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Effect of Liquid Formulations of Organic Fertilizers on Growth and Productivity of Chickpea (*Cicer Arietinum* L.)

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Abstract

A field experiment was conducted at research farm of Vivekananda Global University, Jaipur during Rabi season, 2023-24 to study the effect of liquid formulations of organic fertilizers on growth and productivity of chickpea (*Cicer arietinum* L.). The experiment was laid out according to randomized block design with three replications. The treatments consisting T1- Control, T2-Foliar spray of cow urine @ 7.5 %, T3-Foliar spray of vermiwash @ 7.5 %, T4-Foliar spray of panchagavya @ 2.5 %, T5-Foliar spray of waste decomposer @ 20 %, T Foliar spray of cow urine @ 7.5 % + vermiwash @ 7.5 %, T7- Foliar spray of cow urine @ 7.5 % + waste decomposer @ 20 %, and T8-Foliar spray of vermiwash @ 7.5 % + waste decomposer @ 20 % were applied to the chickpea. Results showed that the highest plant height, dry matter accumulation, number of branches per plant, number of pods per plant, number of seeds per pod, test weight, seed yield and haulm yield of chickpea was significantly increased with the application of foliar spray of cow urine @ 7.5 % + vermiwash @ 7.5 % (T6) which was remained at par with foliar spray of vermiwash @ 7.5 % + waste decomposer @ 20 % (T8) over control. The increased significantly net returns (86185 /ha) and B: C ratio (2.38) of chickpea was obtained by foliar spray of cow urine @ 7.5 % + vermiwash @ 7.5 % (T6) which were higher than control.

Keywords: Growth, nutrient, organic fertilizer and yield

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Introduction

Pulses are the second important constituent of Indian diets after cereals [1]. After common beans (*Phaseolus vulgaris* L.), chickpeas are the second-most significant pulse crop in the world [2]. Chickpea seeds are rich in protein (24.63 %), carbohydrates (64.60 %), ash (3.30 %) and fiber (1.85 %). It is also a good source of K, Ca, Na, Mg, Cu, Fe and Zn with anti-nutritional factors present in raw chickpea seed on the basis of dry matter are phytic acid, tannins, trypsin and total phenols (269.38 mg/g) [3]. Cereal and chickpea proteins are nutritionally complementary, the amino acids which are deficient in one being generally adequate in other [4]. It is used in many forms as 'dal', 'chhole' and 'besan' (gram flour). Gram flour is used for the preparation of sweets, snacks and many attractive dishes. Its leaves contain mallic and citric acid, which are very useful for stomach ailments and blood purification. Its straw is highly rich in nutrients and mostly used as productive ration for animals. The yield, yield components and protein content of chickpea were compared between traditional and organic production systems shows organic farming has many advantages on environment, animal and human health over traditional production systems.

The oldest and most abundant resource available to humans is livestock, with small-scale. A better choice for farming and small holdings is to include cattle in the farming system massive amounts of cow manure, urine, and waste bedding material at the farm level are accessible. Moving to organic farming, or using bio products derived from cattle, has been shown to be beneficial in preventing the growing risks to human, soil, and environmental health caused by economical farming practices. This is because organic farming preserves the integrity of the environment and the health of the land, as well as the consumers. Organic soil conditioners rich in N, P, and K, calcium, magnesium, chloride, sulphates, growth hormones, and a sufficient load of microbial mobilizers and solubilizers are cattle-based products such as cow urine and panchagavya. When cattle-based products are added to soil, microbial populations and activities are increased. This further accelerates the cycling of nutrients, enhances the creation of elements that support plant development, and boosts plant resistance to microbiological assaults. These liquids may also be administered via spraying and fertigation, which are increasingly popular methods for most crops [5]. In

addition, the market for organic food is now expanding at the quickest rate in the globe, including in India, thanks to its numerous advantages. Fertilizer can help grow a variety of high-yielding chickpea cultivars. Since the ammonium nitrogen losses from dairy operations start as soon as the animal excretes faces and urine and continue through manual handling, storage, and application, it was previously believed that the best way to achieve the best yield and quality was to use an organic source such as foliar spraying cow urine, vermiwash, panchagavya, waste decomposer and their combinations. The review of literature clearly indicate that yield of crop can be boosted by applying foliar spray of cow urine, vermiwash, panchagavya, waste decomposer and their combinations.

Material and Methods

A field experiment was conducted during rabi 2023-24 at Research farm, Vivekananda Global University, Jaipur, the study area is located at 74^0 89' East longitudes, at 29^0 22' North latitude on vertisol having pH 8.10 and EC 0.25 dS m-1. The soil organic carbon content was low to medium (0.27 %) and available P_2O_5 (16.3 kg ha-1), and available N is low (137.8 kg ha-1) with high available K_2O content (250.12 kg ha-1). There are 8 treatments combinations were laid out in Randomized Block Design with 3 replications and Treatments details of experiment are presented in **Table 1**.

