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Influence of botanicals, coconut water and PGPR treatments on plant growth, nodulation, yield and seed quality parameters of chick pea (*Cicer arietinum* L.)

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Abstract
A set of priming treatments for studying of "Influence of botanicals, coconut water and PGPR treatments on plant growth, nodulation, yield and seed quality parameters of chick pea (*Cicer arietinum* L.)" was evaluated during *Rabi*, 2019-20 at, Naini Agriculture Institute, Naini. For this purpose, 13 priming treatments including control on chick pea were used. Field experiment was laid out in Randomized Block Design with three replications. Analysis of variance for the data revealed that significance mean sum of squares due to seed fortification treatments were observed for all studied characters. Maximum emergence %, plant height at 45 DAS and 60 DAS (cm), No. of primary branches/plant, No. of pods/plant, No. of seeds per pod, biological yield (g/plot) was recorded in T4 (Neem leaf Extract) (0.1). This treatment also gave significantly lower days to 50% flowering in comparison to other treatments. Maximum seed yield/plant (gm) was also recorded in T4 (Neem leaf Extract) (0.1) along with T10 (Rhizobium) (0.03). Maximum harvest index % was recorded in T6 (*Lantana camara* leaf Extract) (0.1).However, it was statistically at par to T4 (Neem leaf Extract) (0.1). Organic priming with T4 (Neem leaf Extract) (0.1) significantly affected almost all the characters. Thus, application of T4 (Neem leaf Extract) @ 10% is useful for getting higher yield in chickpea.

Keywords: Chickpea, Neem leaf extract

Introduction
Chickpea (*Cicer arietinum* L.), a member of Fabaceae family. It is a self-pollinated true diploid ($2n = 2x = 16$) with genome size of 738 Mbp (Varshney *et al.*, 2013) [13]. It belongs to subfamily Papilionaceae of the family Leguminaceae. Chickpea is the third most important grain legume in the world after dry beans (*Phaseolus vulgaris*) and garden peas (*Pisum sativa*), being widely grown in many sub-tropical and cold-temperate regions. Its cultivation is mainly confined to Asia with 90% of the global area and production (Ali and Kumar 2001) [1]. Chickpea plays an important role in human nutrition as a source of protein, energy, fiber, vitamins and minerals for large population sectors in the developing world and is considered a healthy food in many developed countries. Being legume, chickpea improves physical, chemical and biological properties of soils and thus plays an important role in sustaining soil productivity (Ibrikci *et al*., 2003) [6].
A. vera leaf extract (AvLE) is a very excellent source of plant nutrients, such as calcium, iron, magnesium, potassium, phosphorous and zinc (Dagne *et al.* 2000) [2]; enzymes, such as amylase, catalase, lipase, oxidase and superoxide dismutase, amino acids, such as alanine, glycine, leucine and proline (Reynolds and Dweck 1999) [10] vitamins. Such as B-complex, C, *β*-carotene and *α*-tocopherol (Vinson *et al.* 2005) [14] and other organic compounds, such as triglycerides, triterpenoid, gibberellin, potassium sorbate and salicylic acid (Hamman 2008) [4]. AvLE possesses various biological and physiological attributes: healing ability of skin burns and cutaneous injuries, prophylactic effect against radiation leucopenia, anti-ulcer, inhibitory action against some bacteria and fungi, inflammation-inhibiting effect, inhabitation of the prostaglandin synthesis by anthraquinone-type compounds and inhabitation of the AIDS virus by acemannan (Hernandez-Cruz *et al.* 2002, Ni and Tizard 2004, Talmadge *et al.* 2004) [5, 8, 12].
Plant growth promoting rhizobacteria in primed seeds are colonizing the root surface and competing with other microorganisms in the rhizosphere. Bio-priming is directly involved in the enhancement of plant growth by the secretion of compounds and mineral solubilization. Nitrogen is an important constituent of amino acid, chlorophyll and other structural components of plants. Nitrogen contributes dark green color to plants, promote leaves, stems

and other vegetative growth and improve fruit quality in plants. PGPR in the primed seeds converts atmospheric nitrogen into plant absorbable form by the process of biological nitrogen fixation (BNF) due to the presence of nitrogenase which is coded by '*nif*' genes.

Material and Methods

The experimental material for present investigation comprised of thirteen priming treatments including control on chickpea seed. The experiment was conducted in Randomized Block Design (RBD) with three replications under field conditions. The chick pea seeds were subjected to botanicals, coconut water and PGPR treatments. The chickpea seeds were soaked in distilled water and various solutions at 25 ºC for 10 hours.

