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## Influence of GA<sub>3</sub> on germination and growth of acid lime cv. KAGZILIME seed (*Citrus aurantifolia* Swingle) under field as well as net house conditions

■ K.J. KHATANA<sup>1</sup>, R.G. JADAV<sup>1</sup> AND D.S. NEHETE

**Members of the Research Forum**

**Associated Authors:**

<sup>1</sup>Department of Horticulture, B.A. College of Agriculture, Anand Agricultural University, ANAND (GUJARAT) INDIA

**ABSTRACT :** The investigation was carried out during the year 2011-12 at the Horticultural Research Farm, Department of Horticulture, B.A. College of Agriculture, Anand Agricultural University, Anand to assess the role of different concentration of GA<sub>3</sub> and conditions on seed germination, vegetative growth of acid lime cv. KAGZILIME. The experiment was laid out in Factorial Romized Block Design with twelve treatments and four replications. The fresh, moderate uniform in size and viable seeds of Kagzilime were treated (soaked) with six different levels of GA<sub>3</sub> for 12 hours and sown in prepared raised seed bed in the field and net house condition. The results revealed that the seeds treated with 500 mg/l GA<sub>3</sub> took significantly less time for 75 per cent germination (29.25 days) as well as recorded maximum germination (83.50 %), plant height (24.33 cm), number of leaves (30.03), length of seedling (36.48 cm), thickness of primary roots (2.07 mm), girth of seedling at top (1.01 cm), middle (1.00 cm) and bottom (1.14 cm), fresh weight of seedling (20.81 g), dry weight of seedling (11.58 g), total leaf area of seedling (8.28 cm<sup>2</sup>) as well as survival (74.45 %) at 120 DAS, respectively as compared to rest of the treatments. The results also indicated that the seeds sown under the net house conditions took significantly less time for 75 per cent germination (32.58 days) as well as recorded maximum germination (79.04 %), plant height (22.00 cm), number of leaves (26.50), length of seedling (34.96), thickness of primary roots (2.00 mm), girth of seedling at top (0.98 cm), middle (1.09 cm) and bottom (1.13 cm), fresh weight of seedling (18.92 g), dry weight of seedling (10.07 g), total leaf area of seedling (7.95 cm<sup>2</sup>) as well as survival (71.38 %) at 120 DAS, respectively as compared to open field condition (C<sub>1</sub>). In case of interaction between levels of GA<sub>3</sub> and conditions, significantly the maximum number of leaves (11.75 at 30 DAS), thickness of primary roots (2.26 mm at 120 DAS), fresh weight of seedling (15.70 g at 90 DAS), dry weight of seedling (5.53 g at 90 DAS) and survival percentage of seedling (80.01% at 120 DAS) recorded under the treatment G<sub>5</sub>C<sub>2</sub> (GA<sub>3</sub> 500 mg/l under net house conditions).

**KEY WORDS :** GA<sub>3</sub>, Seed germination, Field, Net house condition, Kagzilime

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**Author for correspondence :**

**D.S. NEHETE**

Department of Horticulture, B.A. College of Agriculture, Anand Agricultural University, ANAND (GUJARAT) INDIA

**C**itrus belongs to the family Rutaceae and it has more than 10 species *Citrus aurantifolia* – lime, *Citrus maxima*-pomelo, *Citrus medica*-citron,

*Citrus reticulata*-mandarin orange. In India, citrus is cultivated in 987.461 ('000' ha) of land with annual production of 9,637.813 ('000' MT). In Gujarat, area

under cultivation of citrus is 37.076 ('000' ha) with annual production of 385.628 ('000' MT) covering districts of Mehsana, Anand, Vadodara and Bhavanagar (Anonymous, 2011). India is the largest producer of acidlime in the world. Lime or acidlime is also commercially known as 'Pati lime' or 'Kagzi lime'. Propagation of Kagzilime is generally done by grafting, budding, air-layering and by seed. The commercial practice of propagation is by seed. The seed of Kagzilime have polyembryonic in nature and seed contain more than one embryo. The polyembryonic seed emerge in more than two seedlings from one seed. Out of them, one seedling having vigorous and it is produced from the somatic cells of the nucleus. Such apogamic seedlings are preferred for planting because they are true to type in nature and contain the characters like their parent plants. Sexually raised plants are long lived, have extensive root system and bear heavy crop. It is observed that citrus seeds lose their viability very soon. The nurserymen and growers faced the problems of poor seed germination and less vigour of seedling under open field conditions. Use of gibberellic acid has been made on a large scale in the recent years in increasing seed germination, stimulating the growth of various parts of plants and enhancing the rate of elongation of young seedlings. Protective cultivation like, net house is found effective for retarding temperature. Therefore, enhancing the better seed germination and seedling growth by using GA<sub>3</sub> under protective net house condition of Kagzilime seed.