Table 1 Details of the treatments

Treatments	Symbols
Control	T_1
Foliar spray of cow urine @ 7.5 %	T_2
Foliar spray of vermiwash @ 7.5 %	T_3
Foliar spray of panchagavya @ 2.5 %	T_4
Foliar spray of waste decomposer @ 20 %	T_5
Foliar spray of cow urine @ 7.5 % + vermiwash @ 7.5 %	T_6
Foliar spray of cow urine @ 7.5 % + waste decomposer @ 20 %	T_7
Foliar spray of vermiwash @ 7.5 % + waste decomposer @ 20 %	T_8
Note - Spraying at branching, flowering and pod initiation stage.	

Treatments application- Liquid organic formulations preparation: Bioinoculants like cow urine, vermiwash, panchagavya, waste decomposer, jeevamruth and their combinations were used to spray in the present investigation. *Cow urine*: Desi cow urine was diluted at 1:10 (cow urine: water). *Vermiwash*: Saturated wash from vermicompost is collected and sprayed by diluting at 1:10 (vermiwash: water), *Panchagavya*: prepared by mixing 7 kg of desi cowdung, 1 kg of cow ghee stirred for three days then added with 10 litres of cow urine and 10 litres of water, stirred for 15 days. The mixture is then added with 3 litres of cow milk, 2 litres of curd, 3 litres of tender coconut water, 3 kg of jaggery and 12 well ripened poovan banana then stir daily up to 30 days thereafter used for spraying at 3 stages of crop. i.e. branching, flowering and pod initiation stage of chickpea by diluting at 1:30 (Panchagavya: water) concentration, *Waste decomposer*: Waste decomposer was prepared by mixing 2 kg of jaggery in 200 litres of water then added with 1 bottle of waste decomposer mixed uniformly and sprayed by diluting at 1:4 (waste decomposer: water) to 3 stages of crop. i.e. branching, flowering and pod initiation stage of chickpea. The growth, yield attributes and yield observations were recorded from the net plots and seed yield was converted to hectare basis in quintal. The economics of each treatment was computed with prevailing market prices of the corresponding year. Standard method of "Analysis of variance" was used for analyzing the data [6].

Result and Discussion

Growth attributes

The experimental data showed that different liquid formulations of organic fertilizers bring significant effect on growth of chickpea. Foliar spray of cow urine @ 7.5 % + vermiwash @ 7.5 % (T_6) produced significantly highest plant population which showed in **Table 2** (at 30 DAS and harvest); plant height (cm) was (43.25 at 60 DAS, 46.95 DAS and 45.85 at harvest); dry matter accumulation (g/plant) of chickpea was (13.08 at 60 DAS, 18.89 DAS and 24.03 at harvest) and branches per plant was (13.14 at 60 DAS, 20.41 DAS and 21.65 at harvest). It was observed that the growth attributing characters of chickpea improved probably due to better supply of nutrients through foliar application of cow urine and vermiwash at higher rates. The increased plant height of chickpea is caused by cow urine, which contains uric acid and ammoniacal nitrogen that plants can readily absorb, also vermiwash, which contains readily available macro and micronutrient sources as well as hormonal action that leads to enhanced growth. Besides this the different enzymes and hormones present in cow urine are also responsible for the better growth of

plant [7]. The growth enzymes found in cow urine and vermiwash, which encouraged quick cell division and multiplication, may be the cause of the rise in the number of branches plant-1. Similar outcome was reported by [8]. In the present study it is also possible that increased branching at higher levels of cow urine have helped the plants in producing higher dry matter production. The findings of present investigation are closely followed by the findings of [8-10].

Table 2 Effect of liquid formulations of organic fertilizers on plant population, plant height and dry matter accumulation of chickpea

Treatments	Plant population ha^{-1}		Plant height (cm)			Dry matter accumulation (g/plant)		
	30 DAS	60 DAS	60 DAS	90 DAS	At harvest	60 DAS	90 DAS	At harvest
T_1-Control	305623	304592	35.12	37.37	38.72	9.81	13.44	17.76
T_2-Foliar spray of cow urine @ 7.5 %	305862	304755	38.25	41.5	40.85	10.88	14.93	18.74
T_3-Foliar spray of vermiwash @ 7.5 %	305984	304786	39.50	42.75	43.1	11.03	15.38	19.77
T_4-Foliar spray of panchagavya @ 2.5 %	306023	304894	37.85	41.15	41.45	10.57	14.80	19.01
T_5-Foliar spray of waste decomposer @ 20 %	306028	304896	37.64	40.69	41.24	10.51	14.64	18.92
T_6-Foliar spray of cow urine @ 7.5 % + vermiwash @ 7.5 %	306256	305525	43.25	46.95	45.85	13.08	18.89	24.03
T_7-Foliar spray of cow urine @ 7.5 % + waste decomposer @ 20 %	306232	305253	41.25	44.5	44.85	11.52	16.51	21.57
T_8-Foliar spray of vermiwash @ 7.5 % + waste decomposer @ 20 %	306208	305502	41.95	45.2	45.55	11.72	17.26	21.89
S.Em. +	764.2	863.45	1.61	1.91	1.98	0.86	1.52	1.92
C.D. at 5 %	NS	NS	3.45	4.10	4.25	1.85	3.25	4.12
General mean	306027	305025.375	39.35	42.51	42.70	11.14	15.73	20.21

