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Pre-sowing Seed Treatment with Organic and Inorganic Treatments on Growth, Yield and Yield Attributes of Desi Chickpea (*Cicer arietinum* L.) Variety (Pusa-362)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The field experiment entitled "Pre-sowing seed treatment with organic and inorganic treatments on growth, yield and yield attributes of desi chickpea (*Cicer arietinum L.*)"variety (Pusa-362) was conducted during rabi at Field Experimentation Centre of the Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj, Uttar Pradesh, India during 2020 - 2021. The experiment consisted of 13 treatments which was laid in Randomized Block Design (RBD). Results revealed that seeds treated with T_9 (vermiwash 6% solution) recorded maximum values in growth parameters *viz.,* germination percentage at 4,7,14 DAS with 10.833%, 44.17, 74.17%, plant height at 30, 60, 90 DAS with 16.60, 41.00, 53.80 cm Days to flowering (74.67 days), number of branches 6.93 branches per plant, number of pods per plant with 36.10 pods per plant, number of seeds 52.30 seeds per plant and pod weight per plant with 24.49 gm. Similar results were observed in yield parameters where highest seed yield per plant was observed in T_9 (vermiwash 6% solution) with 30.35 gm and seed yield per plot 171.7 gm.

Keywords: Vermiwash; cow urine; panchagavya; curry leaf; neem leaf; growth and yield parameters.

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1. INTRODUCTION

Chickpea (*Cicer arietinum* L.) a member of Fabaceae, is a self-pollinated, chromosome number (2n=16). It has been first domesticated within the Middle East. Chickpea (*Cicer arietinum* (L.) is usually reffered to as bengalgram, gram, channa, kadle etc. and is that the third most vital pulse crop in the world after beans and peas. Anatolia in Turkey was the world where chickpea was believed to have originated [1]. Chickpea is popularly cultivated in sub-tropical and semi-arid to warm temperate regions under dry season. Chickpea is predominantly consumed in the form of whole grain dhal, sprouted grain, and green or matured dry seeds and is used in the preparation of variety of snacks, sweets and condiments. It has highly digestible protein (21.1%), carbohydrate (61.5%), and fat (4.5%), relatively free from anti nutritional factors and is rich in phosphorous, iron, niacin and calcium compared to other pulses. Its tender leaves are used as vegetable while, its acid exudates (mainly oxalic and malic acid) as a popular refreshing drink and medicinally for blood purification. Soaked grains and husk are fed to animals as concentrate and roughage respectively. Further, it also accounts for efficient soil enrichment by symbiotic nitrogen fixation, it's ability to meet more than 70 per cent of its nitrogen requirement from symbiotic nitrogen fixation, besides being drought tolerant [2].

India is the largest chickpea producer also as consumer within the world. It's grown on about 10.26 million ha, area with a production of 11.23 million tonnes which accounts for 63.01% of the world chickpea production. Source; (Directorate of Economics and Statistics, Ministry of Agriculture and Farmer Welfare, Government of India, 2018). The current per capita availability of pulses of 80 gm/capita/day as recommended by FAO is very low which could not meet the per capita requirement. Therefore, it is necessary that the agricultural scientists should keep the strategy for increasing the production of pulses to meet the protein requirement of increasing population of the country [3].

Grain legumes play an important nutritional role in the diet of millions of people in the developing countries and are thus sometimes referred to as the poor man's meat. These legume crops are normally grown in rotation with cereals because of their role in nitrogen fixation [4].