## RESEARCH METHODS

The present investigation was carried out at B.A. College of Agriculture, Anand Agricultural University, Anand during the year *Kharif* 2011-12. Monsoon is warm and moderately humid, winter is fairly cold and dry, while summer is quite hot and dry. Soil of the experimental site was sandy loam and well drained with neutral pH. The soil is alluvial by their nature of origin, very deep, well drained and fairly moisture retentive. Seeds are extracted from fully mature and healthy fruits and shade drying till the seed are completely dried. Required quantity of GA<sub>3</sub> was dissolve in 2 ml of 95 per cent ethyl alcohol and added distilled water for final volume of 1 lit stock solution. The seeds of acid lime soaked in different treatments for 12 hours before the sowing. The experiment was laid out in the Randomized Block Design with factorial concept and replicated four

times. The treatments of GA<sub>3</sub> viz., 0, 200, 300, 400, 500 and 600 ppm were applied to seeds and sown at about one centimeter depth in field and net house *i.e.*, 70 per cent shade at the 20.0 × 5.0 cm spacing. The data on seed germination, germination per cent, length of seedling, height of seedling, girth of seedling at top, middle and bottom, number of leaves/seedling, leaf stalk length/seedling, number of primary roots and secondary roots/seedling, total leaf area of seedling (cm<sup>2</sup>), survival percentage (%) were subjected to the statistical analysis using variance techniques as described by Panse and Sukhatme (1967).

## RESEARCH FINDINGS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under following heads :

### Effect of GA<sub>3</sub> and conditions on seed germination:

The result revealed that the minimum time taken for initial (21.75 days), 50 per cent (26.50days) and 75 per cent (29.25 days) seed germination were taken by GA<sub>3</sub> 500 ppm treatment. The highest germination percentage (84.25 %) was also obtained by GA<sub>3</sub> 600 ppm. The effectiveness of GA<sub>3</sub> in promoting the germination is due to its participation in the activities of hydrolyzing enzyme and alpha-amylase at initial stage of germination and thus, facilitated the germination process (Singh *et al.*, 1979). Enhancement of seed germination by growth regulators might be due to increase of transcription and/or translation during protein synthesis. The mobilization of protein and lipid storage bodies upon specific enzymes, which hydrolyze stored molecules and catalyze result into the production of energy and substrates and provide the structural components essential for growth and emergence of the embryo. This result is in agreement with the findings of Feza Ahmad (2010).

Between the conditions, C<sub>2</sub> (net house) condition was found better because it took least time (24.54 days) for completion of initial seed germination, for completion of 50 per cent (29.25 days) and 75 per cent (32.58 days) seed germination as well as recorded highest germination percentage (79.04 %) (Table 1). Under the net house condition seeds took minimum time for germination and gave higher germination per cent may be due to favourable temperature (minimum 21.0 °C and maximum 34.6 °C), higher relative humidity and less wind velocity, which may helpful to increase the seed germination at the earliest.

**Effect of GA<sub>3</sub> and conditions on growth parameters:**

Considerable differences were found on growth parameters due to different concentrations of GA<sub>3</sub>. The maximum seedling height (24.33 cm), number of leaves (30.03), leaf stalk length (12.24 mm), number of secondary roots (24.14), length of seedling (36.48 cm), thickness of primary roots (2.07 mm) (Table 1 and 2) and girth of seedling from top (1.01 cm) at 120 DAS were recorded with GA<sub>3</sub> 500 ppm treatment. While, middle (1.03 cm) and bottom (1.19 cm) girth at the 120 DAS were recorded with GA<sub>3</sub> 600 ppm treatment (Table 3). These might be because of when GA<sub>3</sub> was applied for seed treatment it rapidly takes part in cell division, cell elongation and cell expansion, which in turn would have increased the intermodal length. This results in more vegetative growth, which directly related with photosynthesis and accumulation of carbohydrates. These results are in agreement with the findings of Kadam *et al.* (2010).

