



Evaluation of Natural Farming Practices on the Performance of Chickpea and Fenugreek

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ABSTRACT

Background: Organic farming is an innovative farming approach. It is a low input based, climate resilient and low-cost farming system as all the inputs (manures, fungicides, insect repellents *etc.*) are made up of natural herbs and locally available inputs, thereby reducing the use of chemical fertilizers and industrial pesticides.

Methods: To know the effect of cow-based bio-enhancers on cultivation of chickpea and fenugreek an experiment was carried out during the *rabi* seasons for three consecutive years at organic farm of CNRM, SDAU, Sardarkrushinagar (Gujarat), India. The experiment was laid out in randomized block design with ten different treatments.

Result: The application of vermicompost 1.5 t/ha gave significantly higher grain and stover yields in both chickpea and fenugreek. It is evident from the data that the highest net realization of 58685 ₹/ha with the benefit: cost ratio (BCR) of 1.72 for chickpea whereas, 70939 ₹/ha and 3.06 BCR for fenugreek was obtained under treatment T₁ (*Panchgavya* 3% as foliar spray at 30, 45, 60 DAS). However, treatment T₈ (Vermi compost 1.5 t/ha) recorded the highest gross realization.

Key words: Chickpea, Fenugreek, Natural farming, *Panchgavya*, Vermicompost.

INTRODUCTION

Over the last six decades, the green revolution has significantly increased agricultural production through the use of high-response varieties and hybrids, better irrigation facilities, use of fertilizers and agrochemicals and thus helped to produce enough food for the growing population of the world (Eliazer Nelson *et al.*, 2019). Growing crops across a range of environmental conditions due to effect of climate change have significantly reduce their potential output leading to low production (Sharma *et al.*, 2022). At the same time agricultural intensification due to Green Revolution left its harmful footprints on Indian agriculture. The monocropping system, increased and frequent use of fertilizers and pesticides caused considerable damage to the soil's biological operation, crop diversity, increased cost of cultivation, deterioration of groundwater, loss of flora-fauna, increased human diseases, malnutrition and decreased soil fertility, which have almost left it barren in large areas. As a consequence, farmers with small farms invest in these costly inputs, which are exposed to high monetary risks and push them in the debt cycle. The principles of natural farming are focused on environmental biodiversity and soil health and follow the laws of nature in agricultural production. Several natural farming management strategies have been developed including crop rotation, intercropping, reduced tillage, mulching with plant residue, avoiding the use of agrochemicals and application of biofertilizers. These practices are similar to the organic farming practices conducted in other countries that have been proposed as a more sustainable method of agricultural production than conventional farming (Hartmann *et al.*, 2015). Several studies have confirmed that natural farming can improve

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soil properties, biodiversity and enzyme activity within different agroecosystems.

With pesticide's obvious environmental and ecological effects, government laws have been strengthened. Furthermore, the possible health implications of pesticide residue have terrified many of us into choosing pesticide-free items. Even though rules exist to assure legal maximum residual levels that have been considered scientifically acceptable for food, the campaign to eliminate pesticides has gained traction. Restoring soil health by reverting to non-chemical agriculture has assumed great importance in achieving sustainability in production. In Gujarat, Gujarat Organic Farming Policy-2015 has been introduced by the Gujarat government to support

scientifically advanced organic farming practices for a sustainable farming system and to ensure reliable marketing and supply chains. It was accomplished in recognition of the detrimental effects of excessive chemical use on soil health, human health and the environment. Organic agriculture is encouraged through the use of natural resources in a manner that is technically sound, economically secure, environmentally friendly and socially acceptable. A comprehensive set of practices for the region's primary crops must be developed immediately for the policy to be implemented effectively. Innovative organic growers have invented various cow-based bio-enhancers in diverse organic farming systems, such as "Bijamrut," Jivamrut, Panchgavya, Amrutpani and Sanjivak (Yadav *et al.*, 2017). However, there is a lack of scientific information on such formulations. In 2006, the National Centre for Organic Farming (NCOF) and National Horticulture Mission (NHM) incorporated cow-based bio-enhancers into practices for organic cultivation of different crops. Modules on organic farming also include bio-enhancers. A bio-enhancer is a product derived from fermentations of plant and animal residues over a specified period of time. The plant growth promoting substances, such as immunity enhancers, are abundant in these sources because they contain microbial consortia, macro and micronutrients. This is generally used to treat seeds/seedlings, promote decomposition of organic material and increase plant vigour (Pathak and Ram, 2013). The *vermiwash* liquid is a solution that is derived from water that passes through a column of worm activity. It can be used as a foliar spray for growing plants. Earthworm excretory product and mucous secretion together with micronutrients extracted from soil organic molecules are gathered in this substance. The natural ecosystem transports these to the leaves, shoots and other parts of the plants. In light of these considerations, this experiment was designed to assess the effectiveness of various cow-based bio-enhancers in chickpea and fenugreek cultivation.

