresh weight of root was recorded in treatment T_3 GA_3 400 ppm (0.158 g) followed by T_2 GA_3 200 ppm (0.135 g) and T_7 Thiourea 1000 ppm (0.114 g). However, the minimum fresh weight of roots (0.050 g) was recorded in T_1 Control. Pandiyan *et al.* (2011) the promoting effect of GA_3 on fresh weight of roots may be due to acceleration in the translocation and assimilation of auxin which causes better vegetative growth. GA_3 also increase the auxin level in the roots resulting increase primary root length with number of secondary roots through more nutrient mobilization and uptake. These results are supported with the findings of Yadav *et al.* (2018) in Custard apple, Dilip *et al.* (2017) [12] in Rangpur lime, Kant *et al.* (2017) in Rough lemon, Khatana *et al.* (2015) [23] in Acid lime cv. Kagzi lime, Patil *et al.* (2012) [32] in Rangpur lime.

Dry weight of roots

Dry weight of roots under shade net house condition was recorded at 90 DAS. The data presented in (Table No. 1). Dry weight of roots ranged between 0.026-0.075 g. The maximum dry weight of root was recorded in treatment T_3 GA_3 400 ppm (0.075 g) followed by T_2 GA3 200 ppm (0.062 g), T_7 Thiourea 1000 ppm (0.057 g). However, minimum dry weight of root was recorded in treatment T_1 Control (0.026 g). These results are also supported with the findings by Dilip *et al.* (2017) [12] in Rangpur lime, Parab *et al.* (2017) [30] in Papaya Cv. Solo. GA3 had shown significant effect on dry weight of roots, Vishwakarma *et al.* (2013) in Acid lime cv Kagzi lime, Patil *et al.* (2012) [32] in Rangpur lime

Effect of plant growth regulators and thiourea on seed germination and seedling growth.

Height of seedling

The data on height of seedling under shade net house condition was recorded at 30, 60 and 90 DAS have been presented in (Table No.2). Significant differences were observed in the different seed treatments. The treatment T_3 GA3 400 ppm exhibit significantly increased in seedling height (5.417, 10.350 and 15.400 cm) followed by T_2 GA3 200 ppm (4.800, 9.650 and 14.300 cm) in respective days. Minimum seedling height (2.607, 5.417 and 7.947 cm) was recorded in T_1 Control. The increasing of seedling height with the application of GA3 occurred due to increasing osmotic uptake of nutrients which cause cell elongation and increasing of seedling height (Shanmugavelu, 1966). These findings are supported by Jadhav *et al.* (2019) [16] in Rangpur lime, Jaiswal *et al.* (2018) [19] in Kagzi lime, Murlidhara *et al.* (2015) in Mango, Jadhav *et al.* (2015) [15] in Custard apple, Khatana *et al.* (2015) [23] in Acid lime cv. Kagzi lime, Patil *et al.* (2012) [32] in Rangpur.

Number of leaves

Observations on account of number of leaves per plant under shade net house condition have been presented in (Table No.2). The number of leaves per plant data was recorded at 30, 60 and 90 DAS. The treatment T_3 GA3 400 ppm significantly increased maximum number of leaves (5.400, 10.560 and 16.800) in respective days of observations followed by T_2 GA3 200 ppm (4.800, 9.400 and 13.080), T_7 Thiourea 1000 ppm (3.400, 6.340 and 11.567) and T_6 Thiourea 500 ppm (2.850, 5.850 and 9.300) respectively. However, the minimum number of leaves per plant was recorded in treatment T_1 Control (2.250, 4.393 and 7.340). Increase in the number of leaves per seedling in T_3 GA3 400 and T_2 GA_3 200 was possibly due to induction of cell division and cell growth by the movement of GA_3 to the shoot apex resulting in increase the number of young leaves (Salisbury and Ross, 1988). Similar findings are also supported by Chaudhary *et al.* (2019) [7] in Kagzi lime, Jaiswal *et al.* (2018) [19] in Kagzi lime, Dilip *et al.* (2017) [12] in Rangpur lime, Joshi *et al.* (2015) in lime, Brijwal and Kumar (2013) in Guava, Kalalbandi *et al.* (2003) in Kagzi lime noted that GA3 at 80 ppm was the most effective for improving the germination, height of seedling and number of leaves.

Leaf area

Observations were recorded on account of Leaf area at 90 DAS under shade net house condition. The data have been presented in (Table No. 2). Leaf area ranged between (3.143-7.003 cm2). Among the treatments T_3 GA3 400 ppm showed maximum leaf area (7.003 cm^2) followed by treatments T_7 Thiourea 1000 ppm (6.800 cm^2) and T_2 GA3 200 ppm (6.400 cm^2). However, the minimum leaf area of seedling was recorded in T_1 Control (3.143 cm2). Similar result was also recorded by Khatana *et al.* (2015) [23] in Acid lime cv. Kagzi lime, Kumar (2004) in rough lemon in Ludhiana, Singh (2003) in Kinnow mandarin.

Diameter of stem

The data on diameter of stem under shade net house condition was recorded at 90 DAS, have been presented in (Table No. 2). The diameter of stem ranged between (0.207-0.323 cm), among the treatments T_3 GA_3 400 ppm showed maximum diameter (0.323 cm) followed by T_2 GA_3 200 ppm (0.310 cm). which was at par with treatments T_3 GA3 400 ppm. However, the minimum diameter of stem was recorded in T_1Control. The increasing diameter due to increasing in cell size, cell elongation and cell division with the application of GA_3. These findings are also supported by Jaiswal *et al.* (2018) [19] in Kagzi lime, Khatana *et al.* (2015) [23] in Acid lime cv. Kagzi lime, Gholap *et al.* (2000) in Aonla, Agha *et al.* (1990) in sour orange and Midrange rootstock.