The maximum seedling height (22.00 cm), number of leaves (26.50), leaf stalk length (10.32 mm), number of secondary roots (21.49), length of seedling (34.96 cm), thickness of primary roots (2.00 mm) as well as girth of seedling from top (0.98 cm), middle (1.09 cm) and bottom (1.13 cm) at the 120 DAS were recorded under C<sub>2</sub> (net

house) condition. This might be due to under net house condition there was sufficient light, which influenced the growth of lateral bud and produced more number of leaves and thereby more photosynthesis lead to vital growth of seedling (Patel *et al.*, 2011) also worked on the influence of GA<sub>3</sub> and NAA on yield parameters of cauliflower.

Significantly the maximum thickness of primary roots per seedling (2.26 mm) was recorded in G<sub>5</sub>C<sub>2</sub> (GA<sub>3</sub> 500 ppm under net house) at the 120 DAS, which was significantly highest as compared to rest of the treatment combinations. This might be due treatment of GA<sub>3</sub>, which helps in cell expansion and its elongation. While, net house condition provides sufficient light, which promote the growth of seedlings.

**Effect of GA<sub>3</sub> and conditions on fresh and dry weight of seedling at the 120 DAS :**

The maximum fresh (20.81 g) and dry (11.58 g) weight of Kagzilime seedling were recorded with GA<sub>3</sub> 500 ppm treatment (Table 4). These might be due to higher seed germination per cent and vegetative growth of seedling with GA<sub>3</sub> 500 ppm. The GA<sub>3</sub> 500 ppm treatment helps to mobilization of water and nutrients

**Table 1 : Effect of GA<sub>3</sub> and conditions on days taken for initial seed germination, height of seedling (cm), number of leaves/seedling of acid lime cv. KAGZILIME**

Treatments	Days taken for initial seed germination	Days taken for seed germination		Germination percentage (%)	Height of seedling (cm)				Number of leaves/seedling			
		Germination 50%	Germination 75%		30 DAS	60 DAS	90 DAS	120 DAS	30 DAS	60 DAS	90 DAS	120 DAS
<b>Gibberellic acid</b>												
G <sub>1</sub> :0 ppm	31.38	36.38	38.75	63.63	2.73	7.78	14.46	16.75	5.63	10.65	15.21	22.24
G <sub>2</sub> :200ppm	28.50	34.25	37.50	68.63	3.03	8.36	15.25	20.23	6.63	11.83	18.19	23.86
G <sub>3</sub> :300ppm	26.00	31.38	34.00	71.25	3.28	8.44	16.09	21.09	6.88	12.50	19.40	24.68
G <sub>4</sub> :400ppm	23.00	28.63	31.13	76.75	3.68	9.09	17.48	22.18	7.75	14.70	20.55	25.26
G <sub>5</sub> :500ppm	21.75	26.50	29.25	83.50	4.00	9.38	19.09	24.33	9.38	15.28	23.63	30.03
G <sub>6</sub> :600ppm	24.13	29.13	33.38	84.25	3.88	9.90	18.49	22.90	7.38	14.16	22.28	27.05
S.E. ±	0.81	0.78	0.92	2.17	0.14	0.27	0.50	0.65	0.34	0.52	0.68	0.78
C.D. (P=0.05)	2.34	2.23	2.66	6.25	0.42	0.77	1.44	1.88	0.96	1.49	1.97	2.24
<b>Condition</b>												
C <sub>1</sub> :Field	27.04	32.83	35.42	70.29	3.21	8.37	15.71	20.49	6.46	12.30	18.66	24.54
C <sub>2</sub> :Net house	24.54	29.25	32.58	79.04	3.65	9.28	17.91	22.00	8.08	14.08	21.09	26.50
S.E. ±	0.47	0.45	0.53	1.25	0.08	0.15	0.29	0.38	0.19	0.30	0.39	0.45
C.D. (P=0.05)	1.35	1.29	1.54	3.61	0.24	0.44	0.83	2.66	0.56	0.86	1.14	1.29
<b>G × C interaction</b>												
S.E. ±	1.15	1.10	1.31	3.07	0.20	0.38	0.71	0.92	0.47	0.73	0.97	1.10
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	1.36	NS	NS	NS
C.V. (%)	8.92	7.08	7.69	8.22	11.90	8.58	8.40	8.70	13.05	11.08	9.73	8.63

