Analysis of Response of Chick-pea Cultivars to Various Insecticides–A Pot Evaluation

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Abstract—*Chickpea is one of the earliest pulse crops cultivated by humans. The effect of different traditional plant growth regulators with a single concentration on growth indices in four cultivars of Cicer arietinum L. was examined. This experiment was conducted during the 'rabi' season of 2007-2008 to determine the most useful foliage-applied PGR for the optimum performance of crop and to select the most promising cultivar among them. The PGRs included indole-acetic acid (IAA), gibberellic acid (GA_3), kinetin (Kn), salicylic acid (SA) and triacontanol (Tria) and the cultivars, DCP 92-3, GNG-469, KWR-108 and H1. Each PGR at 10^{-7}M were applied once at pre-flowering stage. Growth characters like Shoot and root length per plant, leaf number and leaf area per plant (LA), leaf area index (LAI), shoot and root fresh weight and dry weight per plant, number, fresh and dry weight of nodule per plant of each variety were influenced by all PGRs but enhancing effect with GA_3 is most prominent. The effect of treatments and their interactions with cultivars on all growth parameters as also cultivar differences at both stages of sampling (100 and 110 DAS) were significant, except the interaction effect on leaf number per plant, shot dry weight per plant and nodule dry weight per plant at 100 DAS and shoot fresh and dry weight per plant as well as cultivar differences for nodule dry weight per plant at 110 DAS. Among foliar treatments of PGRs, GA_3 proved best for most of the growth parameters and regarding cultivars, DCP 92-3 performed best.*

Keywords*: Chickpea, plant growth regulators, IAA, GA, Kn, SA, Tria, yield*

Abbreviations: *PGRs - plant growth regulators; GA_3 - gibberellic acid; LA - leaf area; LAI - leaf area index; IAA - indole-acetic acid; Kn - kinetin; SA - salicylic acid; Tria - triacontanol*

1. INTRODUCTION

Chickpea belongs to family Fabaceae, tribe Cicereae and genus *Cicer*. Among pulses, for production, chickpea occupies the first position in India and third position at global level. Though chickpea is grown in our country in the largest area in comparison with the other countries of the world, but her productivity at 911 kg/ha is much lower than those of the developed countries of world (Mazid, 2014). The only alternative is to increase per hectare productivity (Mazid and Mohammad, 2012). To meet the challenges of the low chickpea production and local requirements, there is need for multipronged strategy. To attain such goal, the use of plant growth regulators (PGRs) may play an important role as they are known as important control agents for growth and development of plants. Growth regulators have been found to have pronounced effect on the performance of plants (Hasssanpourdham *et al.*, 2014; Khan *et al*., 2011; Khan et al. 2014; Mazid, 2014a; Mazid and Naqvi, 2014 a & b; Mazid and Roychowdhury, 2014). Therefore, for enhancing the branching, leaf number, flowering and pod setting, the use of PGRs need to be tested. With this background in view the present investigation was carried out.

2. MATERIALS AND METHODS

The pot experiment was conducted during the *rabi* (winter) seasons of 2007-2008 in a net house of the Department of Botany, Aligarh Muslim University, Aligarh, India. The experiment was planned to determine the most effective leaf-applied PGR for the optimum performance of chickpea cultivars and to select the most promising cultivar. The PGRs included IAA, GA, Kn, SA and Tria and the cultivars, DCP 92-3, GNG-469, KWR-108 and local (H1). A uniform recommended basal dose of 40 kg N + 30 kg P_2O_5/ha was applied to all pots with the half dose of N and full dose of P giving at the time of sowing and the remaining half dose of N after 40 DAS. Authentic seeds of the four high yielding cultivars of chickpea were obtained from the IIPR, Kanpur. Subsequently, seeds were inoculated with the recommended strain of *Rhizobium* and then were sown in earthen pots at the rate of 10 seeds per pot on the 19thOctober, 2007. Before sowing, the earthen pots of equal size were filled with the homogenous mixture and FYM in the ratio of 6:1 at the rate of 7 kg /pot. Just before sowing a composite soil sample, collecting randomly from each pot containing the homogenous mixture of soil and FYM was analyzed for the soil characteristics. Finally, four plants per pot were maintained. Prior to the foliar treatments, 100 milli-litre (ml) stock solutions of PGRs, each at 10^{-3}M were prepared. A water-sprayed control was also included in the scheme of treatments. The experiment was performed according to a factorial randomized design.

