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Influence of plant growth regulator (TA-41) on growth and yield of chickpea (*Cicer arietinum* L.)

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Abstract
A field experiment was conducted to find out the Influence of plant growth regulator (TA41) on growth and yield of Chickpea (var. RVG 202) with seven treatments in the *rabi* 2021. With the different levels of Soil drenching (5.0,7.5,10.0 TA-41lit/ha) and with the foliar application of TA-41 (200,300,400 ml/15lit/acre) respectively, at Crop Research Farm, Department of Agronomy, Faculty of Agriculture, SHUATS, Prayagraj, Uttar Pradesh. By all these findings maximum plant height was recorded significantly higher *viz*., 55.89 cm, maximum dry weight was recorded (46.23 g/day), maximum crop growth rate recorded (23.67 g/day/m2) and maximum relative growth rate recorded (0.02 g/g/day) with the application of treatment combination TA41 at 400ml in 15lit of water. Maximum yield attributes *viz*., seed yield (2356.67 kg/ha), stover yield (4561.67 kg/ha) and harvest index (39.72) and economics *viz*., Gross return 122471.005/ha, net return 80514.735/ha and B:C ratio 1.91 was recorded in treatment with the application of TA41 at 400ml in 15lit of water. Therefore, application of TA-41 at 400ml in 15lit of water was more productive and economically feasible.

Keywords: Plant growth regulators, TA-41

Introduction
Chickpea (*Cicer arietinum* L.) is one of the most important pulse crops. India has the largest area under pulses. The pulses are integral part of the cropping system of the farmers all over the country because this crops fit well in the crop rotation and crop mixture. Vegetarian people mostly depend on pulses, which are major constituents of Indian diets. Chickpea and kabuli chickpea are the main source of dietary protein for the majority of Indians and are grown as grain legume. The legumes are not only important source of human diet but also occupy an important place to keep the soil productive because these crops enrich the soil through symbiotic nitrogen fixation (Panwar *et al.*, 1980). Chickpea is mainly used for preparation of chola dish and other table purposes. It is also used as dal, besan, flour, crushed whole gram, boiled or roasted or cooked, salted or sweet preparation and green foliage as vegetables. Chickpea (Kabuli and Desi) has 17-20% protein and 60-64% carbohydrate (Sindhua *et al*. 1974), During 2016-16 India grows chickpea on about 81.71 lakh ha area producing 59.40 lakh tonnes, productivity 727kg/ha (DACNET, 2015). In M.P. chickpea was grown in 26.21 lakh ha area producing 22.97 lakh tonnes, productivity 877 kg/ha. Chickpea is the most important pulse crop with about 30% of the land area under pulses, which contributes 38% of the world pulse production (Tomar 2010). Chickpea is rich in protein content (17-30%). Two distinct types of chickpea, namely *Desi*, and *Kabuli*,
Plant Growth Regulators are the chemicals used to modify plant growth such as increasing branching, suppressing shoot growth, removing excess fruit or altering fruit maturity. They are expected to play an important role in rectifying the hurdles in manifestation of biological productivity even in pulse crops (Nickell, 1978). Naphthalene acetic acid when it is applied in significant concentrations, promotes adventitious root formation and promotes better rooting activities, thus increasing nutrient absorption. it also works to promote cell division and cell enlargement, thus enhancing plant growth. Gibberellic acid application increases the plant and first node height and increases cell elongation and division and inter nodel elongation Sarker (1980). salicylic acid promotes reduction in the harmful effects of a biotic and stress, which reflects in the increase in germination percentage, seedlings height.

Materials and Methods
The experiment was carried out during Rabi season of 2019-2020 at Crop Research Farm,

Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.) which is located at 250 24' 42" N latitude, 810 50' 56" E longitude and 98 m altitude above the mean sea level. This area is situated on the right side of the river Yamuna by the side of Prayagraj Rewa Road about 5 km away from Allahabad city. The soil samples were collected randomly from 0 to 15 cm depth from 5 spots of the experimental field just before layout of experiment. A representative homogenous composite sample was drawn by mixing all these soil samples together, which was analyzed to determine the physico-chemical properties of the soil. The experiment was conducted in Randomized Block Design consisting of 7 treatment combinations with 3 replications and was laid out with the different treatments allocated randomly in each replication. Fertilizers were applied as band placement, for which 4-5 cm deep furrows were made along the seed rows with a hand hoe. The nutrient sources were urea, single super phosphate (SSP), Murate of potash (MOP). The recommended dose of 20:40:20 kg N:P:K/ ha was applied according to the treatment details. After germination, the gaps were filled up by dibbling of seed at 10 DAS. Seedlings were thinned out in order to maintain spacing of 30 cm x 10 cm. Manual weeding was done with the help of Khurpi at 25 days after sowing to minimize the crop weed competition. The field was maintained in a moist condition and for this, two irrigations (Table 1) were provided, one as pre sowing and other at grand growth period. The crop was harvested separately from each plot taking 1.0 m^2 area on March 22th 2022, i.e., 100 DAS. Thereafter, the produce from net plot was tied in bundles separately and then tagged. The tagged bundles were allowed for sun drying in field and after drying on the threshing floor, the weight of bundles was recorded for obtaining biological yield. Threshing of chickpea was done manually by beating with stick and then seeds were separated by winnowing.