NS = Non-significant

**Table 2 : Effect of GA<sub>3</sub> and conditions on leaf stalk length/seedling (mm), number of secondary roots/seedling, length of seedling (cm) and thickness of primary roots (mm) of acid lime cv. KAGZILIME**

Treatments	Leaf stalk length/seedling (mm)			Number of secondary roots/seedling			Length of seedling (cm)			Thickness of primary roots (mm)		
	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS
<b>Gibberellic acid</b>												
G <sub>1</sub> :0 ppm	3.98	5.88	8.50	14.53	17.15	18.08	11.65	21.19	28.85	0.96	1.30	1.57
G <sub>2</sub> :200ppm	4.80	7.71	8.36	15.05	17.73	19.19	13.55	23.23	31.21	1.09	1.38	1.71
G <sub>3</sub> :300ppm	5.21	7.55	10.01	15.28	18.53	20.08	14.41	23.90	33.16	1.17	1.50	1.82
G <sub>4</sub> :400ppm	5.43	8.20	10.41	16.00	18.96	20.51	16.53	25.61	34.26	1.20	1.59	1.99
G <sub>5</sub> :500ppm	5.85	9.60	12.24	16.95	21.26	24.14	17.35	27.79	36.48	1.27	1.66	2.07
G <sub>6</sub> :600ppm	5.66	8.43	10.24	16.70	20.23	22.53	16.99	26.21	33.94	1.23	1.53	1.95
S.E. ±	0.17	0.25	0.40	0.47	0.66	0.78	0.65	0.90	2.00	0.05	0.05	0.07
C.D. (P=0.05)	0.50	0.73	1.14	1.36	1.90	2.24	1.88	2.60	5.75	0.14	0.14	0.20
<b>Condition</b>												
C <sub>1</sub> :Field	4.97	7.64	9.60	15.29	18.20	20.02	14.53	21.30	30.01	1.06	1.45	1.70
C <sub>2</sub> :Net house	5.34	8.15	10.32	16.21	19.75	21.49	15.63	28.01	34.96	1.25	1.54	2.00
S.E. ±	0.10	0.15	0.23	0.27	0.38	0.45	0.38	0.52	1.15	0.03	0.03	0.04
C.D. (P=0.05)	0.29	0.42	0.66	0.78	1.09	1.29	1.08	1.50	3.32	0.08	0.08	0.11
<b>G × C interaction</b>												
S.E. ±	0.25	0.36	0.56	0.67	0.93	1.10	0.92	1.28	2.83	0.07	0.07	0.10
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.28
C.V. (%)	9.58	9.06	11.25	8.49	9.82	10.60	12.23	10.38	17.41	11.74	9.29	10.36

NS = Non- significant

**Table 3 : Effect of GA<sub>3</sub> and conditions on top girth of seedling (cm), middle girth of seedling (cm) and bottom girth of seedling (cm) cv. KAGZI LIME**

Treatments	Top girth of seedling (cm)			Middle girth of seedling (cm)			Bottom girth of seedling (cm)		
	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS
<b>Gibberellic acid</b>									
G <sub>1</sub> :0 ppm	0.34	0.54	0.76	0.42	0.59	0.76	0.55	0.76	0.88
G <sub>2</sub> :200ppm	0.39	0.62	0.83	0.47	0.67	0.84	0.66	0.80	0.97
G <sub>3</sub> :300ppm	0.45	0.69	0.91	0.53	0.72	0.92	0.73	0.85	1.04
G <sub>4</sub> :400ppm	0.49	0.79	0.94	0.61	0.80	0.97	0.74	0.94	1.09
G <sub>5</sub> :500ppm	0.51	0.84	1.01	0.62	0.85	1.00	0.80	0.97	1.14
G <sub>6</sub> :600ppm	0.52	0.75	0.97	0.67	0.90	1.03	0.84	0.98	1.19
S.E.±	0.02	0.02	0.05	0.03	0.03	0.06	0.05	0.05	0.05
C.D. (P=0.05)	0.07	0.06	0.15	0.09	0.08	0.17	0.13	0.15	0.14
<b>Condition</b>									
C <sub>1</sub> :Field	0.40	0.65	0.83	0.50	0.66	0.75	0.66	0.78	0.97
C <sub>2</sub> :Net house	0.50	0.76	0.98	0.60	0.85	1.09	0.79	0.99	1.13
S.E.±	0.01	0.01	0.03	0.02	0.02	0.03	0.03	0.03	0.03
C.D. (P=0.05)	0.04	0.03	0.08	0.05	0.05	0.10	0.08	0.09	0.08
<b>G × C interaction</b>									
S.E. ±	0.03	0.03	0.07	0.04	0.04	0.08	0.07	0.08	0.07
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V. (%)	14.82	8.39	15.90	15.40	10.69	17.80	18.45	17.11	13.38