3. SAMPLING TECHNIQUES

One plant from each replicate was uprooted randomly at the various sampling stages to assess the performance of the crop on the basis of growth attributes. Growth characters were studied at 100 and 110 DAS. Length of shoot and root on per

plant basis w1as determined separately with the help of a metre scale. Total leaves of each plant were counted separately. LA of a plant was obtained by gravimetric method. LAI is the ratio of foliage area to ground area. The roots of the collected samples were washed carefully and all the nodules were separated manually for counting their number, weighing the fresh weight and later oven dried at 70˚C for 72 hours to record the dry weight of the nodules. All data were analyzed statistically adopting the analysis of variance technique, according to Gomez and Gomez (1984). In applying the F test, the error due to replicates was also determined.

4. RESULTS

F_{GA} registered 12.85% and 25.76% higher value of shoot length per plant at 100 and 110 DAS respectively than F_W. DCP 92-3 gave 43.45% and 40.87% higher values than H 1. At both sampling stages, F_{GA}× DCP 92-3 proved best. F_{GA}× DCP 92-3 gave 64.74% and 88.03% higher value at 100 and 110 DAS respectively than F_W × H 1. F_{GA} registered 44.83% and 46.97% higher value of root length per plant at both stages respectively than F_W. DCP 92-3 gave 53.22% and 24.92% higher than H 1. F_{GA} × DCP 92-3 gave 141.18 and 83.02% higher value than F_W× H 1 at both sampling stages. F_{GA} registered 129.99% and 98.37% higher value of leaf number per plant than F_W. DCP 92-3 produced 147.89% and 158.42% more leaves than H1. F_{GA}× DCP 92-3 gave 550% higher value than F_W × H 1 at this sampling stage.

However, the interaction effect was found non-significant at 90 DAS. F_{GA} registered 83.92% and 78.70% higher value of LA than F_W. DCP 92-3 gave 121.03% and 134.40% higher value at 90 and 100 DAS respectively than H 1. F_{GA}× DCP 92-3 registered 245.98% and 453.75% higher value than F_W × H 1. F_{GA} registered 79.42% and 109.6% higher value of LAI than F_W. DCP 92-3 gave 116.34% and 159.29% higher value than H1. F_{GA}× DCP 92-3 gave 267.83 % and 736.40% higher value at 90 and 100 DAS respectively than F_W × H 1. F_{GA} registered 50.11% and 49.23% higher value of shoot fresh weight per plant than F_W. DCP 92-3 produced 48.81% and 44.23% more fresh matter at 90 and 100 DAS respectively than H 1. F_{GA}× DCP 92-3 registered 146.47% higher value than the F_W × H 1. At 100 DAS, the interactions were, however, at par in their effect. F_{GA} registered 106.27% and 78.36% higher value of root fresh weight per plant at 90 and 100 DAS respectively than F_W. DCP 92-3 produced 62.83% and 106% more fresh matter at 90 and 100 DAS respectively than H1. F_{GA}× DCP 92-3 registered 340.28% and 186.75% higher plant root weight at 90 and 100 DAS respectively than F_W × H 1.

5. DISCUSSION

The PGRs significantly influenced the morphological characters such as plant height, leaf number, nodule number per plant and LAI. It is very interesting to note that there was a increase in shoot and root length per plant over control in all the applied PGRs treatment since they are plant growth regulators. Further, shoot and root lengths per plant were significantly higher with GA_3 followed by SA and Tria respectively. This clearly indicated that the mode of action of each PGRs is different quite. Similarly, in soybean, the application of Tria was more effective and increased the plant height and such increase was due to increased photosynthetic activity (Shukla *et al.* 1997; Mazid *et al.* 2010; Mazid *et al.*, 2014 b). An increase in the plant height due to the growth regulators could be attributed to an increase in the meristematic activity of apical tissues i.e., shoot and root apical meristems.

