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Effect of jeevamrut on productivity and profitability of wheat under organic farming

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ABSTRACT

A field experiment was conducted during *rabi* 2017–18 and 2018–19 at organic farming unit of Instructional Agronomy Farm, Rajasthan College of Agriculture, Udaipur, Rajasthan to study the influence of different concentrations of jeevamrut and its time of application on growth, yield attributes and yield of wheat grown under organic farming. Results revealed that a significant increase in plant height, dry matter accumulation, number of effective tillers, number of spikelets/ear, number of grains/ear, ear length and grain weight/ear, was observed with the application of 10% jeevamrut over control, 4% jeevamrut and 6% jeevamrut. There was no significant difference observed in grain and straw yield of wheat with the application of 4% and 6% jeevamrut over control. However, application of 8% and 10% jeevamrut significantly increased the grain and straw yield of wheat over control. Application of jeevamrut at 60 and 75 DAS significantly increased plant height, dry matter accumulation, number of effective tillers, number of spikelets/ear, number of grains/ear, ear length and grain weight/ear over the application of jeevamrut at 75 and 90 DAS. Application of jeevamrut twice at 60 and 75 DAS and 75 and 90 DAS significantly increased the grain and straw yield of wheat as compared to one time application of jeevamrut 75 and 90 DAS alone. There was no significant interaction found in the concentration of jeevamrut and its time of application.

Keywords: Grain yield, Jeevamrut, Net return, Organic farming, Wheat

Organic farming is an alternative agricultural production method that relies on ecological processes, biodiversity and cycles adapted to local conditions with the aim of sustaining the health of soil, ecosystem and people (IFOAM 2008). Organic farming is being practiced in 188 countries of the world in 112.4 million ha area (FiBL 2019). The ill-effects of chemicals used in agriculture have changed the mindset of some consumers of different countries who are now buying organic products with high premium for health. Area under organic cereals was 4.5 million ha during 2017 in the world which was 0.6% of the total cereal area in the world (718 million ha in 2016; FAOSTAT). The organic cereal area has more than trebled since 2004 (1.3 million ha). In 2017, the area under organic wheat was increased by 6%. Organic cultivation of wheat is increasing in India and in terms of total export value realization (₹ 3453 crore) and millets contributes 10.4% during 2017–18 (APEDA 2019). The main constraint in the organic farming of wheat is the 20-40% low yield of wheat in comparison to conventional farming which may be attributed to lack of supply of nutrient by organic sources as per requirement of wheat plant at different growth stages (Annual Report 2018-19). Besides use of FYM, vermicompost, neem cake, green manures, biodynamic manures, phosphate rich organic manures; application of jeevamrut, panchagavya and matakakhad is being practiced in organic farming of crops for improving the crop yield and better soil health (Yadav *et al.* 2020 and Sharma *et al.* 2018).

Apart from using conventional farm based products, there is an increasing demand for organic liquid formulations like jeevamrut which helps in quick build-up of soil fertility through enhanced activity of soil microflora and fauna. Role of foliar application of jeevamrut in production of many plantation crops had been well documented in India (Selvaraj 2003). Despite many advantages with organic liquid formulations they have not been exploited extensively in crop production and more so in wheat crop. Therefore, a field study was conducted to study effect of jeevamrut on the growth and yield of wheat grown under organic farming.

MATERIALS AND METHODS

Treatments and agronomic practices: The experiment was conducted during *rabi* 2017–18 and 2018–19 at

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Instructional Agronomy Farm, Rajasthan College of Agriculture, MPUAT, Udaipur. The soil of the experimental site was clay loam in texture with 0.55% organic carbon and 241.2, 20.9 and 351.3 kg/ha available nitrogen, phosphorus and potassium, respectively, in 0-30 cm soil depth with *p*H 8.1. The experiment was laid out in factorial randomized block design with three replications and assigning 25 treatment combinations consisting of control and four doses of jeevamrut (4% jeevamrut, 6% jeevamrut, 8% jeevamrut and 10% jeevamrut) as growth promoter and five times of application of jeevamrut (60 DAS, 75 DAS, 90 DAS, 60 and 75 DAS and 75 and 90 DAS). The wheat variety Raj.-4120 was sown on 27 November 2017 at 22.5 cm row to row spacing by using recommended seed rate of 100 kg/ha. The organic farming practices as per National Programme on Organic Production were followed (Organic Farming Crop Production Guide).

Application of organic manures: NADEP compost 8000 kg/ha, vermicompost 4000 kg/ha and cow horn manure (BD 500) 75 g/ha 40 l water was supplied as basal application before one day of sowing and neem cake 770 kg/ha applied half at the time of sowing and rest at tillering stage. The vermiwash (10%) was sprayed at 25 and 45 days after sowing.