NS = Non - significant

transported at higher rate, which might have promoted more production of photosynthetic product and translocated them to various plant parts and there by resulted in better growth of the seedling resulted in maximum fresh and dry weight. This result is in agreement with the findings of Kadam *et al.* (2010).

The maximum fresh (18.92 g) and dry (10.07 g) weight of Kagzilime seedlings were under C<sub>2</sub> (net house) condition. This might be due to less rate of evaporation

under high humid condition of net house that increased cell turgidity. While the highest dry weight was observed due to profuse shoot and root growth of seedlings. Patil and Patil (2010) also worked on the influence of GA<sub>3</sub> and NAA on growth and yield of okra, Saravaiya *et al.* (2010), Lendve *et al.* (2011) on cabbage and Bawkar *et al.* (2011) on carrot and the results found were almost in accordance with the results found in the present investigation.

**Table 4 : Effect of GA<sub>3</sub> and conditions on fresh weight of seedlings (g), dry weight of seedlings (g), total leaf area of seedling (cm<sup>2</sup>) and survival percentage (%) acid lime cv. KAGZILIME**

Treatments	Fresh weight of seedlings (g)			Dry weight of seedlings (g)			Total leaf area of seedling (cm <sup>2</sup> )			Survival percentage (%)		
	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS	60 DAS	90 DAS	120 DAS
<b>Gibberellic acid</b>												
G <sub>1</sub> :0 ppm	8.28	10.55	14.75	1.35	2.79	7.65	3.34	4.86	6.49	71.36	71.31	68.85
G <sub>2</sub> :200ppm	9.09	11.99	16.88	1.76	3.55	8.81	3.28	5.40	7.24	67.73	67.15	66.76
G <sub>3</sub> :300ppm	9.24	12.21	16.50	1.99	4.25	9.34	3.33	5.40	7.49	70.31	69.50	66.88
G <sub>4</sub> :400ppm	9.78	12.18	17.76	2.49	4.35	9.95	3.49	5.44	7.64	69.44	68.93	68.30
G <sub>5</sub> :500ppm	10.41	13.08	20.81	2.81	5.01	11.58	3.80	6.24	8.28	80.36	78.75	74.45
G <sub>6</sub> :600ppm	9.44	12.58	19.34	2.15	4.20	10.33	3.77	5.73	8.14	70.85	66.76	64.56
S.E. ±	0.41	0.51	0.72	0.13	0.13	0.31	0.11	0.18	0.23	3.34	3.17	2.78
C.D. (P=0.05)	1.19	1.48	2.07	0.38	0.36	0.88	0.32	0.51	0.67	NS	NS	NS
<b>Condition</b>												
C <sub>1</sub> :Field	8.98	10.42	16.43	1.77	3.53	9.15	3.39	5.23	7.17	68.54	67.09	65.56
C <sub>2</sub> :Net house	9.77	13.78	18.92	2.42	4.54	10.07	3.61	5.79	7.95	74.80	73.71	71.38
S.E. ±	0.24	0.30	0.42	0.08	0.07	0.18	0.06	0.10	0.13	1.93	1.83	1.61
C.D. (P=0.05)	0.69	0.85	1.20	0.22	0.21	0.51	0.18	0.29	0.39	5.55	5.26	4.62
<b>G × C interaction</b>												
S.E. ±	0.58	0.73	1.02	0.19	0.18	0.43	0.16	0.25	0.33	4.72	4.48	3.93
C.D. (P=0.05)	NS	2.09	NS	NS	0.51	NS	NS	NS	NS	NS	NS	11.32
C.V. (%)	12.45	12.02	11.54	17.87	8.82	8.99	8.98	9.09	8.73	13.18	12.73	11.49