Results and Discussions

Influence of plant growth regulator (TA-41) on growth and yield of chickpea

Data presented in Table 1, tabulated with parameter plant height (cm) of Chickpea and there was increasing in crop age plant height was progressively increased with the advancement of the experimentation. The plant height was significantly higher in all different growth intervals with the levels of TA-41 at 400 ml in 15 lit of water. At harvest, the maximum plant height (55.89 cm) was recorded with the application of TA-41 at 400 ml in 15 lit of water which was significantly superior over all other treatments. except TA-41 at 300 ml in 15 lit of water (54.39 cm) which are statistically at par. The probable reason for increases plant height might due to the TA-41 at 400 ml in 15 lit of water in that application plays crucial role in photosynthesis, respiration, protein synthesis, enzyme activation, water uptake, osmoregulation, growth and yield of plant.

Table 1: Influence of plant growth regulator (TA-41) on plant height of Chickpea

Plant height(cm)						
Treatment Symbols	**Treatment combination**	**20 DAS**	**40 DAS**	**60 DAS**	**80 DAS**	**100 DAS**
T_1	Control (without any treatment)	8.68	15.13	25.97	40.55	51.85
T_2	TA-41 at 5.0 lit in 200 lit of water in 1hectare	9.71	16.11	26.51	42.07	52.41
T_3	TA-41 at 7.5 lit in 200 lit of water in 1hectare	9.16	16.01	26.01	41.66	52.84
T_4	TA-41 at 10.0 lit in 200 lit of water in 1hectare	9.33	16.17	26.00	41.49	52.81
T_5	TA-41 at 200 ml in 15 lit of water	9.26	16.06	26.04	41.49	53.46
T_6	TA-41 at 300 ml in 15 lit of water	9.32	16.36	27.05	43.19	54.39
T_7	TA-41 at 400 ml in 15 lit of water	10.02	17.17	27.43	44.78	55.89
	F-Test	NS	S	S	S	S
	C.D.at 0.5%	1.28	0.95	0.85	1.53	1.41
	S.Em(±)	0.41	0.31	0.28	0.50	0.46

Influence of plant growth regulator (TA-41) *on Dry weight of Chickpea*

Observations regarding the response of different levels of TA-41 at 5.0 lit in 200 lit of water in 1hectare, TA-41 at 7.5 lit in 200 lit of water in 1hectare, TA-41 at 10.0 lit in 200 lit of water in 1hectare and TA-41 at 200 ml in 15 lit of water, TA-41 at 300 ml in 15 lit of water, TA-41 at 400 ml in 15 lit of water treatments on dry weight (g)/plant of chickpea. It was noticed that successive stage there was an incremental trend. At 40, 60, 80, 100 DAS were significant influence in dry weight (g)/plant due to different treatments. While at 20 DAS the effect of different TA-41 at 5.0 lit in 200 lit of water in 1hectare, TA-41 at 7.5 lit in 200 lit of water in 1hectare, TA-41 at 10.0 lit in 200 lit of water in 1hectare and TA-41 at 200 ml in 15 lit of water, TA-41 at 300 ml in 15 lit of water, TA-41 at 400 ml in 15 lit of water of the treatments were non-significant. At Harvest, the highest dry weight/plant was observed with the T_7 TA-41 at 400 ml in 15 lit of water (46.23 g) which was significantly higher over rest of the treatments except T_6 TA-41 at 300 ml in 15 lit of water (44.60 g). Dry matter production increased steadily with advancing growth stages and reached the maximum at harvest.