MATERIALS AND METHODS

To find out whether various cow-based bio-enhancers are effective on chickpea and fenugreek a field experiment was conducted during *rabi* seasons of 2019-20, 2020-21 and 2021-22, at the organic farm, Centre for natural resources management, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat, India. A randomized block design (RBD) with three replications was used with ten different treatments, viz. T₁: Foliar spray of *Panchgavya* 3% at 30, 45, 60 DAS, T₂: Seed treatment with *Bijamrut* 300 ml/kg seed, T₃: 500 L/ha *Jivamrut* with irrigation at sowing, 30 and 45 DAS, T₄: 500 L/ha *Amrutpani* with irrigation at sowing, 30 and 45 DAS, T₅: *Sanjivak* 500 L/ha with irrigation at sowing, 30 and 45 DAS, T₆: Foliar spray of seaweed extract 5 % at 30, 45 and 60 DAS, T₇: Foliar spray of banana sap 1% at 30, 45 and 60 DAS, T₈: 1.5 t/ha Vermicompost, T₉: 5 t/ha FYM and T₁₀: Control. Chickpea variety, GG-3 and fenugreek variety, GF 2, was sown at spacing of 45 cm × 10 cm in a

plot size of 3.6 × 4.0 m² during these years and the harvestable gross-plot size was 13.5 m² (2.7 m × 5 m). Both the crops were planted during the third week of November in each year. Harvesting and threshing were manually performed to determine grain and stover yields. Observations were recorded on five random plants, at different growth stages of the crop and average values for the traits were worked out for ten treatments in each replication. As described by Gomez and Gomez (1984), Fischer's method of analysis of variance was used to analyse and interpret data. At a five percent level of significance, critical differences were calculated for comparing treatment means.

As per the standard method, observations of plant height, branches per plant, pods per plant and seeds per pods were manually recorded on five randomly selected representative plants from each plot of each replication separately. Yield attributes were also recorded at physiological maturity stage. The seed and straw yield was recorded from net plot area of each treatment.

RESULTS AND DISCUSSION

Effects on chickpea growth and yield parameters

According to the analysis of the data shown in Fig 2, various treatments of cow-based bio-enhancers had no significant impact on plant height at harvest, the number of branches per plant, or the number of seeds per pod both during individual years and in pooled analyses had a significant impact on the number of pods per plant. When compared to the other treatments, application of vermicompost at 1.5 t/ha resulted in a significantly higher number of pods per plant.

The data shown in Table 1 and Fig 1 showed that different cow-based bio-enhancers had a substantial impact on chickpea grain yield, while they also had a significant impact on chickpea stover yield. Significantly higher grain yield (1896 kg/ha) was observed with application of vermicompost 1.5 t/ha and it was at par with treatment T₁ (Foliar spray of *Panchgavya* 3% at 30, 45, 60 DAS), T₉ (5.0 t/ha FYM), treatment T₄ (500 L/ha *Amrutpani* with irrigation at sowing, 30 and 45 DAS) and treatment T₇ (Foliar spray of banana sap 1% at 30, 45 and 60 DAS). However, the stover yield of chickpea was found to be significantly higher with treatment T₈ (1.5 t/ha vermicompost) than the other treatments except treatment T₉ (5.0 t/ha FYM). Kumaravelu and Kadambian (2009) reported that a greater number of branches per plant, more pods per plant and the increased plant height can be due to the growth enzymes in *Panchagavya*, promotes rapid cell division and multiplication. De Britto and Girija (2006) found that cow urine provides nitrogen, which is essential for crop growth, whereas cow dung supports the growth of beneficial bacteria in *Panchagavya*. In addition to vermicompost, that contains a huge amount of nitrogen in its organic fractions, fermented *Panchagavya* solution this also contains a variety of salt that are easily available to plants, resulting in stimulated plant growth, leading to higher pod production.

Table 1: Effect of different treatments (pooled basis) on growth and yield attributes of chickpea.