Treatment details

S. No.	Treatments	Components	Intensity	Duration
1	T_0	Control	-	-
2	T_1	Coconut water	3%	10 hours
3	T_2	Coconut water	5%	10 hours
4	T_3	Neem leaf Extract	5%	10 hours
5	T_4	Neem leaf Extract	10%	10 hours
6	T_5	*Lantana camara* leaf Extract	5%	10 hours
7	T_6	*Lantana camara* leaf Extract	10%	10 hours
8	T_7	*Aloe vera* leaf Extract	5%	10 hours
9	T_8	*Aloe vera* leaf Extract	10%	10 hours
10	T_9	*Rhizobium*	1%	10 hours
11	T_{10}	*Rhizobium*	3%	10 hours
12	T_{11}	*Pseudomonas*	1%	10 hours
13	T_{12}	*Pseudomonas*	3%	10 hours

Preparation of solution

For the preparation of solution of the coconut water, to prepare 3% solution of coconut water, 30 ml coconut water was taken in a beaker and the coconut water was added in 1000 ml of distilled water with constant stirring. The volume of solution finally constitutes to one litter and then it became 3% stock solution of coconut water.

For the preparation of solution of the Bio-agent, to prepare 1% solution of Rhizobium, 10gm Rhizobium culture was taken in a beaker or tray. Lentil seeds were presoaked for 12 hours in water. Then all seeds were treated with rhizobium culture @10g/kg seeds using natural gum in beaker or tray. After that seeds were treated with bio agents as per the treatments given and shade dried over night by spreading on ground at room temperature.

For the preparation of solution of the Botanicals, to prepare 5% solution of neem leaf extract, 50 gram neem leaf extract (powder) was taken in a beaker and the chemical was added in 1000 ml of distilled water with constant stirring. The volume of solution finally constitute to one litter, and then it became 5% stock solution of neem leaf extract and so on. The flasks containing chemicals was covered with muslin cloth to avoid any contamination.

Soaking in the solution

After preparation of solution of botanicals, coconut water and PGR, chickpea seeds was soaked in required solution for 10 hrs at 25 ºC temperature. Untreated seed is called as control. After 10 hour of soaking, the solution was drained out from the beaker and presoaked was air dried to original weight and then placed for germination in laboratory under controlled condition.

Statistical analysis

The analysis of data was worked out to test the signification tests. It was done according to the procedure of RBD for each character as per methodology suggested by Fisher (1936) [3]. The total variance and degree of freedom were partition into three components viz. replication, treatment and error. The data were subjected to analysis of variance adopting standard statistical methods. The analysis of variance including source of variations, their degree of freedom (D.F.) and expectations of mean squares are given below:

The mean data of each character replicated three times was worked out statistically by the method of Analysis of Variance (Fisher 1936) [3] using RBD (Randomized block Design by Panse and Sukhatme, 1967) [9].

Result and Discussion

Analysis of variance for the data (table-1) revealed that significance mean sum of squares due to seed fortification treatments were observed for emergence percentage, plant height at 45 days (cm), plant height at 60 days (cm), days to 50% flowering, number of primary branches per plant, number of pods per plant, number of seeds per plant, seed yield per plant, biological yield per plant and harvest index which were highly significant at 1% level of significance except harvest index which was significant at 5% level of significance indicating presence of good amount of variability among the treatments for these characters. This indicated ample scope for seed fortification in chickpea. Replications were non-significant all the characters indicating good homogeneity among replications. This suggests that there is an ample scope to identify suitable seed fortification method to improve seed quality and yield attributing traits of chickpea.

Table 1: Mean sum of squares for different characters in chick pea (*Cicer arietinum* L.)

S. No.	Characters	Mean sum of squares		
		Replication (df=2)	Treatments (df=12)	Error (df=24)
1.	Emergence percentage	4.179	114.342**	6.374
2.	Plant height at 45 days (cm),	6.339	12.915**	3.209
3.	Plant height at 60 days (cm)	6.339	12.915**	3.209
4.	Days to 50% flowering	2.026	7.47**	0.887
5.	Number of primary branches per plant	0.103	2.974**	0.853
6.	Number of pods per plant	18.231	156.201**	7.592
7.	Number of seeds per plant	0.004	0.014**	0.004
8.	Seed yield per plant	0.117	1.48**	0.392
9.	Biological yield per plant	0.285	2.261**	0.286
10.	Harvest index	0.821	19.849*	9.059

*,**significant at 5 and 1% level, respectively

The mean values, the coefficient of variation (CV), standard error of mean (SEm), the critical difference (CD) at 5% and range (minimum and maximum) of 13 seed fortification treatments for 10 quantitative characters under field experiment are presented in table-2 which revealed a wide range of variation for all traits studied. It is necessary to describe here the mean performance of different fortification treatments with respect to different characters for drawing valid conclusion for future planning as well as selection of suitable fortification method to improve chickpea for economic importance.

