



Influence of Farmyard Manure and Jeevamrutha on Growth and Yield of Sunflower

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted during *Kharif* 2017 at ZARS, University of Agricultural Sciences, Bengaluru to study the influence of different levels of Farm Yard Manure (FYM) and Jeevamrutha on growth and yield of Sunflower in red sandy loam soil. There were nine treatment combinations laid out in factorial randomized complete block design, which were replicated thrice. The experimental results revealed that, the application of FYM at 150 per cent nitrogen equivalent and jeevamrutha at 1500 L ha⁻¹ significantly influenced growth parameters like plant height, number of leaves, leaf area, leaf area index and total dry matter production. The interaction effect of FYM and jeevamrutha was significant in enhancing the seed yield of sunflower due to improvement in yield attributes like head diameter, number of seeds per head, hundred seed weight and seed yield per plant.

Keywords: Manure; jeevamrutha; sunflower; growth yield and economics.

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1. INTRODUCTION

Sunflower (*Helianthus annuus* L.) is a major oilseed crop, and Karnataka is popularly known as "Sunflower State" in the country, keeping in view the oilseed scenario of India. It has gained importance because of its wider adaptability to different agro-climatic regions, cropping patterns, shorter duration, photo insensitiveness and excellent oil quality. It is mainly grown for its healthy edible oil with a great consumer acceptance because of its higher content of and polyunsaturated fatty acids such as oleic and linoleic acids. Its oil is labelled as premium oil in the market due to the presence of oleic acids (16.2 %) and linoleic acid (72.5 %) with high percent (60 %) of polyunsaturated fatty acids [1]. Conventional agriculture, especially single and imbalanced use of chemical fertilizers alone, has made an adverse impact on soil and plant health, leading to reduced fertility of the soil and a drastic decrease in yield. In order to prevent soil deterioration and to meet the demand for increased food production, it is necessary to make use of organic manures, which place a significant role in maintaining soil fertility and for sustainable yield. Organic manure improves the physical, chemical and biological properties of soil and maintains the ecological balance [2]. Thus, it is gaining momentum all over the world as it addresses self-reliance in food, rural development, conservation of natural ecosystem and sustained biodiversity.

The technological cycle of the sunflower has the most stressful situations in the early growing season, after herbicide application or during a long drought, when moisture deficit occurs due to high level of temperature [3]. Concerned to this, Organic farming primarily depends on site-specific natural resources and those available locally like farmyard manure, green manures, crop residues, farm wastes, etc., rather than external inputs (fertilizer, herbicide, pesticide, antibiotic, hormone, etc.).

Apart from using conventional farm based products there is an increasing demand for improvised materials like jeevamrutha, panchagavya, fish amino acids, fermented plant juices etc. which mainly enrich the soil with indigenous microorganisms. Jeevamrutha is a low cost improvised preparation that enriches the soil with indigenous microorganisms required for mineralization of the soil (Gore et al., 2011). Organic liquid formulations like jeevamrutha and panchagavya help in quick buildup of soil fertility through enhanced activity of soil microflora and

fauna [4]. These have the properties of both fertilizer and biopesticide and play a key role in promoting growth and providing immunity to plant system. Jeevamrutha is produced from available farm wastes like cattle dung and cattle urine along with other ingredients like jaggery, pulse flour and water. It is an important organic liquid formulation which provides a congenial environment to microorganisms upon its application to soil which helps in making essential nutrients available for plant growth viz., nitrogen, phosphorus and potassium to the plants and providing congenial environment to beneficial microbes [5]. Organic manures provide a good substrate for the growth of microorganisms and maintain a favourable nutritional balance and soil physical properties (Ranjit Singh and Rai, 2004).