It is an honest source of carbohydrates and protein, and protein quality is taken into account to be better than other pulses. Chickpea has significant amounts of all the essential amino acids except sulphur-containing amino acids, which may be complemented by adding cereals to the daily diet. Starch is that the major storage carbohydrate followed by dietary fibre, oligosaccharides and straightforward sugars like glucose and sucrose. Although lipids are present in low amounts, chickpea is rich in nutritionally important unsaturated fatty acids like linoleic and oleic acids. β-Sitosterol, campesterol and stigmasterol are important sterols present in chickpea oil. Ca, Mg, P and, especially, K also are present in chickpea seeds. Chickpea is a good source of important vitamins such as riboflavin, niacin, thiamin, folate and the vitamin A precursor β-carotene. As with other pulses, chickpea seeds also contain anti-nutritional factors which may be reduced or eliminated by different cooking techniques. Chickpea has several potential health benefits, and, together with other pulses and cereals, it could have beneficial effects on a number of the important human diseases such as CVD, type 2 diabetes, digestive diseases and some cancers. Overall, chickpea is a crucial pulse crop with a various array of potential nutritional and health benefits. Nutrient Contents per 100g Protein - 19g.Carbohydrates- 61g.Sugar- 11g. Fibre - 17g, Fat - 6g. Cholestrol -0mg. Calories - 364. Water-60.21g.

Chickpea is the third most important food legume grown in 14 million ton production (2019). Highest chickpea producing states Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh. It are often be grown in coarse-textured sandy to fine-textured deep black soils (vertisols). However, the simplest suited soils are well drained, deep loams or silty clay loams with a pH starting from 6.0 to 8.0. The field should have loose tilth and good drainage. Recommended fertilizer @25:50:25(N:P:K).

Pulses play a crucial role in Indian agriculture for sustainable production, improvement in soil health and environment safety. India is the largest producer and also consumer of pulses in the world and found that it is a cheaper source of protein to overcome malnutrition among human beings. Pulses contain high percentage of quality protein nearly three times as much as cereals [5]. The factors attributed for low yields of pulses in India are non- availability of quality seeds of improved and short duration varieties, growing of

pulses under marginal and sub marginal soils with low inputs under rainfed conditions, moisture stress, poor pest and disease management, unscientific post-harvest practices and storage conditions. Indiscriminate and continuous use of chemical fertilizers also had adverse effect on soil physical, chemical and biological properties there by affecting the sustainability of crop production, besides causing environmental pollution. There is a scope to enhance the productivity of pulses by enhancing the soil fertility and its productivity through increasing soil organic carbon, soil moisture storage capacity and adopting integrated nutrient and pest management practices [6].

2. MATERIALS AND METHODS

The experimental material for present investigation comprised of 12 treatments including control on chickpea seed. The experiment was conducted in Randomized Block Design (RBD) with three replications.

2.1 Treatments Details

The genetically pure seeds of chickpea var Pusa-362 was used for the study. Pusa -362 seeds are very bold seeded and tolerant to wilt, seeds are dark brown and small and were subjected to pre sowing various seed treatments like

1)$Znso_4$ @ 0.2% (12hrs)
2)$Znso_4$ @0.3% (12hrs),
3)Cowurine @6%solution(12hrs),
4)Kno_3 @0.2% (12hrs),
5)Nacl @0.1%(12hrs),
6)Nacl @0.5%(12hrs)
7)Kno_3 @ 0.5% solution(12hrs),
8)Cowurine@2%solution(12hrs),
9)Vermiwash@6% (12hrs),
10)Curry leaf extract @2% (12hrs),
11)Neem leaf extract@6% (12hrs),
12)Panchagavya@3% (12hrs).

The observations for various field emergence percentage, days to 50% flowering, plant height (cm), number of pods per plant, number of seeds per plant, number of seeds per plant, pod weight per plant, seed yield per plant, seed yield per plot, biological yield and harvest index were recorded.

For the preparation of solution of the vermiwash, to prepare 6% solution of vermiwash, 50 ml vermiwash liquid were taken in a beaker and the chemical were added in 1000 ml. of distilled water with constant stirring. The volume of solution will finally constitute to one litter, and then it became 6% stock solution of Vermiwash and so on.

