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Effect of growth regulators on germination and vigour of Chickpea (*Cicer arietinum* L.) seed

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Abstract
A study was conducted during 2016-17 to evaluate the effects of organic and inorganic growth regulators on germination and vigour of Chickpea *(Cicer arietinum* L.) seed at Post Graduate laboratory, Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad (U.P.). The experiment consist of three concentration of GA_3 (10, 20 and 30 ppm), three concentration of IAA (10, 20 and 30 ppm), three concentration of lemon juice (2, 4 and 6%), and three concentration of Panchgavya (2, 4 and 6%). The experiment was laid out in completely randomized block design with four replications. T_8 (GA_3 20ppm) proved significantly superior in germination percent, germination index, shoot length, root length, seedling length, fresh weight of seedling, dry weight of seedling, seed vigour index-I, and seed vigour index-II.

Keywords: Chickpea, Growth Regulators, Germination, Vigour

Introduction
Chickpea (*Cicer arietinum* L.) belongs to family Leguminoseae, an annual legume. It is a self-pollinated crop having chromosome no 2n= 16. It is the third most important pulse crop in the world. In India, chickpea is a premier pulse crop occupying 8.17 million ha and contributing 7.47 million tonnes to pulse basket. It accounts for 20% of the world pulses production. India is the largest producer, with about 8 million tons, accounting of about 70% of total world production. The nutrient composition of chickpea seed has protein (18-22%), fat (4-10%), 6.3%, carbohydrates (52-70%) and minerals (Calcium, Phosphorous, Iron) and Vitamins (El-Adawy 2002) [4].

Plant growth regulators may be defined as any organic compounds, which are active at low concentrations (1-10 mg / ml) in promoting, inhibiting or modifying growth and development. The naturally occurring (endogenous) growth substances are commonly known as plant hormones, while the synthetic ones are called growth regulator. The impact of PGRs in manipulating physiological processes in crop production include germination, vigour, nutrient uptake from soil, photosynthesis, respiration, partitioning of assimilate, growth suppression, defoliation and post-harvest ripening (Rahman and Nath, 1993; Kathiresan and Balasubramanian, 1995) [12, 8]. These are synthesized within the plant bodies but its exogenous application renders a considerable response (Frankenberger and Arshad, 1991) [5].

The growth regulators were also found to be effective in changing the biochemical properties including protein and amino acids (Oluwatosin, 1997) [9]. These growth regulators may be of natural origin or synthetic. The growth regulators both from organic (Panchgavya, lemon) and inorganic sources (GA_3, IAA) along with some traditional growth regulators were tried to increase the germination and vigour of different pulse seeds. In India a large number of experiments have been undertaken in many field and horticultural crops on Gibberelic acid to evaluate germination and vigour seed and it was found to have increased the growth and yield of various economically important crop plants including cereals, vigour and others attributes of chickpea. Therefore, the present investigation has been undertaken to find out 'the effect of organic and inorganic growth regulators on germination and vigour on chickpea (*Cicer arietinum* L.).

Materials and Method
The experiment entitled "Effects of organic and inorganic growth regulators on germination and vigour of chickpea (*Cicer arietinum* L.) Seeds" was carried out during 2016-17 in Post Graduate laboratory, Department of Genetics and Plant Breeding. SHUATS Allahabad (U.P.), which is located at 25º24'41.27" N latitude, 81°51'3.42" E longitude and 98 m altitude above the mean sea level.

This area is situated on the right side of the river *Yamuna* and south east side of Allahabad City. The experiment consisted four growth regulators *viz.*, Lemon juice, Panchgavya, GA_3 and IAA. This experiment had 13 treatments as follows: T_0 = control, T_1 = lemon juice @ 2%, T_2 = lemon juice @ 4%, T_3 = lemon juice @ 6%, T_4 = Panchgavya @ 2%, T_5 = Panchgavya @ 4%, T_6 = Panchgavya @ 6%, T_7 = GA_3 @ 10 ppm, T_8 = GA_3 @ 20 ppm, T_9 = GA_3 @ 30 ppm, T_{10} = IAA @ 10 ppm, T_{11} = IAA @ 20 ppm, T_{12} = IAA @ 30 ppm. In this experiment 50 seeds were used in each treatment and seeds were soaked in different concentrations of four growth regulators for 6 hrs.

The experiment was laid out in a Complete Randomized Design with four replication. The parameters studied were germination per cent (%), germination index, shoot length (cm), root length (cm), seedling length (cm), seedling fresh weight (g), seedling dry weight (g), vigour index I and II. Observations were recorded on five randomly selected seed for all the parameters from each replication. The performance of organic and inorganic growth regulators was evaluated on basis of laboratory germination test by collecting different germination parameters *viz.*, germination per cent(%), germination index, shoot length (cm), root length (cm), seedling length (cm), fresh weight of seedling (gm), dry weight of seedling (gm), seed vigour index-I, and seed vigour index-II. These parameters were statistically analysed and critical differences were calculated.