Table 2: Mean performance of different treatments for different characters in chick pea chick pea (*Cicer arietinum* L.) under field experiment

		Emergence %	Plant height at 45DAS (cm)	Plant height at 60DAS (cm)	Days to 50% flowering	Number of primary branches per plant	Number of pods per plant	Number of seeds per plant	Seed yield per plant (g)	Biological yield per plant(g)	Harvest index (%)
1.	T0 (Control) (-)	62.33	17.33	32.33	72	4	59	1.22	6.23	17.18	36.3
2.	T1 (Coconut water) (0.03)	83.33	15.43	30.43	72	4	59.67	1.26	8.17	18.38	44.39
3.	T2 (Coconut water) (0.05)	82.67	13.23	28.23	71.67	4.33	63.67	1.29	8.2	18.26	44.89
4.	T3 (Neem leaf Extract) (0.05)	84.33	19.17	34.17	68	6.33	79	1.37	8.7	19.65	44.28
5.	T4 (Neem leaf Extract) (0.1)	86.33	19.37	34.37	67	7.33	81	1.5	9.1	20.62	44.18
6.	T5 (*Lantana camara* leaf Extract) (0.05)	83	16.4	31.4	71.33	4.33	65.67	1.29	8.43	18.35	45.96
7.	T6 (*Lantana camara* leaf Extract) (0.1)	83.67	16.5	31.5	70.33	4.67	69.67	1.29	8.57	18.46	46.4
8.	T7 (Aloe vera leaf Extract) (0.05)	80.33	16.73	31.73	70.67	4.67	71.33	1.31	8.17	18.53	44.05
9.	T8 (*Aloe vera* leaf Extract) (0.1)	83.33	16.1	31.1	70.67	5.67	73.33	1.31	8.23	18.83	43.73
10.	T9 (*Rhizobium*) (0.01)	84.67	12.1	27.1	69.33	5.67	74	1.31	8.57	19.04	44.95
11.	T10 (*Rhizobium*) (0.03)	85	16.5	31.5	69.67	6	74	1.32	9.1	19.65	46.32
12.	T11 (*Pseudomonas*) (0.01)	84.67	17.8	32.8	69	5.33	76.67	1.33	8.33	18.41	45.26
13.	T12 (*Pseudomonas*) (0.03)	85.67	18.1	33.1	68.67	5.33	78	1.36	8.37	19.59	42.71
	Minimum	62.33	12.1	27.1	67	4	59	1.22	6.23	17.18	36.3
	Maximum	86.33	19.37	34.37	72	7.33	81	1.5	9.1	20.62	46.4
	Mean	82.26	16.52	31.52	70.03	5.2	71.15	1.32	8.32	18.84	44.11
	S.Em+	1.46	1.03	1.03	0.54	0.53	1.59	0.04	0.36	0.31	1.74
	CD (P = 0.05)	4.26	3.01	3.01	1.58	1.55	4.64	0.12	1.05	0.9	5.08
	CV	3.07	10.84	5.68	1.34	17.74	3.87	5.02	7.52	2.84	6.82

Maximum emergence %, plant height at 45 DAS and 60 DAS (cm), No. of primary branches/plant, No. of pods/plant, No. of seeds per pod, biological yield (g/plot) was recorded in T4 (Neem leaf Extract) (0.1). This treatment also gave significantly lower days to 50% flowering in comparison to other treatments. Maximum seed yield/plant (gm) was also recorded in T4 (Neem leaf Extract) (0.1) along with T10 (Rhizobium) (0.03). Maximum harvest index % was recorded in T6 (*Lantana camara* leaf Extract) (0.1).However, it was statistically at par to T4 (Neem leaf Extract) (0.1).