2. MATERIALS AND METHODS

A field experiment was carried out during *Kharif* 2017 at Zonal Agricultural Research Station, UAS, GKVK, Bengaluru. Soil of the experimental site was red sandy loam classified as *Alfisols*. Organic carbon, available nitrogen, phosphorus and potassium content of the soil were medium (0.58%, 329 kg ha⁻¹, 44 kg ha⁻¹ and 214 kg ha⁻¹, respectively). The experiment was laid out in factorial randomized complete block design (FRCBD), having farmyard manure and jeevamrutha as two factors and tried each at three levels, respectively. These nine treatment combinations were replicated thrice. FYM was applied to the soil three weeks before sowing, and jeevamrutha was applied as soil application at 20, 40, 60 and 80 days after sowing.

2.1 Soil Characteristics of the Experimental Site

Soil of the experimental site was red sandy loam and classified as *Alfisols*. Soil pH was slightly acidic (6.90) with an electrical conductivity of 0.17 dS m⁻¹. The soil organic carbon content was medium (0.58 %) and soil was medium in available nitrogen (329 kg ha⁻¹), available phosphorus (44 kg ha⁻¹) and available potassium content (214 kg ha⁻¹).

2.2 Actual Climatic Condition Prevailed during the Period of Experimentation

Total rainfall received during the year 2017 was 1110.9 mm. The highest rainfall was received during the month of October (264.4 mm) and the lowest rainfall was in the month of December

(6.4 mm). Total rainfall received during crop growth period *i.e.*, from October to December was 280.8 mm. The actual mean minimum temperature was higher than normal temperature. The actual mean sunshine hours recorded was higher in December (6.9 hours) and lower in November (5.4 hours). Mean monthly relative humidity varied from 90 to 91 per cent during crop growth period. The mean temperature and relative humidity existed during the period of experimentation was conducive for the growth and development of sunflower. In general, the plant growth was not affected by any of the weather parameters throughout the crop growth.

Jeevamrutha preparation and application:

Jeevamrutha was prepared by mixing 10 kg cow dung, 10 liter cow urine, 2 kg local jaggery, 2 kg pigeon pea flour and a hand full of soil. All these were put in 200 liter capacity drum and mixed thoroughly, and volume was made up to 200 litre. The mixture was stirred well in a clockwise direction and kept in the shade, covered with a wet jute bag. The solution was regularly stirred clockwise in the morning, afternoon, and in the evening continuously for ten days, and it was then used for soil application. Jeevamrutha was applied when the soil was wet near the root zone of the crop.

Sunflower hybrid KBSH-53, which is moderately resistant to powdery mildew was used for the field experiment. Sunflower crop was sown on 1st October 2017 with a seed rate of 5 kg ha⁻¹ and seeds were sown at a spacing of 60 cm X 30 cm. Irrigation was provided at 10-15 days interval depending on the stage of crop and soil condition. Necessary aftercare operations were followed as per the recommendations. No major pest and disease incidences were noticed during crop growth. Observations on growth parameters were recorded at regular intervals *viz.*, 30 and 60 days after sowing and at harvest. Experimental data collected were subjected to statistical analysis by adopting Fisher's method of Analysis of Variance (ANOVA) as outlined by Gomez and Gomez [6]. Critical Difference (CD) values were calculated whenever the 'F' test was found significant at the 5 per cent level.

3. RESULTS

3.1 Growth Parameter

The application of FYM at different levels, irrespective of varying levels of jeevamrutha has

recorded significantly higher growth parameters. Application of FYM at 150 per cent N equivalent has recorded higher plant height (180.3 cm), number of leaves (20.9), leaf area (5685 cm²), leaf area index (3.16), and total dry matter production (128 g plant⁻¹) compared to FYM at 100 per cent N equivalent (167.0 cm, 18.8, 4769 cm², 2.87, 113 g plant⁻¹, respectively) (Table 1).

Among different levels of application of jeevamrutha, significantly higher plant height (182.3 cm), number of leaves (21.3), leaf area (6031 cm²), leaf area index (3.35), and total dry matter production (109 g plant⁻¹) recorded at 1500 L ha⁻¹ jeevamrutha as compared to without jeevamrutha application (161.1 cm, 17.0, 4512 cm², 2.51, 109.03 g plant⁻¹, respectively) (Table 1).