Treatments	Plant height at harvest (cm)	Branches per plant (No.)	Pods per plant (No.)	Seed per plant (No.)	Grain yield (kg/ha)	Stover yield (kg/ha)	Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio
T ₁ : <i>Panchgavya</i> 3% as foliar spray at 30, 45 and 60 DAS	62.34	4.42	41.56	1.76	1823	3554	92805	34120	58685	2.72
T ₂ : <i>Bijamrut</i> 300 ml/kg seed as seed treatment	62.84	4.36	37.89	1.73	1561	3272	79896	29462	50434	2.71
T ₃ : <i>Jivamrut</i> 500 L/ha with irrigation at sowing, 30 and 45 DAS	64.19	4.22	38.51	1.67	1678	3369	85582	34576	51006	2.48
T ₄ : Amrutpani 500 L/ha with irrigation at sowing, 30 and 45 DAS	62.29	4.33	37.98	1.80	1744	3496	88960	33676	55284	2.64
T ₅ : Sanjivak 500 L/ha with irrigation at sowing, 30 and 45 DAS	62.49	4.29	37.07	1.62	1694	3301	86220	36136	50084	2.39
T ₆ : Seaweed extract 5% foliar spray at 30, 45 and 60 DAS	64.45	4.40	40.84	1.62	1686	3595	86421	38926	47495	2.22
T ₇ : Banana sap 1% foliar spray at 30, 45 and 60 DAS	61.29	4.40	40.71	1.59	1711	3500	87433	32176	55257	2.72
T ₈ : Vermicompost 1.5 t/ha	64.74	4.42	49.04	1.78	1896	4041	97183	38586	58597	2.52
T ₉ : FYM 5 t/ha	63.60	4.11	41.53	1.69	1765	3673	90285	37086	53199	2.43
T ₁₀ : Control	57.90	3.67	31.89	1.51	1418	2860	72376	28906	43470	2.50
S.E.m _t	1.70	0.19	1.71	0.07	66.34	156.81	-	-	-	-
C.D. at 5%	NS	NS	4.9	NS	188.1	444.6	-	-	-	-
C.V. %	8.15	13.71	4.9	12.42	11.72	13.57	-	-	-	-

Effects on fenugreek growth and yield parameters

Plant height, number of branches per plant, number of seeds per pod and pod length were not significantly affected by different cow-based bio-enhancers as shown in Fig 4. On the other hand, the number of pods per plant was found

to be significant. Treatment with vermicompost 1.5 t/ha (T_8) recorded significantly maximum number of pods per plant (42.11) compared to other cow-based bio enhancer. Treatments with FYM 5 t/ha (T_9) and *Panchgavya* 3% as foliar spray at 30, 45 and 60 DAS (T_1) did not show

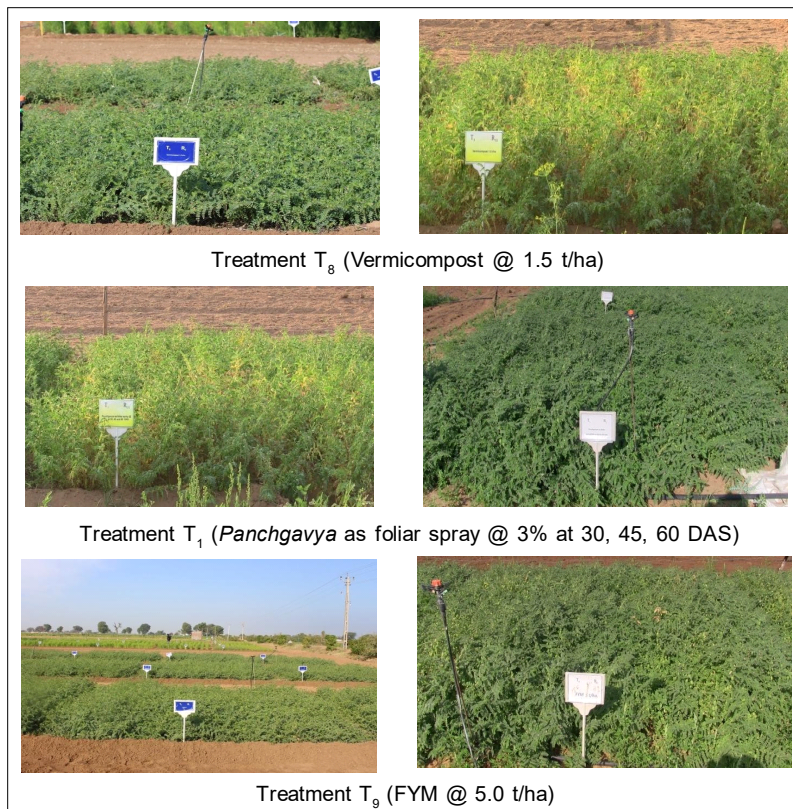


Fig 1: Effect of different treatments on chickpea crop.

