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Evaluation of Different Organic Manures on Growth and Yield of Chia (*Salvia hispanica* L.)

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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

A field trial was conducted during *Rabi* 2020-21 and 2021-22 at Research Institute on Organic framing (RIOF), University of Agricultural sciences, GKVK, Bengaluru to find out the effect of organic manures on growth and yield of chia. A three factorial randomized block design was employed with first factor as nutrient sources *viz.,* S_1 = FYM (100%) on N equivalent basis, S_2= FYM + vermicompost (50:50) ratio on N equivalent basis, S_3= FYM+ vermicompost (75:25) ratio on

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N equivalent basis, second factor *viz.*, jeevamrutha levels J_0 = Without jeevamrutha, J_1= With Jeevamrutha 1000 liters ha^{-1} and panchagavya levels P_0= Without panchagavya, P_1= With Panchagavya 5% foliar spray being third factor. Pooled data of two years revealed that higher seed and haulm yield of chia (920,1480 kg ha^{-1} respectively) was obtained with application of (S_2). Soil application of jeevamrutha (J_1) resulted in higher seed and haulm yield (984, 1598 kg ha^{-1} respectively) and among panchagavya levels foliar application of panchagavya (P_1) resulted in seed and haulm yield (952,1468 kg ha^{-1} respectively), besides the higher plant height, leaf area, dry matter accumulation and seed yield per plant were recorded with application of FYM+ Vermicompost (50:50) on N equivalent basis and among liquid organic manures application of jeevamrutha (1000 L ha^{-1}) and panchagavya 5% foliar spray resulted in higher growth and yield attributes.

Keywords: Chia; nutrient uptake; FYM; vermicompost; jeevamrutha; panchagavya.

1. INTRODUCTION

The success of industrial agriculture and the green revolution in recent decades has often masked significant externalities affecting natural resources and human health as well as agriculture itself [1]. Globally 795 million people are undernourished with a share of 12.9 percent of developing countries [2]. Currently only 150 plant species are commercialized on global level of which 12 species provide approximately 80% of calorie demand, while these grains are devoid of essential micronutrient [3]. To address this problem there is a need to broaden the field of research by exploiting neglected crop species, which have potential to gain high market value, which have traditionally played the key role in many cultures as staple food, but presently neglected as they percolated in small niches of global food system. Potential crops or underutilized crops or orphan crops or neglected crops are considered as crops of 21st century as they possess high nutritional profile, besides they acts as life support species in extreme environmental conditions. Organic agriculture as a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Farm yard manure is one of the most commonly used organic manures in India since time immemorial [4]. Vermicompost is the product of biodegradation of organic material through interaction between earth worms and microorganisms. It is made up of carbon, hydrogen and oxygen and contains macro and micro nutrients which exhibits similar effect as of inorganic fertilizers on plants. Liquid organic manure is the organic matter in liquid formulation mostly obtained from cattle dung and urine which could be used as organic fertilizer in agriculture. Jeevamrutha is considered as soil tonic as it has higher amount of microbes which results in intense biological activity in soil and improves the nutrient availability and uptake by crop. Panchagavya is the liquid organic manure obtained from fermentation of five products of *viz*., cow dung, cow urine, milk, curd and ghee from cow [5]. It act as plant growth stimulant by activating the biological reactions in the soil and protects the plants from pest and disease incidence, improves the growth and vigor of crops and improves the shelf life of perishable fruits and vegetables.

Chia (*Salvia hispanica* L.) is nutri rich crop belongs to *Lamiaceae* family which played an important role in the diet of prehispanic Mexicans and had undeniable importance as rich source of nutrients. It is a pseudo cereal and its center of origin is between Mexico and Guatemala, it is becoming popular as “super food” as it is considered to be one of the greatest vegetarian source of omega (ω) 3 fatty acid (50 to 57 %) and omega (ω) 6 fatty acid (17 to 26%), oil (24.36 % to 35%), fiber (34% to 40%), protein(16.54% to 25%), carbohydrates(26.5% to 42.12%), moisture(5.8%), vitamin A and C, niacin, antioxidants along with higher content of minerals [6,7]. Chia crop is a new introduction to India by Central Food Technological Research Institute (CFTRI), Mysore to the rainfed farmers of Mysore and Chamrajnagar districts of Karnataka. With increase of public health awareness, the demand for organic food products in the market is increasing. So for the profitable cultivation of chia under organic production system there is need to standardize the organic nutrients required, for higher productivity with this background a field experiment was conducted to evaluate the effect of different organic manures on growth and yield of chia.