Yield and yield attributes

The data showed that the yield attributes and yield of chickpea were significantly influenced with the foliar application of liquid formulations of organic fertilizers gave highest number of pods per plant, number of seeds per pod, test weight, seed yield and haulm yield and biological yield of chickpea in the treatment of cow urine @ 7.5 % + vermiwash @ 7.5 % (T_6), however it being at par with treatment of T_8-Foliar spray of vermiwash @ 7.5 % + waste decomposer @ 20 %, and T_7-foliar spray of cow urine @ 7.5 % + waste decomposer @ 20 % for almost all the characters (**Table 3** and **Figure 1**). Significant improvement was noted in with foliar spray of cow urine @ 7.5 % + vermiwash @ 7.5 % (T6) and recorded significantly maximum number of pods/plant (60.09), seeds/pod (1.45) and test weight (18.65 g) of chickpea as compared to control. The highest seed yield (26.10 q/ha) and biological yield (62.33 q/ha) and haulm yield (36.23 q/ha) of chickpea was recorded by foliar spray of cow urine @ 7.5 % + vermiwash @ 7.5 % (T6) which was closely followed by T8-Foliar spray of vermiwash @ 7.5 % + waste decomposer @ 20 % and proved significantly higher over control. Vermiwash contains growth hormones like auxine, cytokinins etc and cow urine also contains mixture of hormones, enzymes, minerals etc, which resulted into more number of pods per plant in chickpea crop. The results are in close association with [11]. The seed yield of chickpea crop was increased due to cumulative effect of yield attributing characters, enhanced photosynthetic efficiency and improvement in the capacity of the reproductive sinks to utilize the incoming assimilates due to the foliar application of cow urine and vermiwash. These findings are well corroborated with [12]. As nitrogen is one of the major component of cow urine, its application has been found to enhance the process of tissue differentiation, cell multiplication, cell enlargement i.e. from somatic to reproductive phase, meristematic activity and development of floral primordial leading thereby to increased flowering. In another study, grain and straw yield of wheat were improved due to foliar spray of cow urine and maximum values of these parameters recorded under foliar spray of

100% cow urine at 3 weeks intervals [13]. Further, the observation recorded in present study also confirms with the findings of [14, 15].

Table 3 Effect of liquid formulations of organic fertilizers on branches per plant, yield attributing traits and yields of chickpea

Treatments	Branches per plant			Yield attributing traits			Yields			
	60 DAS	90 DAS	At harvest	Pods per plant	Seed per pod	Test weight (g)	Biological yield (q/ha)	Seed yield (q/ha)	Haulm yield q/ha)	Harvest index (%)
T_1-Control	9.67	14.96	15.2	40.72	1.25	15.2	41.96	17.65	24.31	42.06
T_2-Foliar spray of cow urine @ 7.5 %	10.74	16.45	16.69	48.77	1.31	17.17	49.01	20.62	28.39	42.07
T_3-Foliar spray of vermiwash @ 7.5 %	10.89	16.9	17.14	51.52	1.36	17.24	52.76	20.89	31.87	39.59
T_4-Foliar spray of panchagavya @ 2.5 %	10.43	16.32	16.56	46.2	1.35	16.95	47.44	20.46	26.98	43.13
T_5-Foliar spray of waste decomposer @ 20 %	10.37	16.16	16.4	45.82	1.31	16.75	46.06	20.24	25.82	43.94
T_6-Foliar spray of cow urine @ 7.5 % + vermiwash @ 7.5 %	13.14	20.41	21.65	60.09	1.45	18.65	62.33	26.1	36.23	41.87
T_7-Foliar spray of cow urine @ 7.5 % + waste decomposer @ 20 %	10.98	18.03	18.57	52.17	1.41	18.17	53.41	22.62	30.79	42.35
T_8-Foliar spray of vermiwash @ 7.5 % + waste decomposer @ 20 %	11.58	18.78	19.02	53.27	1.40	18.22	54.51	23.67	30.84	43.42
S.Em. +	0.94	1.14	1.45	2.87	0.13	0.58	4.46	2.63	2.75	3.25
C.D. at 5 %	2.01	2.45	3.10	6.15	NS	1.25	9.56	5.64	5.89	NS
General mean	10.98	17.25	17.62	49.82	1.36	17.29	50.94	21.53	29.40	42.30