After preparation of solution of panchagavya, vermiwash and plant extract, chickpea seeds were soaked in required solution for 12 hrs at 25^0C temperature. Untreated seed is called as control. After 12 hours of soaking the solution were drained out from the beaker and presoaked were air dried to original weight and then placed for germination in laboratory under controlled condition. After seed treatments seed were sown in field for occurring field observation.

3. RESULTS AND DISCUSSION

3.1 Percent Field Emergence at 4,7,14 Days after Sowing

The field germination percent at 14 DAS was ranged between 47.50 to 44.17%. The treatment T_9 (6% vermiwash solution) was found superior among the rest of the treatments tested with 74.17% germination percentage, followed by T_8 (cow urine 2% solution), T_{12} (panchagavya 3% solution),T_{10} (curry leaf extract 2% solution), T_4 (kno_3 0.2% solution), T_{11} (neem leaf extract 6% solution) with 70.83, 68.33, 68.33 and 66.67% respectively whereas, the T_0 (control) with 47.50% recorded least germination percentage as compared to rest of the treatments [7,8,9, 10].

3.2 Plant Height of Chickpea at 30, 60 and 90 Days after Sowing (DAS)

The data on plant height at 90 DAS was recorded between 39.73 to 53.80 cm.The data revealed significant differences among the various treatments used. The treatment T_9 (6% vermiwash solution) recorded 53.80 cm and found superior among the rest of the treatments, followed by T_{12} (panchagavya 3% solution), T_8 (cow urine 2% solution), T_{10} (curry leaf extract 2% solution), T_4 (kno_3 0.2% solution), T_{11} (neem leaf extract 6% solution), T2 ($znso_4$ 0.3% solution), and T_3 (cow urine 6% solution) with 53.77, 52.77, 52.70, 52.10, 51.30, 50.77 and 49.77 cm respectively and were statistically at par with each other. The least plant height was recorded in T_0 (control) with 25.43 cm only [7,8,11,12].

3.3 Days of Flowering

The data ranged from 74.67 to 94.00 days. The treatment T9 (6% vermiwash solution) recorded least number of days to flowering i.e 74.67 days

followed by T11 (neem leaf extract 6% solution), T8 (cow urine 2% solution), T10 (curry leaf extract 2% solution) with 76.33, 76.67, 78.33 days and were found statistically at par with each other. The rest of treatments ranged 80 to 89 days and maximum number of days to flowering was recorded in T0 (control) with 94.00 days [13,14].

3.4 Number of Branches Per Plant

The data varied from 2.60 to 6.93 branches per plant. The highest number of branches were observed in treatment T_9 (vermiwash 6% solution) with 6.93 branches per plant, followed by T_8 (cow urine 2% solution), T12 (panchagavya 3% solution), T_{10} (curry leaf extract 2% solution), T_4 (kno_3 0.2% solution), T_{11} (neem leaf extract 6% solution) and T_4 (cow urine 6% solution) with 6.47, 6.20, 5.73, 5.53 and 5.47 branches respectively and were statistically at par with each other. Whereas least number of branches were observed in T_0 (control) with 2.60 branches per plant [7].

3.5 Number of Pods Per Plant

The data ranged from 18.10 to 36.10 pods per plant. The highest number of pods were observed in T_9 (vermiwash 6% solution) with 36.10 pods per plant, followed by T_8 (cow urine 2% solution), T_{12} (panchagavya 3% solution), T10 (c leaf extract 2% solution), T_4 (kno_3 0.2% solution), T_{11} (neem leaf extract 6% solution) and T_4 (kno_3 0.2% solution) with 33.40,32.20, 30.20 and 28.60 pods per pant respectively and were found at par with each other [11,15].