Result and Discussion

Germination percent (%)

The data revealed that germination per cent (%) shows significant difference among the various treatments. Germination per cent (%) ranged from 73.50 to 96.50 (Table 1). The maximum germination per cent (97.50%) was observed in T_8 (GA_3 20ppm) which was found followed by T_7 (GA_3 10ppm) 96.50% whereas, minimum germination per cent was recorded in control T_0 (73.50%).

Maximum germination percentage was recorded when seeds soaked in GA_3 might be due to the fact that GA_3 involved in the activation of cytological enzymes which stimulates α – amylase enzyme that converts insoluble starch into soluble sugars and it also initiates the radical growth by removing some metabolic blocks Babu *et al*., 2010 [2]. GA_3 also plays an important role in leaching out of the inhibitors which in turn helps in breaking the seed dormancy. Similar finding has been found by Pandit *et al*., 2001, Anburani and Shakila (2010) [10, 1].

Germination index

The data revealed that speed of germination shows significant difference among the various treatments. The speed of germination in chickpea as influenced by various seed treatments are presented in Table 1. The speed of germination ranged from 11.58 to 15.00.The maximum speed of germination (15.00) was observed in T_8 (GA_3 20 ppm) which was found to be significantly superior followed by T_7 (GA_3 10 ppm) 14.75 whereas, minimum speed of germination was recorded in control T_0 (11.58).

The maximum speed of germination with GA_3 might be due to its influence in early germination and increased percent germination. The results are in conformity with findings of Rajamanickam and Anbu (2001) [13].

Table 1: Mean performance of chickpea for germination per cent, germination index and vigour index.

Treatment	Germination per cent (%)	Germination index	Vigour Index I	Vigour Index II
T0	73.50	11.58	1236.58	82.48
T1	92.50	14.25	2419.74	121.41
T2	93.50	14.25	2593.58	99.57
T3	92.50	14.25	2308.02	94.79
T4	94.50	14.50	2782.08	122.87
T5	95.00	14.67	2839.62	114.09
T6	94.00	14.42	2688.22	74.74
T7	96.50	14.75	3148.77	132.71
T8	97.50	15.00	3223.03	149.93
T9	95.50	14.67	2903.21	135.13
T10	85.50	13.75	2078.03	97.42
T11	91.00	13.92	2257.62	105.38
T12	83.00	11.67	1652.68	65.79
G Mean	91	13.97	2471.63	107.41
C.D. (5%)	5.136487	5.219	317.50	14.27
SE(m)	1.79565	1.817	110.991	4.99
SE(d)	2.539433	2.570	156.96	7.05
C.V.	3.94149	23.568	8.98	9.29

Shoot length (cm)

The data revealed that shoot length (cm) shows significant difference among the various treatments. The shoot length in chickpea as influenced by various seed treatments are presented in Table 2. The shoot length ranged from 8.61cm to 17.87cm. The maximum shoot length (17.87cm) was observed in T_8 (GA_3 20ppm) which was found to be significantly superior followed by T_7 (GA_3 10 ppm) *i.e.* 17.31cm whereas, minimum root length was observed in control T_0 (8.61cm).

This improvement in shoot growth could be due to activation of dormant embryo of seeds with GA_3 and also GA_3 treatment helps to increase cell division, cell elongation and cell multiplication which might have reflected into maximum seedling shoot length. These results are in accordance with results obtained by Gawade (2008) [6], Gholap *et al.,* (2000) [7].

Root length (cm)

The data revealed that root length (cm) shows significant difference among the various treatments. The root length (cm) in chickpea as influenced by various seed treatments are presented in Table 2. The root length ranged from 8.15cm to 15.89 cm. The maximum root length (15.89 cm) was observed

in T_8 (GA3 20ppm) which was found to be significantly superior followed by T_7 (GA_3 10 ppm) *i.e.* 15.36 whereas, minimum root length was recorded in control T_0 (4.34cm).
The maximum root length with GA_3 might be due to its influence to promoted more root formation through root cell elongation and more nutrient uptake as suggested by Shanmugavelu (1970) [14]. It has been reported that GA_3 at lower concentration initiate the growth of the roots whereas higher concentration has little effect on root growth Wittwer and Bukovac (1958) [15].

Seedling length (cm)
The data revealed that seedling length (cm) shows significant difference among the various treatments. The seedling length (cm) in chickpea as influenced by various seed treatments are presented in Table 2. The seedling length ranged from 16.84cm to 33.07cm.The maximum seedling length (33.07cm) was observed in T_8 (GA_3 20 ppm) which was found to be significantly superior followed by T_7 (GA_3 10 ppm) *i.e*. 32.63cm whereas, minimum seedling height was recorded in control T_0 (16.84cm).
This improvement in seedling growth could be due to activation of dormant embryo of seeds with and also GA_3treatment helps to increase cell division, cell elongation and cell multiplication which might have reflected into maximum seedling growth. These results are in accordance with results obtained by and Gawade (2008) [6]; Gholap *et al.* (2000) [7].

Table 2: Mean performance of chickpea for shoot length, root length, seedling length, fresh weight and dry weight.