PGRs are involved in increasing photosynthetic activity, efficient translocation and utilization of photosynthates causing rapid cell elongation and cell division at growing region of the plant leading to stimulation of growth, besides increasing the uptake of nutrients (Mazid and Khan, 2014; Mazid *et al.*, 2013; Naqvi *et al.*, 2014). The numbers of leaves were maximum at 90 DAS and declined later due to shedding. In general, the application of PGRs increased the number of leaves. Among them, GA was found to be more effective followed by SA at both sampling stages. However, at later stages of crop growth, application of GA_3 (10^{-6}M) and miraculan (1000 ppm) was found to be more effective in retention of more number of leaves. Similarly, the application of chamatkar at 120 ppm also increased the number of leaves in black gram. In general, the response of chickpea cultivar, DCP 92-3 to GA was more as compared to other applied PGRs such as Tria, SA, Kn and IAA treatments. The present study clearly indicated the significant role of PGRs in improving expression of morphological traits in chickpea.

Similarly, application of GA_3 lead to increased shoot and root dry weight by 57.1% and 131.7% over control in chickpea at 90 DAS (Mazid 2014a). Mazid *et al.* (2014c) reported that the application of mepiquat chloride increased the leaf dry weight in chickpea. The present study also revealed that the cultivar DCP 92-3 possessed significantly higher dry matter at all the stages as compared to other three cultivars viz.KWR 108, GNG 469, and H1. It is further seen by the data that these parameters were more in GA_3, SA and Tria at all the sampling stages studied. Dry matter production, in general, is an indication of the efficiency of the cultivars; the pattern in which it is distributed in different plant parts would give a better understanding of the cultivar, DCP 92-3. Similar effects were found in mung bean and chickpea due to the application of CCC. The present study DCP 92-3 started bearing after 60 DAS and this cultivar had put forth maximum dry matter and hence translocation of assimilates towards reproductive parts was less. It is thus inferred that the PGRs had profound influence on the production of dry matter and its partitioning between the various organs of the plant.

The application of PGRs significantly increased the TDM and it was found that the increase was more with GA_3 followed by

the SA and Tria. The effect of PGRs was more pronounced than other such as mineral nutrients (Mazid *et al.,* 2014b) which indicated that they have the capacity to alter source-sink relationship to a greater extent than the other growth enhancing materials. The present results also indicated that the TDM was significantly higher in GA_3 treatments as compared to control and other PGRs. LA fairly gives a good idea of the photosynthetic capacity of the plant. In the present study, the LA and LAI increased up to 90 DAS and decreased thereafter due to senescence and ageing of leaves. However, PGRs, GA3 SA and Tria recorded significantly higher LA and LAI as compared to control at all growth stages. The higher LA and LAI could be attributed to higher dry matter accumulation in reproductive parts. Growth promoting substances, GA_3 had a positive effect on cell division and cell elongation leading to enhanced leaf expansion. This is in accordance with Yadav and Bharud (2006) who reported that with the foliar application of GA and other PGRs, there was an increase in the LA in green gram. Similarly, Khan *et al.* (2014) also reported an increase in LAI due to the application of Tria in soybean.

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Table 1: Effect of five foliage-applied PGRs (T) on shoot length per plant (cm) of four cultivars of chickpea (C) at two growth stages

Cultivar		Foliage		applied PGRs							Foliage applied PGRs					
				90 DAS							100 DAS					
	Fw	FIAA	FGA	FKn	FSA	FTria	Mean		FW	FIAA	FGA	FKn	FSA	FTria	Mean
DCP 92-3	48.05	48.05	53.95	48.93	51.13	50.62	50.22		46.70	51.00	67.50	58.65	60.20	61.75	57.63
KWR 108	38.25	39.85	48.05	41.23	44.03	43.13	47.52		42.90	43.80	49.45	44.15	48.70	46.00	45.83
GNG 469	36.95	37.90	40.20	37.35	38.28	38.98	38.98		38.03	40.50	45.68	40.60	42.03	41.68	41.42
H1	32.75	34.35	36.85	34.58	36.10	35.45	35.01		35.90	39.55	43.03	42.03	42.83	42.15	40.91