Among interaction effects, application of FYM at 150 per cent N equivalent and jeevamrutha at 1500 L ha⁻¹ at 20, 40, 60 and 80 days after sowing recorded significantly higher growth parameters like more leaf area (6213 cm²) and leaf area index (3.45) and total dry matter production (133.24 g plant⁻¹) (Table 1).

3.2 Yield and Yield Attributes

Application of FYM at 150 per cent N equivalent recorded significantly higher seed yield (2335 kg ha⁻¹) with an increase of 16.10 percent higher over FYM at 100 per cent N equivalent application (1959 kg ha⁻¹). Similarly, significantly higher oil yield was also recorded with FYM at 150 per cent N equivalent (991 kg ha⁻¹) with an increase of 17.25 percent over FYM at 100 per cent N equivalent (820 kg ha⁻¹) (Table 2).

Also, irrespective of different FYM levels, soil application of jeevamrutha at 1500 l ha⁻¹ which was applied at 20, 40, 60 and 80 DAS accounted for higher seed yield (2349 kg ha⁻¹) with an increase of 19.71 percent over without jeevamrutha application (1886 kg ha⁻¹). Similarly, significantly higher oil yield was also recorded with jeevamrutha at 1500 l ha⁻¹ (992 kg ha⁻¹) with an increase of 20.26 percent over without jeevamrutha application (791 kg ha⁻¹).

Significantly higher seed yield recorded with application of FYM at 150 per cent N equivalent was due to better yield attributing characters like head diameter (14.8 cm), number of seeds per head (1116.9), hundred seed weight (4.62 g), seed yield per plant (59.2 g) (Table 2).

Table 1. Growth attributes of sunflower as influenced by FYM and jeevamrutha at 60 DAS

Treatments	Plant height (cm)	Number of leaves	Leaf area (cm ²)	Leaf Area Index	Dry matter production (g/ plant)
FYM					
F ₁ - 100% N*	167.0	18.8	4769.44	2.87	113.45
F ₂ - 125% N*	173.1	19.9	5517.11	3.07	119.36
F ₃ - 150% N*	180.3	20.8	5685.00	3.16	124.86
S.Em ±	3.2	0.7	83.90	0.047	2.53
C.D at 5 %	9.7	1.99	251.53	0.140	7.58
Jeevamrutha					
J ₀ - Control	161.1	17.0	4512.22	2.51	109.03
J ₁ - 1000 litre ha ⁻¹	171.5	19.0	5827.44	3.24	122.18
J ₂ - 1500 litre ha ⁻¹	182.3	21.3	6031.33	3.35	126.47
S.Em ±	3.2	0.67	83.90	0.047	2.53
C.D at 5 %	9.7	1.99	251.53	0.140	7.58
FYM X Jeevamrutha					
F ₁ J ₀	157.4	16.44	4308.33	2.39	105.67
F ₁ J ₁	167.7	18.51	5335.33	2.96	115.10
F ₁ J ₂	175.9	20.03	5863.00	3.26	119.59
F ₂ J ₀	160.5	17.69	4526.33	2.51	109.00
F ₂ J ₁	177.3	20.92	6007.33	3.34	122.51
F ₂ J ₂	181.8	21.07	6017.67	3.34	126.57
F ₃ J ₀	165.4	17.80	4702.00	2.61	112.41
F ₃ J ₁	186.1	21.94	6139.67	3.41	128.93
F ₃ J ₂	189.3	22.87	6213.33	3.45	133.24
S.Em ±	5.6	1.15	145.32	0.081	4.38
C.D at 5 %	NS	NS	435.96	0.243	12.92

* Nitrogen equivalent

Table 2. Yield attributes, grain yield and oil yield of Sunflower as influenced by FYM