Fresh weight of shoot

Observation was recorded on account of fresh weight of shoot at 90 DAS under shade net house condition. The data have been presented in (Table No. 2). Fresh weight of shoot ranged between (0.162-0.398 g). Among the treatments maximum fresh weight of shoot was recorded in treatment T_3 GA3 400 ppm (0.398 g) followed by T_2 GA3 200 ppm (0.334 g). However, minimum fresh weight (0.162 g) was recorded in treatment T_1 Control. The increasing more fresh weight resulting due to more production of photosynthetic produce

and their translocation to different plant part which is induced by higher rate of mobilization of water and nutrients. These results are also supported with the findings of Jaiswal *et al*. (2018) [19] in Kagzi lime, Patel *et al*. (2018) in Tamarind, Joshi *et al*. (2015) in Acid lime, Khatana *et al*. (2015) [23] in Acid lime cv. Kagzi lime, Kadam *et al*. (2010) in Kagzi lime.

Dry weight of shoot

Observation was recorded on account of dry weight of shoot at 90 DAS under shade net house condition. The data have been presented in (Table No. 2). The maximum dry weight of shoot (0.186 g) was recorded in treatment T_3 GA3 400 ppm followed by T_2 GA3 200 ppm (0.163 g). However, minimum dry weight (0.059 g) was recorded in treatment T_1 Control, the application of different plant growth regulators and thiourea shows remarkable increased of dry weight of shoot due to production of more number of leaves, higher seedling length and more fresh weight resulting in increased the dry weight of shoot, may be also due to improve mobilization of nutrients with the application of GA3. These results are supported with the findings by Dilip *et al*. (2017) [12] in Rangpur lime, Chiranjeevi *et al*. (2017) in Aonla and Rawat (2016) in Custard apple, Shukla *et al*. (2012) [38] in Kagzi lime.

Table 1: Effect of plant growth regulators and thiourea on seed germination and roots growth of Jatti Khatti

Treatments	Days taken to start seed germination (days)	Germination percentage (%)	Earliness index	Vigour index	Length of primary root (cm)	Number of secondary roots			Fresh weight of roots	Dry weight of roots
						30 DAS	60 DAS	90 DAS		
T_1 Control	18.000	49.167	0.641	128.178	5.200	1.680	2.270	3.800		
T_2 GA_3 200 ppm	9.700	88.223	0.878	423.470	6.970	2.270	4.657	8.573	0.050	0.026
T_3 GA_3 400 ppm	8.000	94.473	0.886	511.760	8.820	3.120	6.210	11.523	0.135	0.062
T_4 IAA 30 ppm	16.333	54.740	0.688	187.758	5.340	1.740	2.427	4.700	0.158	0.075
T_5 IAA 50 ppm	15.780	58.100	0.708	222.116	5.700	1.853	2.580	5.747	0.072	0.032
T_6 Thiourea 500 ppm	12.260	77.843	0.756	251.977	6.140	1.917	2.857	6.613	0.095	0.037
T_7 Thiourea 1000 ppm	11.300	82.667	0.766	324.054	7.120	1.957	3.083	7.237	0.086	0.048
T_8 Kinetin 500 ppm	14.957	62.583	0.747	173.167	5.390	1.783	2.333	6.250	0.114	0.057
T_9 Kinetin 1000 ppm	13.493	67.260	0.714	201.981	5.730	1.883	2.730	8.030	0.070	0.040
SE(m)	0.530	1.462	0.001	0.578	0.018	0.028	0.012	0.045	0.082	0.052
C. D. at 5%	1.587	4.378	0.004	1.731	0.054	0.083	0.037	0.136	0.001	0.001

Table 2: Effect of plant growth regulators and thiourea on seed germination and seedling growth of Jatti Khatti

Treatments	Height of seedling growth at DAS			No. of leaves per plant at DAS			Leaf area (cm^2)	Diameter of stem (cm)	Fresh weight of shoot (g)	Dry weight of shoot(g)
	30 days	60 days	90 (days)	90 days	60 days	90 days	90 days	90 (days)		
T_1 Control	2.607	5.417	7.947	2.250	4.393	7.340	3.143	0.207	0.162	0.059
T_2GA_3 200 ppm	4.800	9.650	14.300	4.800	9.400	13.080	6.400	0.310	0.334	0.163
T_3GA_3 400 ppm	5.417	10.350	15.400	5.400	10.560	16.800	7.003	0.323	0.398	0.186
T_4 IAA 30 ppm	3.430	6.063	8.357	2.300	4.950	8.100	5.333	0.243	0.249	0.076
T_5 IAA 50 ppm	3.823	6.560	8.843	2.570	5.960	9.050	5.767	0.270	0.267	0.103
T_6-Thiourea 500 ppm	3.237	6.710	10.107	2.850	5.850	9.300	6.280	0.273	0.270	0.122
T_7Thiourea 1000 ppm	3.920	7.447	11.333	3.400	6.340	11.567	6.800	0.293	0.291	0.141
T_8 Kinetin 500 ppm	2.767	5.830	8.387	2.500	4.880	7.700	6.033	0.253	0.255	0.087
T_9 Kinetin 1000 ppm	3.003	6.073	8.717	2.380	5.600	8.633	6.400	0.280	0.275	0.104
SE(m)	0.073	0.068	0.059	0.024	0.028	0.089	0.064	0.006	0.002	0.002
C. D. at 5%	0.220	0.204	0.177	0.072	0.085	0.267	0.191	0.019	0.005	0.005

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