Mean	39.00	40.19	44.01	40.52	42.38	42.04			40.88	43.71	51.41	46.36	48.44		47.89	
C.D. at 5%		T = 0.6955		C = 0.8511		T× C= 1.7002				T = 2.0444		C = 2.5033			T × C = 5.0066	

Table 2: Effect of five foliage-applied PGRs (T) on root length per plant (cm) of four cultivars of chickpea (C) at two growth stages

Cultivar		Foliage applied PGRs							Foliage applied PGRs						
				90 DAS					100 DAS						
	Fw	FIAA	FGA	FKn	FSA	FTria	Mean		FW	FIAA	FGA	FKn	FSA	FTria	Mean
DCP92-3	13.95	15.20	18.45	15.43	15.75	15.55	15.72		16.200	17.500	21.78	18.93	21.48	19.90	19.30
KWR108	10.70	13.20	15.80	13.80	15.20	14.90	13.93		13.663	16.660	20.800	17.75	19.68	17.83	17.71
GNG469	8.73	10.75	13.60	11.98	12.60	11.80	11.58		15.000	15.118	20.700	17.30	19.35	18.70	17.70
H1	7.65	9.70	11.60	10.30	11.43	10.88	10.26		11.900	12.300	20.008	15.30	17.60	15.550	15.45
Mean	10.26	12.21	14.86	12.88	13.74	13.28			14.118	15.539	20.884	17.32	19.53	17.98	
C.D. at 5%		T = 0.4552		C = 0.5554		T × C = 1.1077					T = 0.2944		C = 0.3600		T × C = 0.7221	

Table 3: Effect of five foliage-applied PGRs (T) on leaf number per plant (cm) of four cultivars of chickpea (C) at two growth stages

Cultivar		Foliage applied PGRs					Foliage applied PGRs
			90 DAS				100 DAS

	Fw	FIAA	FGA	FKn	FSA	FTria	Mean		FW	FIAA	FGA	FKn	FSA	FTria	Mean
DCP92-3	50	57	98	63	80	71	69.83		67	74	117	75.75	102	81	86.13
KWR108	43	48	89	51	76	65	62		56.50	59	107	62	82	75	73.58
GNG469	32	41	80	49	64	59	54.17		45	52	87	56.50	76	72	54.75
H1	12	20	49	23	40	25	28.17		18	24	59	26	45	28	33.33
Mean	34.25	41.50	79	46.50	65	55									
C.D. at 5%		T = 2.797		C = 3.426		T× C = 6.852				T = 3.3833		C = 4.1444			T × C = 8.2888	

Table 5: Effect of five foliage-applied PGRs (T) on leaf area index (cm) of four cultivars of chickpea (C) at two growth stages

Cultivar		Foliage applied PGRs							Foliage applied PGRs						
				90 DAS					100 DAS						
	Fw	FIAA	FGA	FKn	FSA	FTria	Mean		FW	FIAA	FGA	FKn	FSA	FTria	Mean
DCP92-3	15.37	26.67	29.50	25.35	25.10	16.23	23.04		23.79	25.32	49.885	26.155	31.74	26.57	30.57
KWR108	14.91	25.15	29.20	22.40	21.91	17.61	21.86		18.600	19.633	31.335	20.111	25.71	25.27	23.44
GNG469	13.779	20.82	18.09	15.95	14.63	13.53	16.14		13.771	17.225	27.800	18.669	25.39	22.94	20.96

H1	8.02	11.85	16.64	9.34	9.42	8.66	10.65		5.96	8.40	21.15	9.00	15.84		10.40	11.79
Mean	13.02	21.12	23.36	18.26	17.77	14.01			15.52	17.65	32.53	18.49	24.67		21.29	
C.D. at 5%		T = 0.329		C = 0.403		T×C =0.806				T = 1.937		C = 2.372			T × C = 4.744	