2. MATERIALS AND METHODS

The study was conducted during two consecutive years of *Rabi* 2020 and *Rabi* 2021 at research and demonstration block on Research Institute of Organic farming (RIOF), University of Agricultural Sciences, GKVK, Bangalore, Karnataka, India. Local variety of chia, developed by All India Coordinated Research Project(AICRP) on potential crops was selected as it is suitable for successful production in Bangalore. Direct sowing was done with spacing of 90 cm ×15 cm. The dimension of the plot was 5.4 m × 3.6 m. The nutrient sources used were Farm yard manure (FYM), vermicompost (VC), jeevamrutha (J) and panchagavya (P). A three factorial randomized block design was employed with three nutrient sources*,viz.,*S_1 nutrients supplied through FYM alone (S_1 = FYM100%), S_2 50 % nutrients supplied through FYM and 50 % nutrients supplied through vermicompost (S_2= FYM+ vermicompost 50:50), S_3 75% nutrients supplied through FYM and 25 % nutrients applied through vermicompost (S_3=FYM+ vermicompost 75:25), two levels of jeevamrutha J_0 = without jeevamrutha, J_1= with jeevamrutha 1000 liters (L) ha^{-1} soil application and two levels of panchagavya P_0= without panchagavya, P_1= With panchagavya 5% foliar spray. The treatments were replicated thrice. The basal dose of FYM 10 t ha^{-1} was applied 20 days before sowing. Treatment wise FYM was applied 15 days before sowing, whereas VC was top dressed at 30Days after sowing (DAS). Soil application of jeevamrutha @1000 L ha^{-1} and foliar spray of panchagavya (5%) was done at 20, 40 and 60 DAS according to treatment. Irrigation was supplied to each and every plot at every 15 to 20 days interval. Regular weeding was done till 35-40 DAS and earthing operation was done at 40 DAS. Nondestructive and destructive method of sampling was done to record the observations of growth and yield attributes from five randomly selected and tagged chia plants in each net plot at different intervals throughout the investigation period during two consecutive years of research. Experimental data collected was subjected to statistical analysis by adopting Fishers method of analysis of variance (ANOVA) as outlined by [8]. Critical difference values were calculated whenever the F -test was significant at 5 percent level. Wherever F- test was significant, for comparison between the treatment means, an appropriate value of critical difference (C. D.) was worked out.

2.1 Preparation of Liquid Organic Manures

The preparation of liquid manures was done based on Subhas palekars method [9].

2.1.1 Preparation of jeevamrutha

Jeevamrutha was prepared by mixing 10 kg cow dung, 10 liters of cow urine, 2 kg organic jaggary, 2 kg pulse flour and hand full of soil collected from the field. All these were put in 200 liters' plastic drum and mixed thoroughly and volume was made up to 200 liters by adding water. The mixture was stirred well in clock wise direction thrice a day and plastic drum was kept in shade covered with wet jute bag. Jeevamrutha fermented for 10 days was applied to the wet soil by diluting in water.

2.1.2 Preparation of panchagavya

Panchagavya was prepared by mixing 7 kg fresh cow dung and 1 kg cow ghee and incubated in a container for 2 days. On third day, 10 liters of desi cow urine and 10 liters of water were added, mixed thoroughly and incubated for fermentation for 13 days. Then, 3 liters of cow milk, 2 liters of cow curd, 3 liters of organic tender coconut water, 3 kg of organic jaggary and 12 ripened cavendish bananas were added and contents were incubated for 6 days. The mixture was stirred thoroughly thrice a day at morning, afternoon and evening. Container was kept in shade and it was covered with wet jute bag. After 21 days of fermentation mixture was filtered through a cotton cloth and used for spraying. 50 ml of panchagavya was diluted with water and sprayed by knapsack sprayer according to treatment.