Treatments	Head diameter (cm)	Number of seeds per head	Hundred seed weight (g)	Seed yield per plant	Seed yield per hectare (kg)	Oil yield (kg/ha)
FYM						
F ₁ - 100% N*	13.60	1021.00	3.90	51.02	1959	820
F ₂ - 125% N*	13.86	1050.90	4.17	55.09	2168	912
F ₃ - 150% N*	14.82	1116.89	4.62	59.22	2335	991
S.Em ±	0.30	15.64	0.12	2.13	30.03	12.71
C.D at 5 %	0.90	46.90	0.35	6.39	90.03	38.11
Jeevamrutha						
J ₀ - Control	13.32	1008.80	3.72	49.59	1886	791
J ₁ - 1000 litre ha ⁻¹	14.33	1075.65	4.31	57.92	2227	938
J ₂ - 1500 litre ha ⁻¹	15.31	1104.33	4.76	57.83	2349	992
S.Em ±	0.30	15.64	0.12	2.13	30.03	12.71
C.D at 5 %	0.90	46.90	0.35	6.39	90.03	38.11
FYM X Jeevamrutha						

Treatments	Head diameter (cm)	Number of seeds per head	Hundred seed weight (g)	Seed yield per plant	Seed yield per hectare (kg)	Oil yield (kg/ha)
Jeevamrutha						
F ₁ J ₀	12.77	1001.67	3.61	47.97	1737	695
F ₁ J ₁	14.00	1026.67	4.01	52.25	2032	850
F ₁ J ₂	14.04	1034.67	4.07	52.84	2108	877
F ₂ J ₀	13.33	1006.08	3.64	49.16	1894	793
F ₂ J ₁	14.07	1054.61	4.31	58.54	2243	942
F ₂ J ₂	14.17	1092.00	4.55	57.57	2367	994
F ₃ J ₀	13.85	1018.67	3.92	51.63	2028	848
F ₃ J ₁	14.93	1145.67	4.61	62.97	2405	1011
F ₃ J ₂	15.67	1186.33	4.63	63.07	2573	1103
S.Em ±	0.52	27.09	0.20	3.69	52.01	22.02
C.D at 5 %	NS	NS	NS	10.88	156.03	66.06

* Nitrogen equivalent

Among the interaction effects, yield and yield attributes were improved due to the application of both FYM and jeevamrutha to Sunflower. Significantly higher seed yield (2573 kg ha⁻¹) was recorded with the application of FYM at 150 per cent N equivalent and jeevamrutha at 1500 L ha⁻¹. Significantly, higher oil yield (5183 kg ha⁻¹) was recorded with the application of FYM at 150 per cent N equivalent and jeevamrutha at 1500 L ha⁻¹.

4. DISCUSSION

4.1 Growth Parameter

The increase in growth parameters of sunflower was due to the fact that FYM besides supplying N, P and K also improves the soil condition which improves the source to sink relationship and also make unavailable sources of elemental nitrogen, bound phosphates, micronutrients, and decomposed plant residues into an available form to facilitate the plants to absorb the nutrients [7]. These results follow the findings of the Guriqbal Singh et al. [8] and Siddappa [9]. An increase in growth attributes due to jeevamrutha application might be attributed to the solubilization of nutrients in the soil, and subsequent absorption of the same has made them available to plants throughout the growth. Similar results have been reported by Reshma Sutar et al. [10], Yogananda et al. [11], Jidhu Vaishnavi and Jayakumar [12] and Siddappa [9].

4.2 Yield and Yield Attributes

The application of FYM increased yield and yield attributing characters, which may be attributed to

the fact that the added FYM acts as a storehouse of several macro and micronutrients which are released during the process of mineralization for the plants to take up and thus enhancing the nutrient use efficiency. Also, FYM helps in stimulating the activity of microorganisms as evident from the increased populations of bacteria, fungi, actinomycetes, N fixers and P-solubilizers that helped to make the plant nutrients readily available to the crops. These findings are in conformity with Manjunath et al. [13]. Similar results have also been obtained in the groundnut [14]. Guriqbal Singh et al. [8] and Ghuman and Sur [15] have also reported increased yield in wheat at higher levels of FYM application.