3.6 Number of Seeds Per Plant

The number of seeds were found in the range of 34.93 to 52.30 seeds per plant. The highest number of seeds were observed in T_9 (vermiwash 6% solution) with 55.00 pods per plant, and found superior among the rest of the treatments, followed by T_8 (cow urine 2% solution), T_{12} (panchagavya 3% solution), T_{10} (curry leaf extract 2% solution), T_4 (kno_3 0.2% solution) T_{11} (neem leaf extract 6% solution), and T_3 (cow urine 6% solution) with 49.47, 47.07, 46.80, 45.30 and 44.14 seeds per plant respectively and were found at par with each other.

3.7 Pod Weight Per Plant

The pod weight was ranged from 18.93 to 24.49 gm. The highest pod weight per plant observed in T_9 (vermiwash 6% solution) with 24.49 gm, followed by T_8 (cow urine 2% solution), T_{12} (panchagavya 3% solution), T_{10} (curry leaf extract 2% solution), T_4 (kno_3 0.2% solution) T_{11} (neem leaf extract 6% solution), with 23.77, 23.33, 23.00, 22.39 gm respectively and were found at par with each other.[8].

3.8 Seed Yield Per Plant

The seed yield per plant ranged from 16.43 to 30.35 gm per plant. The highest seed yield per plant was observed in T_9 (vermiwash 6% solution) with 30.35 gm, followed by T_8 (cow urine 2% solution), T_{12} (panchagavya 3% solution), T_{10} (curry leaf extract 2% solution), T_4 (kno_3 0.2% solution) T_{11} (neem leaf extract 6% solution), with 29.22, 28.52, 26.68, 25.54 and 24.77gm respectively and were found at par with each other.[16,17,18,19]

3.9 Seed Yield Per Plot

The seed yield per plot ranged from 124.47 to 171.67 gm per plot. The highest seed yield per plot was observed in T_9 (vermiwash 6% solution) with 171.7 gm, followed by T_8 (cow urine 2% solution), T_{12} (panchagavya 3% solution), T_{10} (curry leaf extract 2% solution), T_4 (kno_3 0.2% solution) T_{11} (neem leaf extract 6% solution), with 166.93, 160.57, 156.40 and 153.33 gm respectively and were found at par with each other.

3.10 Seed Yield Per Hectare

The seed yield per ha ranged from 1244.67 to 1716.67 kg per ha. The highest seed yield per plot was observed in T_9 (vermiwash 6% solution) with 1716.67 kg, followed by T_8 (cow urine 2% solution), T_{12} (panchagavya 3% solution), T_{10} (curry leaf extract 2% solution), T_4 (kno_3 0.2% solution) T_{11} (neem leaf extract 6% solution), with 1669.33, 1605.67, 1564.00 and 1533.33 kgs respectively and were found at par with each other.

3.11 Biological Yield Per Heactare

The biological yield per ha ranged from 3206.38 to 4066.84 kg per ha. The highest biological yield per ha was observed in T_8 (cow urine 2% solution) with 4066.84 kg, followed by T_{10} (curry leaf extract 2% solution), T_9 (vermiwash 6% solution) T_{12} (panchagavya 3% solution), T_{11} (neem leaf extract 6% solution), T_3 (kno_3 0.5% solution) with 4066.84, 4040.21,3936.42, 3916.64 and 3904.57 kg per ha respectively and were found at par with each other.

Table 1. Effect of different organic and inorganic seed treatment on yield and yield attributing characteristics of chickpea