Table 1. Nutrient composition of different manures used in the experiment (2020 &2021)

Nutrient sources	2020			2021		
	N (%)	P_2O_5 (%)	K_2O (%)	N (%)	P_2O_5 (%)	K_2O (%)
FYM	0.50	0.15	0.61	0.50	0.17	0.65
Vermicompost	1.00	0.65	0.80	1.01	0.69	0.81
Jeevamrutha	1.09	0.19	0.29	0.89	0.12	0.28
Panchagavya	1.21	0.16	0.29	1.01	0.15	0.27

3. RESULTS AND DISCUSSION

3.1 Growth Attributes of Chia as Influenced by Different Sources of Organic Nutrients

Growth parameters of chia viz., Plant height, Leaf area and dry matter accumulation were significantly influenced organic manure application are presented in Table 2.

3.1.1 Plant height (cm) of chia at harvest

Plant height of chia varied significantly due to application of solid and liquid organic manures. Significantly higher plant height of chia (80.51 cm) was recorded due to application of 50 per cent N equivalent through FYM and 50 per cent N equivalent through VC and was found on par with application of 75 per cent N equivalent through FYM 25 per cent N equivalent vermicompost (78.79 cm), whereas lower plant height was observed with application of N equivalent 100 percent through FYM (74.53 cm). Soil application of jeevamrutha 1000 L ha^{-1} recorded higher plant height of (83.56 cm) as compared to without application of jeevamrutha (72.33 cm). Foliar spray of 5% panchagavya recorded higher plant height (81.29 cm) as compared to without application of panchagavya (74.60 cm). Plant height of chia did not vary significantly due to the interaction of nutrient sources, jeevamrutha and panchagavya at harvest. The significant increase in plant height of chia might be due to readily available nutrient present in the manures. Application of FYM and vermicompost along with liquid organics might have accelerated the soil microbial activities that helped to continuous mineralization leading to better availability of nitrogen, besides hormones like IAA and GA_3 in liquid organics which might have enhanced rapid cell division and reflected in the increase of chia plant height. Similar results were reported by Kanimozhi [10].

3.1.2 Leaf area (cm^2) of chia at 60 DAS

Leaf area of chia differed significantly due to application of bulky and liquid organic. Maximum leaf area (1083.32 cm^2) was recorded with the application 50 per cent N equivalent through FYM and 50 per cent N equivalent through VC and was found on par with application of 75 per cent N equivalent through FYM 25 per cent N equivalent vermicompost (1037.72 cm^2), whereas lower leaf area (1011.63 cm^2) was recorded with application of N equivalent 100 percent through FYM. Application of jeevamrutha 1000 L ha^{-1} recorded higher leaf area (1102.88 cm^2) as compared to without application of jeevamrutha (985.56 cm^2) and foliar spar of 5% panchagavya recorded higher leaf area (1085.72 cm^2) as compared to without application of panchagavya (1002.73 cm^2). Leaf area of chia did not differ significantly due to interaction effect of solid and liquid organic manures at 60 DAS. The increase of leaf area is due to more number of branches and number of leaves per plant. Application of FYM and vermicompost and jeevamrutha might have improved the biological efficiency of chia crop by creating the greater source and increase of photosynthetic efficiency of plants. The effective conversion of Fe, Mg and Zn at sight of photosynthesis and presence of kinetin in panchagavya might have increased the chlorophyll content of leaf which resulted in more leaf area. This was also in conformity with Subramanian [11].