Economics

Now-a-days in agriculture, the feasibility of any treatment can be decided only on the basis of benefit: cost ratio. The gross returns from chickpea crop varied markedly under the influence of various treatments that ultimately influenced the overall net returns and benefit: cost ratio. The foliar spray of cow urine @ 7.5 % + vermiwash @ 7.5 % (T_6) fetched highest gross, net returns and B: C ratio of chickpea (**Table 4**). The cost involved under these treatments was comparatively lower than additional income, which led to more returns under these treatments as compared to other treatments. Similar finding have also been reported by [12, 13].

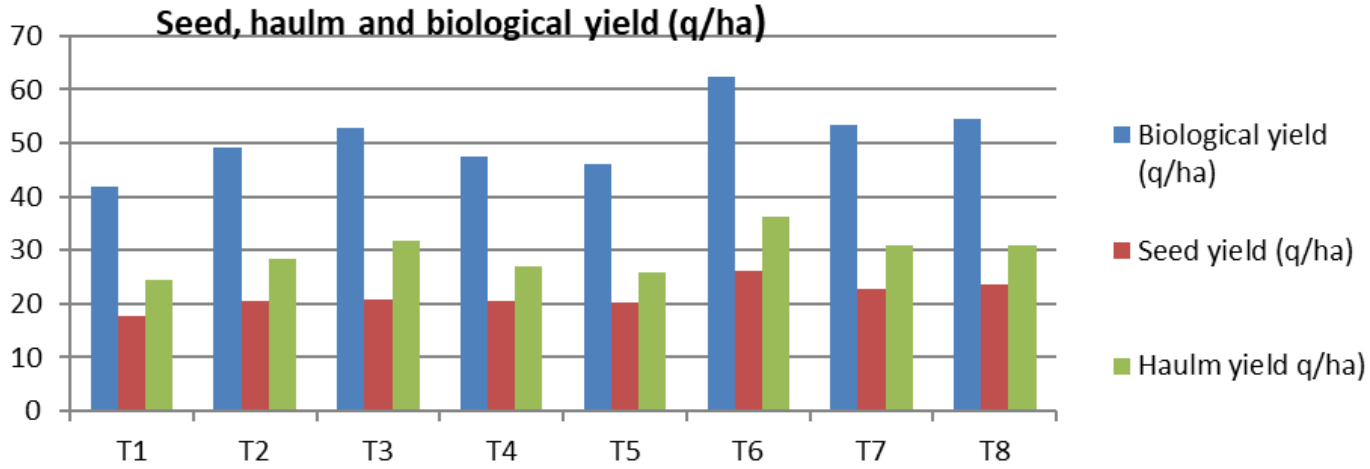

Figure 1 Effect of different treatments on yields

Table 4 Effect of liquid formulations of organic fertilizers on economics of chickpea

Treatments	**Economics**			
	Cost of cultivation (Rs./ha^{-1})	**Gross monetary returns (`Rs./ha^{-1})**	**Net monetary returns (`Rs./ha^{-1})**	**B:C Ratio**
T_1-Control	60450	100405	39955	1.66
T_2-Foliar spray of cow urine @ 7.5 %	61320	117295	55975	1.91
T_3-Foliar spray of vermiwash @ 7.5 %	61560	120385	58825	1.96
T_4-Foliar spray of panchagavya @ 2.5 %	61725	115790	54065	1.88
T_5-Foliar spray of waste decomposer @ 20 %	61720	114110	52390	1.85
T_6-Foliar spray of cow urine @ 7.5 % + vermiwash @ 7.5 %	62430	148615	86185	2.38
T_7-Foliar spray of cow urine @ 7.5 % + waste decomposer @ 20 %	62590	128495	65905	2.05
T_8-Foliar spray of vermiwash @ 7.5 % + waste decomposer @ 20 %	62830	133770	70940	2.13
S.Em. +	756	--	--	--
C.D. at 5 %	NS	21225	10320	0.20
General mean	61828.12	122358.12	60530	1.98

Conclusion

On the basis of results of present study, it was concluded that foliar spray of cow urine @ 7.5 % + vermiwash @ 7.5 % (T_6) increased significantly all growth characters, seed yield (26.10 q/ha), haulm yield (36.23 q/ha) along with higher net returns (86185 Rs. /ha) and B: C ratio (2.38) of chickpea which was significantly superior over control.

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