Disease and pest control: Disease and pest free seeds of the Raj-4120 variety of wheat were used for sowing. For pest monitoring, 16 yellow mataka traps per ha were established at 15 days after sowing and 0.5% neem oil was sprayed 20 days after sowing.

Jeevamrut preparation and application: Two hundred litres of water were put in a barrel; 10 kg of fresh desi cow dung was added followed by 10 l of aged cow's urine; to this 2 kg of jaggery, 2 kg of pulse flour (gram) and a handful of live soil from under canopy of the banyan tree (about 100 g) are added. The mixture was stirred well in clock wise direction and kept in shade covered with wet jute bag. The solution was regularly stirred clockwise in the morning, afternoon and in the evening continuously for 7 days as has been suggested by Palekar (2006). Now jeevamrut is ready for application. Two hundred litres of jeevamrut is sufficient for one acre of land. Different concentrations of jeevamrut were applied as foliar spray as per treatment during crop period. After dilution, the jeevamrut solution was double filtered before using it for spraying.

Bio-chemical composition of jeevamrut: Jeevamrut solution was analysed on the 7th day of its preparation. The nutrient content of jeevamrut was 1.90% N, 0.20%, 0.29% K, 4.25 ppm Zn and 285 ppm Fe, whereas 6.33×10^{8}cfu/ml bacteria, 5.1×10^{4} cfu/ml fungal and 3×10^{5} actinomycetes were detected. Also 0.931 µg/ml acid phosphates, 1.068 µg/ml alkaline phosphates and 2.771 µg/ml dehydrogenase activity were observed. The pH of jeevamrut is 4.04 and electric conductivity 1.70 dS/m was recorded.

RESULTS AND DISCUSSION

Yield attributes and yield: The pooled data analysis showed that the application of jeevamrut 10% significantly increased number of effective tillers/m row length, number of spiklets/ear, number of grains/ear and ear length of wheat in comparison to control, 4% and 6% jeevamrut. However, the effect of 8% and 10% concentration of jeevamrut on yield attributes, viz. number of effective tillers/m row length, number of spiklets/ear, number of grains/ear and ear length were found to be at par (Table 1). The effect of jeevamrut application on test weight of wheat was found non-significant. In the present investigation, application of 10% jeevamrut recorded significantly higher grain and straw yield of wheat during 2017–18, 2018–19 and on pooled basis. On pooled basis the grain yield of wheat (41.19 q/ha) was higher by 13.13, 8.68, 7.18 and 3.72% over control, 4%, 6% and 8% jeevamrut concentration, respectively. The maximum biological yield of wheat was recorded under the 10% jeevamrut during 2017–18, 2018–19 and on pooled basis (100.36 q/ha, 103.50 and 101.93 q/ha, respectively) (Table 2). The increase in grain yield and straw yield of wheat due to application of 10% jeevamrut could be due to better availability of nutrients and plant growth hormones during the critical period of crop growth. Whenever liquid manures are applied at regular intervals (2 to 3 times), they act as a stimulus in the plant system and in turn increase the production of growth regulators in the cell system. These findings are in accordance with Kasbe *et al.* (2009) wherein it is reported that better nutrient status of jeevamrut formulation (2500 l/ha) resulted in profused growth in the form of higher dry matter accumulation and yield parameters. Similar results were also observed by Shwetha (2008) who reported 25–35% increase in seed yield of soybean with the application of beejamrut, jeevamrut and panchagavya along with different organic manures.

Grain yield of wheat was also affected significantly with the time of application of jeevamrut. Application of jeevamrut twice either at 60 and 75 DAS recorded higher yield of wheat in comparison to application of jeevamrut at 75 and 90 alone DAS (Table 2). Data further indicates that number of effective tillers/m row length, number of spiklets/ear, number of grains/ear, ear length, grain weight/ear, grain yield and straw yield (Table 2) increased significantly on pooled basis with the application of jeevamrut at 60 and 75 DAS as compared to other stages of application which might be ascribed to the sustained availability of nutrients (N, P, K, S, Zn and Fe) at growth stages of wheat and also due to enhanced carbohydrate synthesis and effective translocation of photosynthates to the developing sink. Jeevamrut increased synthesis of growth promoting substances which in turn helped in increased growth and yield attributes and finally grain yield. Palekar (2006); Vasantkumar (2006) and Devakumar *et al.* (2008) reported the beneficial effects of jeevamrut which was attributed to high microbial population and enzymes which in turn might have availability and uptake of nutrients and growth hormones which ultimately have resulted in better growth and yield of crops.