3.1.3 Dry matter accumulation of chia at harvest

Significantly higher dry matter accumulation was recorded with application of 50 per cent N equivalent through FYM and 50 per cent N equivalent through VC (130.53 g) and was found on par with application of 75 per cent N equivalent through FYM 25 per cent N equivalent vermicompost (124.48 g), whereas lower leaf area was recorded with application of N equivalent 100 percent through FYM (114.93 g). Application of jeevamrutha 1000 L ha^{-1} recorded higher dry matter (141.88 g) as compared to without application of jeevamrutha (104.74 g) and foliar spar of 5% panchagavya recorded higher dry matter (131.79 g) as compared to without panchagavya (114.84g). Dry matter accumulation of chia did not differ significantly due to interaction effect of solid and liquid organic manures. The dry matter production is the function of growth attributes, where the carbon substrates provided by FYM, vermicompost along with application of fermented liquid organics which might have steadily maintained the enzymatic and biological activity for favourable soil bio chemical reaction. Thereby creating favourable environment for mineralization and continuous supply of essential macro and micro nutrients, which reflected in increased dry matter production of chia. Similar results were observed by Yadav [1].

Table 2. Growth attributes of chia as influenced by different organic manures application at harvest

Treatments		Plant height (cm)			Leaf area (cm ^{2})			Dry matter accumulation(g)		
		J_0	J_1	Mean	J_0	J_1	Mean	J_0	J_1	Mean
Nutrient sources (S)										
S_1		67.45	81.61	**74.53**	957.78	1065.47	**1011.63**	100.02	129.85	**114.93**
S_2		75.34	85.69	**80.51**	1001.45	1165.20	**1083.32**	109.51	151.55	**130.53**
S_3		74.20	83.39	**78.79**	997.47	1077.97	**1037.72**	104.70	144.25	**124.48**
Mean		**72.33**	**83.56**		**985.56**	**1102.88**		**104.74**	**141.88**	
		S.Em ±	**C.D.**		**S.Em ±**	**C.D.**		**S.Em ±**	**C.D.**	
S		1.49	4.36		16.12	47.29		2.88	8.45	
J		1.21	3.56		13.17	38.61		2.35	6.90	
S X J		2.10	NS		22.80	NS		4.07	NS	
		P_0	**P_1**	**Mean**	**P_0**	**P_1**	**Mean**	**P_0**	**P_1**	**Mean**
S_1		70.97	78.09	74.53	971.75	1051.50	1011.63	103.08	126.79	114.93
S_2		76.86	84.17	80.51	1025.28	1141.37	1083.32	123.08	137.98	130.53
S_3		75.98	81.61	78.79	1011.16	1064.28	1037.72	118.36	130.59	124.48
Mean		**74.60**	**81.29**		**1002.73**	**1085.72**		**114.84**	**131.79**	
		S.Em ±	**C.D.**		**S.Em ±**	**C.D.**		**S.Em ±**	**C.D.**	
S		1.21	3.56		13.17	38.61		2.35	6.90	
S X P		2.10	NS		22.80	NS		4.07	NS	
		P_0	**P_1**	**Mean**	**P_0**	**P_1**	**Mean**	**P_0**	**P_1**	**Mean**
J_0		68.40	76.25	72.33	953.92	1017.21	985.56	97.41	112.08	104.74
J_1		80.80	86.32	83.56	1051.54	1154.22	1102.88	132.28	151.49	141.88
Mean		**74.60**	**81.29**		**1002.73**	**1085.72**		**114.84**	**131.79**	
		S.Em ±	**C.D.**		**S.Em ±**	**C.D.**		**S.Em ±**	**C.D.**	
J X P		1.72	NS		18.62	NS		3.33	NS	
Interaction		**P_0**	**P_1**							
S X J X P					**P_0**	**P_1**		**P_0**	**P_1**	
S_1	**J_0**	62.32	72.58		905.82	1009.73		90.48	109.56	
	J_1	79.61	83.60		1037.68	1093.27		115.67	144.02	
S_2	**J_0**	71.44	79.23		978.98	1023.91		104.71	114.32	
	J_1	82.27	89.11		1071.58	1258.82		141.46	161.65	
S_3	**J_0**	71.44	76.95		976.95	1017.99		97.03	112.37	
	J_1	80.51	86.26		1045.36	1110.58		139.70	148.81	
S X J X P		**S.Em ±**	**C.D.**		**S.Em ±**	**C.D.**		**S.Em ±**	**C.D.**	
		2.97	NS		32.25	NS		5.76	NS	