Table 2: Influence of plant growth regulator (TA-41) on Dry weight/plant of Chickpea

Dry weight (g)/plant						
Treatment Symbols	**Treatment combination**	**20 DAS**	**40 DAS**	**60 DAS**	**80 DAS**	**100 DAS**
T_1	Control (without any treatment)	0.22	3.48	12.39	23.07	33.96
T_2	TA-41 at 5.0 lit in 200 lit of water in 1hectare	0.28	4.12	14.42	26.51	38.56
T_3	TA-41 at 7.5 lit in 200 lit of water in 1hectare	0.26	4.85	15.20	27.11	38.96
T_4	TA-41 at 10.0 lit in 200 lit of water in 1hectare	0.25	4.62	14.44	25.74	38.18
T_5	TA-41 at 200 ml in 15 lit of water	0.27	5.48	15.73	27.31	38.80
T_6	TA-41 at 300 ml in 15 lit of water	0.29	5.93	18.15	30.92	44.60

T_7	TA-41 at 400 ml in 15 lit of water	0.32	6.43	18.97	32.03	46.23
	F-Test	NS	S	S	S	S
	C.D.at0.5%	0.06	0.83	0.97	1.22	1.59
	S.Em(±)	0.02	0.27	0.32	0.40	0.52

Table 3: Influence of plant growth regulator (TA-41) on yield and yield attributes of Chickpea

		Yield attributes					
Treatment Symbols	**Treatment combination**	**Pods/plant**	**Seeds/pod**	**Test weight (g)**	**Seed yield (kg/ha)**	**Stover yield (kg/ha)**	**Harvest Index (%)**
T_1	Control (without any treatment)	22.17	1.33	21.67	1816	4011.33	34.92
T_2	TA-41 at 5.0 lit in 200 lit of water in 1hectare	32.67	1.67	23.00	1914	4122	36.53
T_3	TA-41 at 7.5 lit in 200 lit of water in 1hectare	32.00	1.83	22.67	1942	4165.67	36.46
T_4	TA-41 at 10.0 lit in 200 lit of water in 1hectare	34.67	1.50	23.00	2087	4215.33	37.48
T_5	TA-41 at 200 ml in 15 lit of water	31.50	1.67	23.00	2104	4327.67	36.71
T_6	TA-41 at 300 ml in 15 lit of water	41.00	2.00	24.67	2236	4448.67	39.09
T_7	TA-41 at 400 ml in 15 lit of water	43.33	2.67	25.67	2356.67	4561.67	39.72
	F-Test	S	S	S	S	S	S
	C.D.at 0.5%	8.49	0.63	1.20	84.20	241.41	1.51
	S.Em(±)	2.76	0.21	0.39	27.33	78.35	0.49

Influence of plant growth regulator (TA-41) on yield and yield attributes of Chickpea.

Observations regarding the response of different levels of TA-41 at 5.0 lit in 200 lit of water in 1hectare, TA-41 at 7.5 lit in 200 lit of water in 1hectare, TA-41 at 10.0 lit in 200 lit of water in 1hectare and TA-41 at 200 ml in 15 lit of water, TA-41 at 300 ml in 15 lit of water, TA-41 at 400 ml in 15 lit of water on yield and yield attributes of chickpea are given in Table 3. The observation showed that at yield and yield attributes there was significant difference between treatments. Significantly higher number of pods/plant was observed with the T_7 TA-41 at 400 ml in 15 lit of water (43.33) which was significantly higher over rest of the treatments except T_6 TA-41 at 300 ml in 15 lit of water (41.00) and which are statistically on par. The highest Number of seeds/pod was observed with the T_7 TA-41 at 400 ml in15 lit of water (2.67) which was significantly higher over rest of the treatments except T_6 TA-41 at 300 ml in 15 lit of water (2.00), which are statistically on par. The highest Seed yield was observed with the T_7 TA-41 at 400 ml in15 lit of water (2356.67 kg/ha) which was significantly higher over rest of the treatments except T_6 TA-41 at 300 ml in 15 lit of water (2236 kg/ha) which is statistically on par. The highest Stover yield was observed with the T_7 TA-41 at 400 ml in15 lit of water (4561.67 kg/ha) which was significantly higher over rest of the treatments except T_6 TA-41 at 300 ml in 15 lit of water (4448.67 kg/ha) which is statistically on par. The highest Harvest index was observed with the T_7 TA-41 at 400 ml in15 lit of water (39.72%) which was significantly higher over rest of the treatments except T_6 TA-41 at 300 ml in 15 lit of water (39.09%) which are statistically on par.

Conclusion

Study suggests that to achieve maximum plant height was recorded significantly higher *viz*., 55.89 cm, maximum dry weight was recorded (46.23 g/day), maximum crop growth rate recorded (23.67 g/day/m^2) and maximum relative growth rate recorded (0.02 g/g/day) with the application of treatment combination T_7 TA-41 at 400 ml in15 lit of water. Maximum yield attributes *viz*., seed yield (2356.67 kg/ha), stover yield (4561.67 kg/ha) and harvest index (39.72) and economics *viz*., Gross return 122471.005 /ha, net return 80514.735/ha and B:C ratio 1.91 was recorded in treatment with the application of T_7 TA-41 at 400 ml in15 lit of water.

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