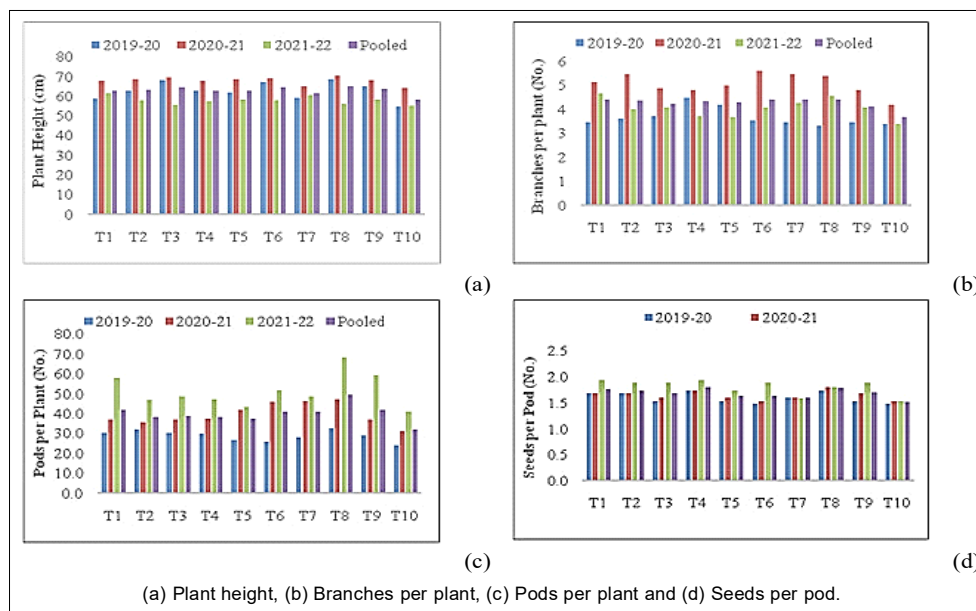


Fig 2: Year wise and pooled data of the growth parameters of chickpea.

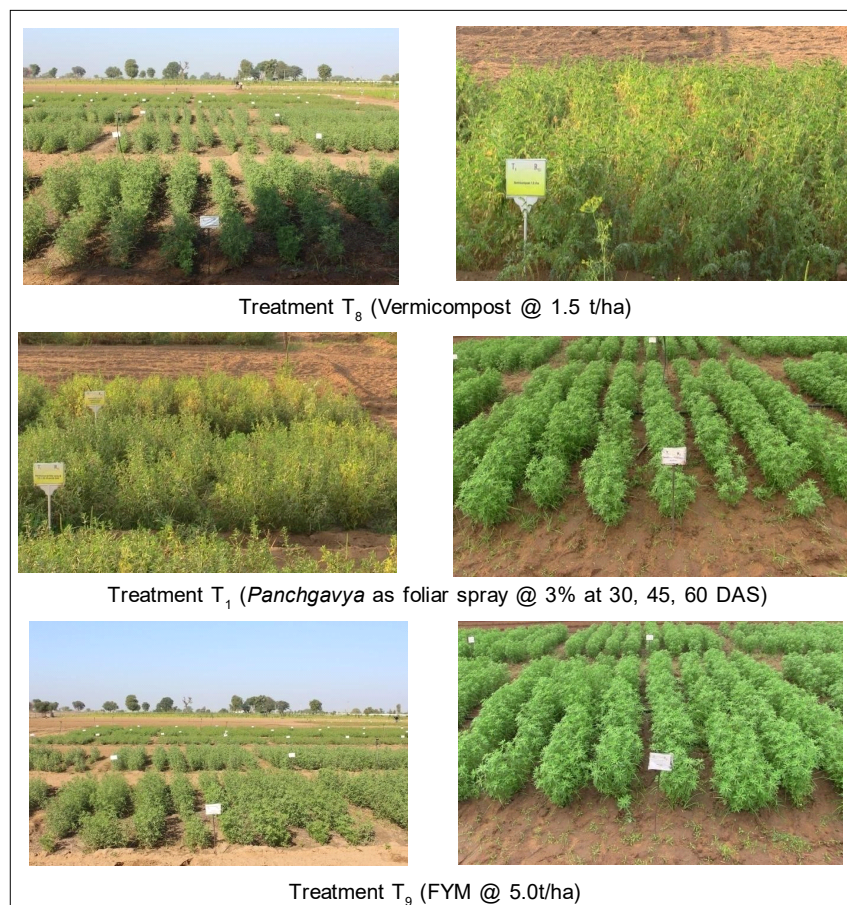


Fig 3: Effect of different treatments on fenugreek crop.