***Note**: CD at 5%, **J_0** = Without Jeevamrutha, **J_1**= With Jeevamrutha 1000 liters ha^{-1}, **P_0**= Without Panchagavya, **P_1**= With Panchagavya5%, **S_1**= FYM (100%), **S_2**= FYM+ vermicompost (50:50), **S_3**=FYM+ vermicompost (75:25), **DAS**= Days After Sowing, **NS**= non-significant*

Table 3. Yield attributes and yield of chia as influenced by different organic manures application

Treatments		Seed yield per plant			Seed yield (kg ha^{-1})			Haulm yield (kg ha^{-1})		
		J_0	J_1	Mean	J_0	J_1	Mean	J_0	J_1	Mean
Nutrient sources (S)										
S_1		17.55	27.32	**22.43**	778	957	**867**	1085	1506	**1295**
S_2		20.70	28.30	**24.50**	829	1012	**920**	1281	1679	**1480**
S_3		19.45	27.92	**23.68**	819	982	**901**	1204	1607	**1405**
Mean		**19.23**	**27.84**		**809**	**984**		**1190**	**1598**	
		S.Em ±	**C.D.**		**S.Em ±**	**C.D.**		**S.Em ±**	**C.D.**	
S		0.45	1.32		12.70	37.23		36.43	106.85	
J		0.37	1.08		10.37	30.40		29.75	87.24	
S X J		0.64	**NS**		17.95	**NS**		51.52	NS	
		P_0	P_1	Mean	P_0	P_1	Mean	P_0	P_1	Mean
S_1		19.76	25.11	**22.43**	806	929	**867**	1216	1375	**1295**
S_2		21.44	27.56	**24.50**	867	974	**920**	1359	1602	**1480**
S_3		21.08	26.29	**23.68**	850	951	**901**	1331	1480	**1405**
Mean		**20.76**	**26.32**		**841**	**952**		**1302**	**1486**	
		S.Em ±	**C.D.**		**S.Em ±**	**C.D.**		**S.Em ±**	**C.D.**	
S		0.37	1.08		10.37	30.40		29.75	87.24	
S X P		0.64	**NS**		17.95	**NS**		51.52	**NS**	
		P_0	P_1	Mean	P_0	P_1	Mean	P_0	P_1	Mean
J_0		17.63	20.84	**19.23**	760	857	**809**	1091	1288	**1190**
J_1		23.89	31.80	**27.84**	921	1046	**984**	1513	1683	**1598**
Mean		20.76	26.32		**841**	**952**		**1302**	**1486**	
		S.Em ±	**C.D.**		**S.Em ±**	**C.D.**		**S.Em ±**	**C.D.**	
J X P		0.52	1.53		14.66	**NS**		42.07	**NS**	
Interaction		P_0	P_1							
S X J X P					P_0	P_1		P_0	P_1	
S_1	J_0	16.31	18.79		713	843		1000	1169	
	J_1	23.20	31.43		899	1016		1433	1580	
S_2	J_0	18.41	22.99		792	865		1162	1400	
	J_1	24.48	32.13		941	1083		1555	1803	
S_3	J_0	18.16	20.73		776	863		1111	1296	
	J_1	23.99	31.84		924	1040		1550	1665	
S X J X P		**S.Em ±**	**C.D.**		**S.Em ±**	**C.D.**		**S.Em ±**	**C.D.**	
		0.90	**NS**		25.39	NS		72.86	**NS**	

***Note**: CD at 5%, J_0 = Without Jeevamrutha, J_1= With Jeevamrutha 1000 liters ha^{-1}, P_0= Without Panchagavya, P_1= With Panchagavya5%, S_1= FYM (100%), S_2= FYM+ vermicompost (50:50), S_3=FYM+ vermicompost (75:25), **DAS**= Days After Sowing, **NS**= non-significant*

3.2 Yield Attributes and Yield of Chia as Influenced by Different Sources of Organic Nutrients

Yield attributes and yield of chia *viz*., Seed yield per plant, Seed and haulm yield were significantly influenced organic manure application are presented in Table 3.