Dating from traditional practices, various plant extracts have shown insecticidal properties and can be used effectively on field crops. The most well-known and commonly used is azadirachtin isolated from the seed, wood, bark, leaves and fruits of the neem tree (Azadirachta indica). Azadirachtin has both antifeedent and growth retarding properties and can lead to death at one or the other stage in the life cycle probably by interfering with the neuroendocrine control of metamarphosis in insects. The neem (*Azadirachta indica* A. Juss) is a tropical evergreen tree (Fam. Meliaceae; Subfam. Melioideae) traditionally well known for its medicinal value. Beneficial effects of different parts of neem are attributed to its biologically active principle 'Azadirachtin'. Apart from Indian subcontinent, neem is widely used in African countries as therapeutics, preservatives and insecticides. Neem leaves, natural source of flavonoids, polyphenols, isoprenoids, sulphurous and polysaccharides, play important role in scavenging the free radical and subsequently arresting disease pathogenesis. Thus continued healthy growth of the plant with the priming of neem leaf extract seems to the reason for better growth and development of the chick pea plant in comparison to the application of other botanical. Neem leaf extract solution 5% significantly increased the yield attributing traits of groundnut under field conditions compared to control plot. These results emphasize the need for the use of botanical and chemical for ensuring sustainable production, better growth and improved productivity of this important oil yielding plant. Prabha *et al*., (2015) studied priming with some plant leaf extract on seedling growth characteristics and root rot disease in tomato [wood apple (*Aegle marmelos*), Neem (*Azadirachta indica*), White Musale (*Chlorophytum borivilianum*)] and found that, seed priming with leaf extract of Wood apple exhibited maximum survival rate (76.50%) followed by Neem (68.46%) and White Musale (52.60%). Kumar (2004) [7] found that okra seeds treated with nimbecidine prevents the attack by pests.

Thus it is summarized that different seed fortification treatments had highly significant effect on various characteristics of chick pea under field experimentation. Among these treatments seed priming with Neem leaf Extract@10% significantly affected almost all the charterers studied in chick pea (fig. 1).

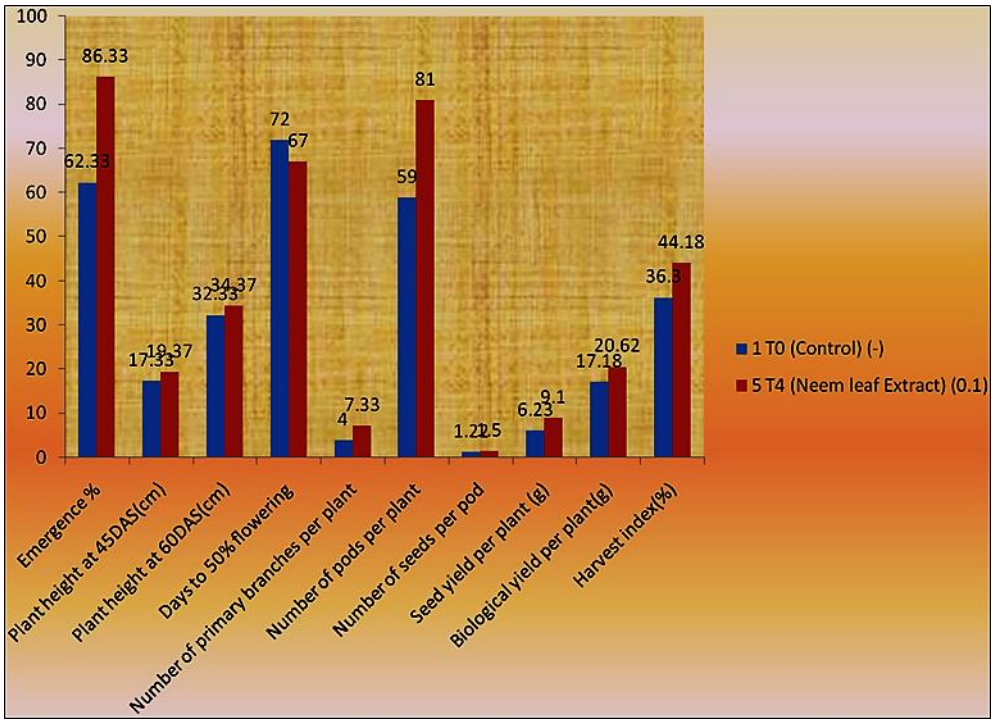

Fig 1: Bar diagram representing the performance of T0 and T4 for various characters

Conclusion

It is concluded from the present investigation of seed treatments with different kind of priming exhibited significant effect on seed yield and its contributing characters. Organic priming with T4 (Neem leaf Extract) (0.1) significantly affected emergence %, Number of primary branches per plant, No. of pods/plant, Number of seeds per pod, seed yield per plant (g)a and biological yield per plant(g). Thus, application of T4 (Neem leaf Extract) @ 10% useful for getting higher yield in chickpea.

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