Sr no.	Treatments	Percent Field Emergence			Plant Height			Number of Branches per plant	Days to Flowering	Number of Pods per plant	Number of seeds per plant	Pod weight per plant	Seed yield per plant	Seed yield per plot	Seed yield (Kg/ha)	Biological yield (Kg/ha)	Harvest index
		4 DAS	7 DAS	14 DAS	30 DAS	60 DAS	90 DAS										
T0	Control	2.50	22.50	47.50	8.70	25.43	39.73	2.60	94.00	18.10	34.93	18.93	16.43	124.47	1244.67	3206.38	0.39
T1	$Znso_4$ @ 0.2% solution	5.00	32.50	58.33	10.97	33.40	48.97	4.53	80.00	23.80	44.53	21.73	21.88	148.13	1481.33	3787.48	0.39
T2	$Znso_4$ @ 0.3% solution	3.33	30.00	63.75	14.93	37.97	50.77	4.00	83.50	18.70	40.60	18.93	18.40	133.20	1332.00	3613.46	0.37
T3	Cow urine @ 6% solution	5.00	35.00	61.67	12.60	34.20	49.47	4.60	84.50	25.10	43.87	22.39	22.82	152.87	1528.67	3904.57	0.39
T4	Kno_3 @ 0.2% solution	7.50	36.67	66.67	14.27	35.23	52.10	5.47	82.00	28.60	47.87	22.39	25.54	156.40	1564.00	3855.34	0.41
T5	Nacl @ 0.1% solution	3.33	27.50	54.17	9.20	27.00	43.30	3.13	89.00	19.40	39.40	19.68	18.25	130.53	1305.33	3515.31	0.37
T6	Nacl @ 0.2% solution	5.00	29.17	55.83	11.63	31.83	46.87	4.07	86.33	20.50	40.20	19.91	19.50	141.00	1410.00	3617.39	0.39
T7	Kno_3 @ 0.5% solution	5.00	31.67	56.67	15.63	32.87	48.07	4.00	84.33	21.80	41.82	20.37	20.48	145.33	1453.33	3712.57	0.39
T8	Cow urine @ 2% solution	7.50	40.83	70.83	15.33	39.57	52.77	6.47	76.67	33.40	50.67	23.77	29.22	166.93	1669.33	4066.84	0.41
T9	Vermiwash@ 6%	10.83	44.17	74.17	16.60	41.00	53.80	6.93	74.67	36.10	55.00	24.49	30.35	171.67	1716.67	3962.32	0.43
T10	Curry leaf extract @ 2% solution	5.83	38.33	68.33	14.77	35.63	52.70	5.73	78.33	30.20	46.70	23.00	26.68	160.57	1605.67	4040.21	0.40
T11	Neem leaf extract @ 6% solution	5.00	35.00	65.00	13.60	35.33	51.30	5.53	76.33	27.10	45.70	22.17	24.77	153.33	1533.33	3916.64	0.39
T12	Panchagavya @ 3%	7.50	40.00	68.33	15.07	36.00	53.17	6.20	82.33	32.20	47.20	23.23	28.52	162.53	1625.33	3936.42	0.41
SE(m) ±		0.41	2.03	4.12	0.85	1.89	3.3	0.27	4.14	1.57	2.05	1.08	1.33	7.63	76.3	156.30	
CD at 5%		1.19	5.92	12.1	2.48	5.53	9.62	0.78	12.20	4.57	5.98	3.14	3.98	22.7	222.71	456.20	
CV%		12.55	10.3	11.42	11.03	9.57	11.54	9.47	8.78	13.64	8.20	8.65	10.13	8.82	8.82	7.16	

3.12 Harvest Index

Harvest index ranged from 0.37 to 0.43%. The highest harvest index percentage was observed in T_9 (vermiwash 6% solution) with 0.43, followed by T_8 (cow urine 2% solution), T12 (panchagavya 3% solution), T_4 (kno_3 0.2% solution) ,T_{10} (curry leaf extract 2% solution), T_{11} (neem leaf extract 6% solution), with 0.41, 0.41,0.41, 0.40 and 0.39 respectively. The rest of treatments ranged from 0.37 to 0.39 respectively.