3.2.1 Seed yield per plant (g) of chia

Seed yield per plant of chia differed significantly due to application of organic manures. Significantly higher seed yield per plant was with 50 per cent N equivalent through FYM and 50 per cent N equivalent through VC (24.50 g) and was found on par with application of 75 per cent N equivalent through FYM 25 per cent N equivalent vermicompost (23.68 g), whereas lesser seed yield per plant of chia was recorded with application of N equivalent 100 percent through FYM (22.43g). Application of jeevamrutha 1000 L ha^{-1} recorded higher seed yield per plant (27.48 g) as compared to without jeevamrutha (19.23 g) and foliar spar of 5% panchagavya recorded higher seed yield per plant (26.32 g) as compared to without panchagavya (20.76 g). Interaction of jeevamrutha and panchagavya resulted in significantly higher seed yield per plant (31.80 g). The other interactions of FYM and vermicompost with jeevamrutha and panchagavya were found to be non-significant. Increase in seed yield per plant might be associated to more efficient sink formation, greater sink size and greater carbohydrates translocation from vegetative parts to seeds. Humic substances of vermicompost which is known for induction of lateral root growth by stimulation of H^+- ATPase activity in the plasma membrane and might have enhanced the uptake and transfer of nutrients and finally resulted in good source to sink relationship as per Dotaniya et al. [12].

3.2.2 Seed yield (kg ha^{-1}) of chia

Significantly higher seed yield of chia was due to application 50 per cent N equivalent through FYM and 50 per cent N equivalent through VC (920 kg ha^{-1}) and was found on par with application of 75 per cent N equivalent through FYM 25 per cent N equivalent vermicompost (901kg ha^{-1}), whereas lesser seed yield of chia was recorded with application of N equivalent 100 percent through FYM (867 kg ha^{-1}). Application of jeevamrutha 1000 L ha^{-1} recorded seed yield (984 kg ha^{-1}) as compared to without jeevamrutha (809 kg ha^{-1}) and foliar spar of 5% panchagavya recorded higher seed yield (952 kg ha^{-1}) as compared to without panchagavya (841 kg ha^{-1}). Seed yield of chia did not differ significantly due to interaction effect of solid and liquid organic manures. The improvement in yield is due to faster mineralization of nutrients to soil which increases the soil available nutrients and enhanced the sink potential and in turn production and translocation of photosynthates to spikes When jeevamrutha and panchagavya are applied at regular intervals (2-3 times) during crop growth period they act as a stimulus in plant and in turn produce growth regulators and hormones in cell system increasing the biomass by sustaining the availability and nutrient uptake of applied and native soil nutrients which ultimately reflected in increase of yield. Similar findings were observed by Devakumar et al. [13] and Gopinath et al. [14].

3.2.3 Haulm yield (kg ha^{-1}) of chia

Haulm yield of chia differed significantly due to application of organic manures. Application of 50 per cent N equivalent through FYM and 50 per cent N equivalent through VC resulted significantly higher haulm yield (1480 kg ha^{-1}) and was found on par with application of 75 per cent N equivalent through FYM 25 per cent N equivalent vermicompost (1405 kg ha^{-1}), whereas lesser haulm yield of chia was recorded with application of N equivalent 100 percent through FYM (1295 kg ha^{-1}). Application of jeevamrutha 1000 L ha^{-1} recorded haulm yield (1598 kg ha^{-1}) as compared to without jeevamrutha (1190 kg ha^{-1}) and foliar spar of 5% panchagavya recorded higher haulm yield (1486 kg ha^{-1}) as compared to without panchagavya (1302 kg ha^{-1}). Haulm yield of chia did not differ significantly due to interaction effect of solid and liquid organic manures. Haulm yield of any crop is a function of growth attributes of a crop. Mineralization of organic sources might have provided ample opportunity for availability of soil nutrients rather than fixation in soil. The extensive root system leads to increase of vegetative growth, besides hormonal influence of panchagavya along with photosynthetic activity which might have developed better source-sink relationship and reflected in increase of growth attributes. The results are in conformity with findings of Negi et al. [15].