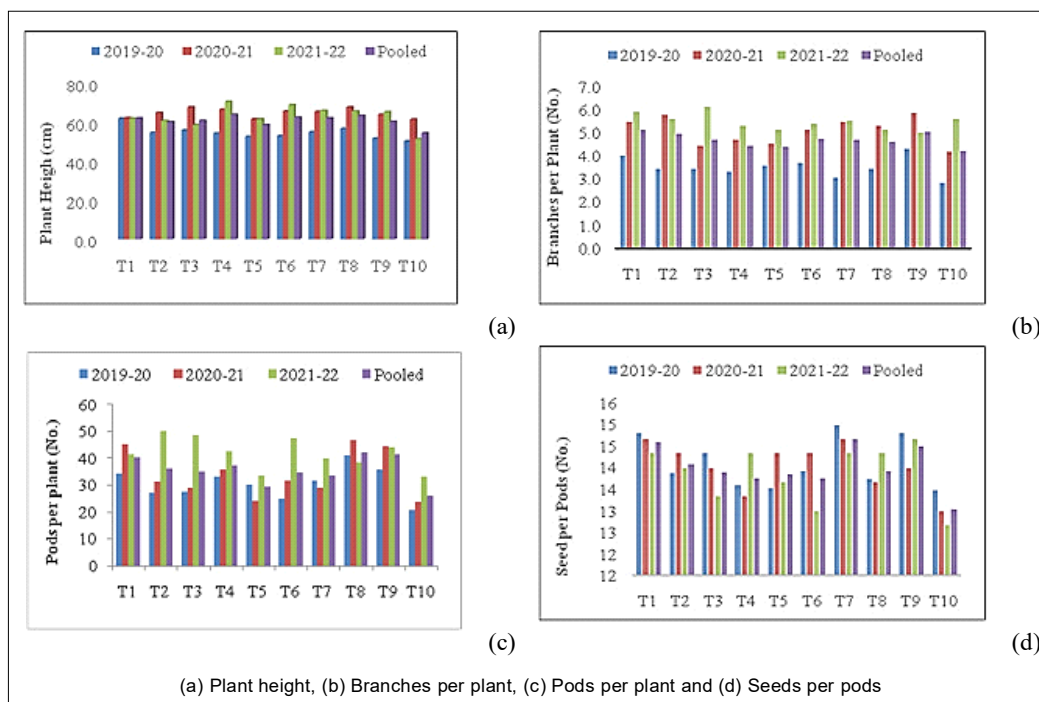


Fig 4: Year wise and pooled data of the growth parameters of fenugreek.

Table 2: Effect of different treatments (pooled basis) on growth and yield attributes of fenugreek.