Treatment	Shoot length (cm)	Root length (cm)	Seedling length (cm)	Seedling fresh weight (gm)	Seedling dry weight (gm)
T0	8.61	8.15	16.84	4.03	0.80
T1	13.09	13.02	26.14	6.24	1.14
T2	14.58	14.21	27.73	6.19	1.16
T3	13.09	13.48	24.92	5.83	1.12
T4	15.29	14.29	29.44	6.92	1.30
T5	15.57	14.62	29.86	7.32	1.31
T6	14.65	14.02	28.58	6.69	1.20
T7	17.31	15.36	32.63	7.62	1.42
T8	17.87	15.89	33.07	7.71	1.54
T9	16.18	15.11	30.37	7.32	1.38
T10	11.22	11.58	24.31	5.11	1.03
T11	11.85	12.74	24.72	5.58	1.07
T12	10.94	9.12	19.89	4.60	0.80
G Mean	13.86	13.20	11.50	6.24	1.17
C.D.(5%)	1.086	2.543	2.739	1.137	0.146
SE(m)	0.378	0.886	0.954	0.396	0.051
SE(d)	0.535	1.253	1.349	0.560	0.072
C.V.	5.459	13.421	7.116	12.688	8.664

Fresh weight (g)
The data revealed that fresh weight (g) shows significant difference among the various treatments. The fresh weight (g) in chickpea as influenced by various seed treatments are presented in Table 2**.** The seedling fresh weight ranged from 4.03g to 7.71g. The maximum fresh weight (7.71g) was observed T8 (GA_3 20 ppm) which was found to be significantly superior followed by T_7 (GA_3 10 ppm) *i.e*. 7.62g whereas, minimum fresh weight was recorded in control T_0 (4.03g).
The higher fresh weight of seedling with GA_3 pre-soaking seed treatment can be correlated with higher overall growth in the corresponding treatment of GA_3. Hence, it can be stated that increase in overall growth of the seedling has lead to the overall assimilation and redistribution of food material with the seedling (Brian and Hemming, 1955) [3] and hence, resulted in higher fresh weight.

Dry weight (g)
The data revealed that dry weight (g) shows significant difference among the various treatments. Dry weight (g) in chickpea as influenced by various seed treatments are presented in Table 2**.** The seedling fresh weight ranged from 0.80g to 1.54g. The maximum dry weight (1.54g) was observed T8 (GA_3 20 ppm) which was found to be significantly superior T_7 (GA_3 10 ppm) *i.e*. 1.42g whereas minimum seedling dry weight was recorded in Control T_0 (0.80g).
The maximum dry weight of seedling with GA_3 pre-soaking seed treatment can be correlated with higher overall growth in the corresponding treatment of GA_3. Hence, it can be stated that increase in overall growth of the seedling has lead to the overall assimilation and redistribution of food material with the seedling (Brian and Hemming, 1955) [3] and hence, resulted in higher fresh weight. Thus, increased growth is a consequence of increased dry matter accumulation.

Vigour Index I
The data revealed that vigour index I shows significant difference among the various treatments. Vigour index I in chickpea as influenced by various seed treatments are presented in Table 1**.** The Vigour Index I ranged from 1236.58 to 3223.03.The maximum vigour index I (3223.03) was observed in T8 (GA_3 20 ppm) which was found to be significantly superior T_7 (GA_3 10 ppm) *i.e*. 3214.03 whereas, minimum vigour index I was recorded in control T_0 (1236.58).
The vigour index I of seedlings is directly dependent on germination percentage and seedling length. Higher seedling vigour index I in GA_3 treated seeds might be due to the cumulative effect of higher seedling length and germination percentage which were greatly influenced by GA_3 in chickpea seed at laboratory conditions. The results are in line with the findings of Anburani and Shakila (2010) [1].

Vigour Index II
The data revealed that vigour index II shows no significant difference among the various treatments. Vigour index in

chickpea as influenced by various seed treatments are presented in Table 1. The Vigour Index II ranged from 82.48 to 149.93**.** The maximum vigour index I (149.93) was observed in T8 (GA_3 20 ppm) which was found to be significantly superior T_7 (GA_3 10 ppm) *i.e.* 139.36 whereas, minimum vigour index I was recorded in control T_0 (82.48).
The vigour index II of seedlings is directly dependent on germination percentage and seedling dry weight. The maximum vigour index II with GA3 pre-soaking seed treatment might be due to cumulative effect of seedling dry weight and germination percentage which were greatly influenced by GA3 in chickpea seed at laboratory conditions. The results are in line with the findings of Babu *et al.* (2010) [2].

Conclusion
It was concluded from the present investigation that the seed treated with GA_3 20 ppm was found to be the most suitable growth regulator for germination and vigour of chickpea since it revealed superior performance in most of the parameter *viz*., germination per cent (97.50%), germination index (15.00), shoot length (17.87cm), root length (15.89cm), seedling length (33.07 cm), seedling fresh weight (7.71 g), seedling dry weight (1.54g), vigour index I (3223.03) and vigour index II (149.93). As the experiment is based on one trial, further research has to be done for conformity and recommendation.

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