In the present study, all the yield attributing parameters were significantly higher in jeevamrutha at 1500 L ha⁻¹. It was due to the favourable effects of growth hormones like IAA, GA₃, macro and micronutrients and also beneficial microorganisms present in the liquid organic manures in the same line as reported by Somasundaram [16] wherein upon their application to soil, liquid manures acted as a stimulus in the plant system and in turn increased the production of growth regulators in the cell system. Beneficial effects of jeevamrutha due to massive quantity of microbial load and growth hormones leading to sustained the availability and uptake of applied as well as native soil nutrients resulting in enhanced growth and yield of crops has been well documented by Palekar [5]; Devakumar et al. [4] and Sharma and Thomas [17].

Table 3. Cost of cultivation, gross return, net return and B:C ratio of sunflower as influenced by farmyard manure and jeevamrutha

Treatments	Cost of cultivation (₹ ha ⁻¹)	Gross return (₹ ha ⁻¹)	Net return (₹ ha ⁻¹)	B:C ratio
T ₁ : 100% N equivalent through FYM + Jeevamrutha @ 0 l ha ⁻¹ (Control)	28027	60795	32768	2.16
T ₂ : 100% N equivalent through FYM + Jeevamrutha @ 1000 l ha ⁻¹	33027	71120	38093	2.15
T ₃ : 100% N equivalent through FYM + Jeevamrutha @ 1500 l ha ⁻¹	35527	73780	38253	2.07
T ₄ : 125% N equivalent through FYM + Jeevamrutha @ 0 l ha ⁻¹ (Control)	30445	66290	35845	2.17
T ₅ : 125% N equivalent through FYM + Jeevamrutha @ 1000 l ha ⁻¹	35445	78505	43060	2.21
T ₆ : 125% N equivalent through FYM + Jeevamrutha @ 1500 l ha ⁻¹	37945	82845	44900	2.18
T ₇ : 150% N equivalent through FYM + Jeevamrutha @ 0 l ha ⁻¹ (Control)	32862	70980	38118	2.15
T ₈ : 150% N equivalent through FYM + Jeevamrutha @ 1000 l ha ⁻¹	37862	84175	46313	2.22
T ₉ : 150% N equivalent through FYM + Jeevamrutha @ 1500 l ha ⁻¹	40362	90055	49693	2.23

Among the interaction effects, yield and yield attributes were improved due to the application of both FYM and jeevamrutha to Sunflower. Significantly higher seed yield (2573 kgha⁻¹) was recorded with the application of FYM at 150 per cent N equivalent and jeevamrutha at 1500 L ha⁻¹. Significantly, higher oil yield (5183kgha⁻¹) was recorded with the application of FYM at 150 per cent N equivalent and jeevamrutha at 1500lha⁻¹.

Thus, the combined application of FYM and jeevamrutha results in better growth and yield attributes resulting in 32.49 per cent increased seed yield over FYM at 100 per cent N equivalent and without application of jeevamrutha in Sunflower. FYM and jeevamrutha can effectively and efficiently be used to get higher seed yield in Sunflower. Hence, this study has shown that organic manures and organic liquid formulations, thus can be exploited extensively in crop production.

4.3 Economics

Among the different treatment combinations, application of FYM at 150 per cent N equivalent and jeevamrutha application at 1500 L ha⁻¹ recorded higher gross return (Rs. 90055 ha⁻¹), net return (Rs. 49693 ha⁻¹) and benefit-cost ratio (2.23) (Table 3) compared to 100 per cent N equivalent FYM and without jeevamrutha application. The higher gross return was mainly

due to the higher seed yield of sunflower. The findings are in conformity with the Siddappa et al. [9].

5. CONCLUSION

Combined application of FYM and jeevamrutha resulted in better growth and yield attributing parameters and improved yield was due to the slow release of nutrients throughout the growing period of crop and also improved the soil physical, chemical and mineralogical properties of soil which intern increase the fertility status of the soil. Combined application of FYM at 150 per cent N equivalent and jeevamrutha at 1500 L ha⁻¹ recorded 32.49 per cent increased seed yield (2573 kg ha⁻¹ over control 1737 kg ha⁻¹) FYM at 100 per cent N equivalent and without application of jeevamrutha. Hence, these organic manures and liquid formulations are efficient natural substitutes for obtaining higher yield besides improving the nutrient status of the soil.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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