Treatments	Plant height at harvest (cm)	Branches per plant (No.)	Pods per plant (No.)	Number of seeds per pod	Pod length (cm)	Seed yield (kg/ha)	Stover yield (kg/ha)	Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio
T ₁ : <i>Panchgavya</i> 3% as foliar spray at 30, 45 and 60 DAS	62.42	5.13	40.44	14.60	11.93	2086	3641	105339	34400	70939	3.06
T ₂ : <i>Bijamrut</i> 300 ml/kg seed as seed treatment	60.44	4.96	36.20	14.07	11.53	1613	3045	81906	29580	52326	2.77
T ₃ : <i>Jivamrut</i> 500 L/ha with irrigation at sowing, 30 and 45 DAS	61.16	4.69	35.07	13.89	11.64	1767	3006	89060	34856	54204	2.56
T ₄ : Amrutpani 500 L/ha with irrigation at sowing, 30 and 45 DAS	64.22	4.47	37.29	13.76	11.71	1881	3455	95333	33956	61377	2.81
T ₅ : <i>Sanjivak</i> 500 L/ha with irrigation at sowing, 30 and 45 DAS	58.98	4.42	29.40	13.84	11.60	1865	3088	93820	36416	57404	2.58
T ₆ : Seaweed extract 5 % foliar spray at 30, 45 and 60 DAS	62.91	4.76	34.78	13.76	11.84	1778	3305	90161	39206	50955	2.30
T ₇ : Banana sap 1% foliar spray at 30, 45 and 60 DAS	62.49	4.69	33.62	14.67	11.71	1822	3384	92385	32456	59929	2.85
T ₈ : Vermicompost 1.5 t/ha	63.71	4.64	42.11	13.91	11.44	2168	3735	109381	38866	70515	2.81
T ₉ : FYM 5 t/ha	60.67	5.07	41.36	14.49	12.09	2061	3577	104037	37366	66671	2.78
T ₁₀ : Control	54.71	4.22	25.98	13.04	11.16	1304	2657	66580	29186	37394	2.28
S.E.m±	1.97	0.22	1.83	0.35	0.19	76.06	131.59	-	-	-	-
C.D. at 5 %	NS	NS	5.2	NS	NS	215.7	373.1	-	-	-	-
C.V. %	9.67	13.81	15.42	7.50	4.81	12.44	12.00	-	-	-	-

statistically significant differences when compared with vermicompost 1.5 t/ha (T_8). Gore and Sreenivasa (2011) and Jondhale *et al.* (2014) obtained similar results.

Liquid organics have a noticeable effect on fenugreek growth attributes because they are readily absorbed forms of nutrients, leading to faster growth and development of the components. There are a number of macro- and micro-nutrients in fermented liquid organic manures, along with vitamins, essential amino acids, diverse microorganisms and growth-promoting compounds like IAA and GA *etc.* It has been shown that these factors improve plant growth, metabolic activity and resistance to pests and diseases (Natarajan, 2007 and Sreenivasa *et al.*, 2010).

Based on the data presented in Table 2 and Fig 3, it was found that the application of vermicompost 1.5 t/ha (T_8) was significantly associated with the highest grain yield (2168 kg/ha), whereas (T_9) FYM 5 t/ha (2061 kg/ha) and (T_1) spray of *Panchgavya* 3% at 30 and 45 DAS (2086 kg/ha) were found statistically at par with vermicompost 1.5 t/ha (T_8). Various cow-based bio enhancers had a substantial impact on fenugreek's stover yield. When compared with treatment T_1 , T_9 , T_4 and T_7 , treatment T_8 (vermicompost 1.5 t/ha) produced a higher stover yield (3735 kg/ha). There might be a connection between cow urine and crop growth, as cow manure serves as a medium for beneficial bacteria to thrive in *Panchagavya* (De Britto and Girija, 2006). In order to increase the yield of grain amaranthus cv. CO₃, Rajendran *et al.* (2006) suggested using 5 t/ha vermicompost together with a spray of *Panchagavya* 3% at 10 DAS.

Economics

The ultimate purpose of agricultural growers is economic gain. The economics worked out for different treatments of cow-based bio-enhancers are outlined in Table 1 and 2. It is evident from the data that the highest net realization of 70939 ₹/ha with the B: C ratio of 3.06 was observed under treatment T_1 (Spray of *Panchgavya* 3% at 30, 45 and 60 DAS) for fenugreek. For chickpea highest net realization of 58685 ₹/ha with the benefit: cost ratio (BCR) of 1.72 was obtained in the same treatment. However, treatment T_8 (Vermicompost 1.5 t/ha) recorded the highest gross realization. Singh and Kushwah (2006); Singh *et al.* (2011); Biswas *et al.* (2012); Choudhary *et al.* (2013) and Salunkhe *et al.* (2013) obtained similar results.

CONCLUSION

This study was performed to assess the effectiveness as well as the impact of cow-based bio-enhancers on chickpea and fenugreek. Pooled data across three years led us to conclude that cow-based bio-enhancers were providing the suitable quantity of required nutrients to these important crops. The preliminary review of this present investigation shows that to increase chickpea and fenugreek yields and net returns under natural farming, it is recommended that 1.5 t/ha vermicompost or a spray of *Panchgavya* 3% at 30,

45, 60 DAS be applied in addition to 400 kg castor cake at the time of sowing. Foliar spray of *Panchagavya* may have resulted in easy transfer of nutrients and growth stimulants to the plants leading to enhanced yield.

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Conflict of interest

Authors declare that there is no conflict of interest to disclose.

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