4. CONCLUSION

The results of this trial could enlighten the knowledge on importance of adding solid organic manures by integrating with liquid organic manure in order to enhance the growth and yield of chia crop. From the present study it was concluded that among the different nutrient sources S_2 (50 per cent N equivalent through FYM and 50 per cent N equivalent through VC) resulted in higher growth, yield attributes and yield of chia crop and was found on par with S_3, whereas lower growth, yield attributes and yield of chia was with S_1. Soil application of jeevamrutha @ 1000 L ha^{-1} and panchagavya foliar sparay 5% resulted in significantly higher growth, yield attributes and yield of chia crop as compared to without application of jeevamrutha and panchagavya.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Yadav M, Subhash M, Kalyansingh G, Yadav S, Suresh, P. A review of organic farming for sustainable agriculture in Northern India. International Journal of Agronomy. 2013;718145: 8.
2. Mary J, Veeranna HK, Girijesh GK, Shridhar RV, Dhananjaya BC. Effect of spacings and fertilizer levels on yield paramters, yield and quality of chia (*Salvia hispanica* L.). Journal of Pharmacognysis and Phytochemistry. 2018;SP3:65-68.
3. Praveen TM, Patil SR, Patil BC, Seetharamu GK, Rudresh DL, Pavankumar P, Patil RT. Influence of biostlimulants on growth and yield of floribunda rose cv. Mirabel. Journal of pharmacognysis and Phytochemistry. 2019;10(1): 2701-2705.
4. Angeles VL, Tecante A. Chia (*Salvia hispanica*) a review of native Mexican seed and its nutritional and functional properties. Advances in Food Nutrition Research. 2015;75:53-75.
5. Verma HP, Sharma OP, Yadav LR, Yadav SS, Shivran AC, Kumar R, Balwan. Growth indices and yield of wheat (*Triticum aestivum* L.) as influenced by irrigation scheduling and organic manures. Journal of Pharmacognysis and Phytochemistry. 2018;7(1):908-912.
6. Ramesh S. Grain yield, nutrient uptake and nitrogen use efficiency as influenced by different sources of vermicompost and fertilizer nitrogen in rice Journal of Pharmacognysis and Phytochemistry. 2104;7(5):52-55.
7. Seth M and Kumar. R. Growth indices, nutrient uptake and productivity of wheat + chickpea as influenced by soil moisture regimes and sources of nutrients. Journal of Crop and Weed. 2109;15(2): 65-71.
8. Gomez KA, Gomez AA. Statistical procedure for agricultural research. 2nd ed. New York, USA: John Wiley & Sons. 1984;84–129.
9. Palekar S. Shoonya Bandavalada naisargika Krushi, Agri Prakashana, Bengaluru. 2006;145-158.
10. Kanimozhi B. Effect of organic manures and biostimulants on productivity and quantity of Brahmi (*Bacopa Monnieri* L.). M.Sc (Hort.) Thesis, TNAU, Coimbatore; 2004.
11. Subramanian A, Effect of Panchagavya on *Escherchia coli* in procured milk. Indian Veterinary Journal. 2005;82:799-800.
12. Dotaniya CK, Niranjan RK, Kumar U, Lata M, Regar KL, Doutaniya RK, Mohbe S, Priyanka J. Quality, yield and nutrient uptake of fenugreek as influenced by integrated nutrient management. International Journal of Plant Soil Science. 2019;29(3):1-7.
13. Devakumar N, Eswarrao GG, Shubha S, Imrankhan Nagaraj and Gowda SB. Activities of organic farming research Centre, navile, shimoga. Univ. Agric. Sci., Bengaluru, Karnataka, India; 2008.
14. Gopinath KA. Supradipsaha BL, Narendrakumar M, Haripande. Bell pepper yield and soil properties during conversion from conventional to organic production in Indian Himalayas. Scientific Horticulture. 2009;122(3):339-345.
15. Negi M, Sharma JC, Shukla YR, Chauhan A, Sharma S, Sharma K. Comparative assessment of different

nutrient sources on growth, yield and nutrient uptake by onion (*Allium cepa* L.). Journal of Plant Nutrition. 2022; 45(10):1516–1522.

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