NS = Non-significant

**Table 5 : Interaction effect between GA<sub>3</sub> and conditions on acid lime seedlings cv. KAGZILIME**

G × C	Number of leaves/seedling at 30 DAS		Thickness of primary roots per seedling at 120 DAS		Fresh weight of seedling at 90 DAS		Dry weight of seedling at 90 DAS		Survival percentage of seedling at 120 DAS	
	C <sub>1</sub> :Field	C <sub>2</sub> :Net house	C <sub>1</sub> :Field	C <sub>2</sub> :Net house	C <sub>1</sub> :Field	C <sub>2</sub> :Net house	C <sub>1</sub> :Field	C <sub>2</sub> :Net house	C <sub>1</sub> :Field	C <sub>2</sub> :Net house
G <sub>1</sub> : 0 ppm	5.25	6.00	1.12	2.03	10.45	10.65	2.40	3.18	66.39	71.31
G <sub>2</sub> : 200ppm	6.00	7.25	1.61	1.81	10.40	13.58	3.00	4.10	72.78	60.75
G <sub>3</sub> : 300ppm	6.25	7.50	1.79	1.86	10.48	13.95	3.40	5.10	67.32	66.45
G <sub>4</sub> :400ppm	7.25	8.25	1.89	2.09	10.13	14.23	4.10	4.60	62.69	73.91
G <sub>5</sub> :500ppm	7.00	11.75	1.88	2.26	10.45	15.70	4.58	5.53	70.90	80.01
G <sub>6</sub> :600ppm	7.00	7.75	1.95	1.96	10.60	14.56	3.68	4.73	53.28	75.84
S.E. ±	0.47		0.10		0.73		0.18		3.93	
C.D. (P=0.05)	1.36		0.28		2.09		0.51		11.32	
C.V. (%)	13.05		10.36		12.02		8.82		11.49	

### Effect of GA<sub>3</sub> and conditions on total leaf area of seedling :

The maximum leaf area of seedling (8.28 cm<sup>2</sup>) was recorded with GA<sub>3</sub> 500 ppm treatment (Table 4). This might be due to more number of leaves produced by GA<sub>3</sub> 500 ppm treatment. The maximum leaf area of seedling (7.95 cm<sup>2</sup>) was recorded under C<sub>2</sub> (net house) condition as compared to C<sub>1</sub> (7.17 cm<sup>2</sup>). This might be due to more light being able to be passed and available inside the net house, which directly enhance the rate of photosynthesis. The increase in the growth of leaves increased the leaf area under net house condition as compared to open field condition.

### Effect of GA<sub>3</sub> and conditions on survival percentage of seedling :

Data on effect of GA<sub>3</sub> on survival per cent of seedling at the 120 DAS indicated maximum survival (74.45 %) with GA<sub>3</sub> 500 ppm as compared to rest of the treatments (Table 4). This is because of healthy seedlings obtained with GA<sub>3</sub> 500 ppm, which survived more as compared to rest of the treatments. These findings are in agreement with those reported by Gupta (1989) who obtained improved seed germination with higher survival percentage of seedlings by GA<sub>3</sub> treatment on citrus seeds.

Data on effect of conditions on survival per cent of seedling at the 120 DAS are revealed maximum survival (71.38 %) under C<sub>2</sub> (net house) condition as compared to C<sub>1</sub> (65.56 %). This might be due to availability of favourable amount of light, temperature and humidity, which makes the plant harder and able to withstand against adverse climatic conditions.

Significantly the highest survival percentage of seedling (80.01 %) was recorded in G<sub>5</sub>C<sub>2</sub> (GA<sub>3</sub> 500 ppm under net house) at the 120 DAS as compared to rest of the treatment combinations (Table 5). This might be due to GA<sub>3</sub> treatment, which helps in cell expansion and its elongation. While, net house condition provides sufficient light, which promote the growth of seedlings.

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