All the treatments recorded significant differences among all and observed all the treatments showed superior results than untreated control. The results revealed that among the all treatment used for priming, the seeds of chickpea primed at field germination which ranged from 47 to 74%, plant height ranged from 39 to 53.83 cm, number of branches ranged from 2.60 to 6.93 per plant and days to flowering ranged from 74.67 to 94 days, number of seeds and pods per plant ranged from 33 to 49 and 18.10 to 36.10 pods per plant. Whereas seed yield per ha ranged from 1244.47 to 1716.67 kg. Whereas biological yield ranged from 3206.38 to 3962.32 kg per ha with harvest index of 0.37 to 0.43 percent. The data revealed that the treatments *viz.,* T_9 (vermiwash 6% solution) was found superior among the rest of the treatments in regard to field germination, plant height, no. of branches, pods, seeds per plant, seed yield, harvest index . Followed by (cow urine 2% solution), T12 (panchagavya 3% solution), T10 (curry leaf extract 2% solution), T4 (kno_3 0.2% solution), T11 (neem leaf extract 6% solution). The above treatments were found superior and suitable for pre-sowing treatment.

According to Rathod et al., [20] who reported that seed soaking in vermiwash for 8 hours resulted in 50% flowering, maximum number of pods plant-1, pod weight plant-1, seed weight plant-1, 100 seed weight, seed yield and haulm yield with early emergence (33.33 plants m-2), higher plant height (36.8 cm), total dry matter production (24.8 g plant-1), required minimum duration for fist (32.2 days) and 50% flowering (45.2 days). This treatment also exhibited maximum number of pods plant-1 (37.3), pod weight plant-1 (83.93 g), seed weight plant- (10.48 g), 100 seed weight (19.87 g), seed yield (1341 kg ha-1), haulm yield (3353 kg ha-1) and harvest index (28.57).

Seed priming is a process in which seeds are imbibed in water or osmotic solutions followed by drying before radical emergence (McDonald, 2000). This process has been used to improve germination, reduce seedling germination time, improve stand establishment, increase emergence, and to induce earlier flowering and maturing, which result in higher grain yield (Basra et al., 2005a). Moreover, priming (osmo-conditioning) is one among the physiological methods, which improves seed performance and provides faster and synchronized germination. Priming affects the lag phase and causes early DNA replication, increased RNA and protein synthesis, greater ATP availability and accelerates embryo growth. However, osmopriming has been shown to activate the processes associated with germination, through affecting the oxidative metabolism like as increasing superoxide dismutase (SOD) and peroxidase (POD)or by the activation of ATPase also as acid phosphatase and RNA synthesis [21]. Seed priming could be done either by hydro priming or osmotic priming with different salts (CaCl2, KNO_3 and KH2PO4) and organics (Neem leaf extract, Vermivash, Panchagavya). The seed priming process affects activity of different activity of various enzymes, especially amylase and increase mobilization of starch granules in cotyledons thus, stimulating germination, growth and final yield [20]. Information on the effect of seed priming on growth and yield of chickpea under rainfed conditions is extremely. Considering the above factors, research work on chickpea was carried out to evaluate the organic and inorganic pre-sowing treatments on growth, yield and yield attributing traits of Chickpea.

4. CONCLUSION

It is concluded from the present investigation of seed treatments with different kind of priming were found affecting significantly different characters of growth and yield under study in chickpea.The treatment T_9 (vermiwash 6% solution) found superior in all the growth and yield parameters followed by T_8 (cow urine 2% solution), T_{12} (panchagavya 3% solution), T_{10} (curry leaf extract 2% solution), T_4 (kno_3 0.2% solution), T_3 (cow urine 6% solution), T_{11} (neem leaf extract 6% solution). it can be concluded that seed quality could be improved through pre-soaking treatments with cheap, non-toxic and eco-friendly organic sources. These results have great practical significance, since it indicates the likelihood of upgrading the standard of seed with help of straightforward seed treatment like vermiwash, cow urine, panchagavya. Looking at the cost of organic substances, these organics

are cheaper and easy to be practiced by everyone at rural area.[22] Thus ,Seed priming with vermiwash is useful for improving yield in chickpea. Further investigations under field conditions might be needed to clarify the role of organic and in-organic in chickpea and other crops for commercial cultivation by farmers.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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