Economics: Application of 10% jeevamrut gave significantly higher net return during 2017-18, 2018-19 and

Table 1 Yield attributes of wheat influenced by jeevamrut application under organic farming

Treatment	Yield attributes														
	Number of effective tillers/m row length			Number of spiklets/ ear			Number of grains/ ear			Ear length (cm)			Test weight (g)		
	2017-18	2018-19	Pooled	2017-18	2017-18	Pooled	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled
Concentration of jeevamrut															
Control	72.47	73.91	73.19	16.20	17.64	16.92	38.32	39.77	39.05	11.40	12.84	12.12	51.18	51.81	51.50
4% Jeevamrut	75.53	77.04	76.29	17.33	18.84	18.09	40.87	42.37	41.62	11.75	13.26	12.51	51.26	51.89	51.58
6% Jeevamrut	79.67	81.19	80.43	19.67	21.19	20.43	41.92	43.45	42.69	12.65	14.18	13.41	51.92	52.59	52.25
8% Jeevamrut	82.60	84.37	83.48	20.40	22.17	21.28	42.57	44.34	43.46	13.02	14.78	13.90	51.93	52.63	52.28
10% Jeevamrut	84.67	86.49	85.58	21.13	22.95	22.04	43.20	45.02	44.11	13.84	15.66	14.75	51.88	52.58	52.23
SEm ±	0.78	0.78	0.78	0.40	0.40	0.40	0.72	0.73	0.73	0.27	0.27	0.27	0.31	0.30	0.30
CD (P=0.05)	2.22	2.23	2.23	1.14	1.13	1.14	2.06	2.07	2.06	0.76	0.76	0.76	NS	NS	NS
Time of application															
60 DAS	76.53	78.13	77.33	17.93	19.53	18.73	39.93	41.53	40.73	11.95	13.55	12.75	51.81	52.47	52.14
75 DAS	77.80	79.41	78.61	18.33	19.95	19.14	40.46	42.07	41.26	12.33	13.94	13.14	51.86	52.52	52.19
90 DAS	78.87	80.48	79.67	19.20	20.81	20.01	41.57	43.18	42.38	12.49	14.10	13.30	51.47	52.15	51.81
60 and 75 DAS	80.27	81.88	81.07	19.33	20.95	20.14	42.19	43.80	43.00	12.66	14.27	13.47	51.37	52.04	51.71
75 and 90 DAS	81.47	83.09	82.28	19.93	21.56	20.75	42.73	44.36	43.55	13.22	14.85	14.04	51.65	52.33	51.99
SEm ±	0.78	0.783	0.783	0.40	0.40	0.40	0.72	0.73	0.73	0.27	0.27	0.27	0.31	0.30	0.30
CD (P=0.05)	2.22	2.23	2.23	1.14	1.13	1.14	2.06	2.07	2.06	0.76	0.76	0.76	NS	NS	NS

Table 2 Yield and economics of wheat influenced by jeevamrut application under organic farming

Treatment	Yield (q/ha)						Economics					
	Grain			Straw			Net return (₹/ha)			B-C ratio		
	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled
Concentration of jeevamrut												
Control	35.83	36.98	36.40	50.24	52.46	51.35	78208	82537	80373	1.66	1.75	1.71
4% Jeevamrut	37.33	38.48	37.90	53.93	56.15	55.04	84193	88524	86359	1.78	1.87	1.83
6% Jeevamrut	37.86	39.01	38.43	54.57	56.79	55.68	85980	90310	88145	1.82	1.91	1.87
8% Jeevamrut	39.13	40.28	39.71	56.27	58.49	57.38	90378	94708	92543	1.91	2.0	1.96
10% Jeevamrut	40.73	41.65	41.19	59.62	61.84	60.73	96511	100197	98354	2.04	2.12	2.08
SEm ±	0.91	0.50	0.52	1.66	0.73	0.90						
CD (P=0.05)	2.60	1.43	1.47	4.71	2.10	2.58						
Time of application												
60 DAS	36.23	37.38	36.81	51.98	54.20	53.09	80142	84472	82307	1.69	1.79	1.74
75 DAS	36.70	37.85	37.28	52.86	55.08	53.97	81889	86219	84054	1.73	1.82	1.78
90 DAS	37.54	38.69	38.12	52.80	55.02	53.91	84211	88541	86376	1.78	1.87	1.83
60 and 75 DAS	39.82	40.97	40.39	57.71	59.93	58.82	93037	97367	95202	1.97	2.06	2.02
75 and 90 DAS	40.59	41.51	41.05	59.27	61.49	60.38	95991	99677	97834	2.03	2.11	2.07
SEm ±	0.91	0.50	0.52	1.66	0.73	0.90						
CD (P=0.05)	2.60	1.43	1.47	4.71	2.10	2.58						

on pooled basis (96511 ₹/ha, 100197 ₹/ha and 98354 ₹/ha, respectively) as compared to other treatments. Application of jeevamrut (4–10%) resulted in a higher net return of 6000 ₹/ha to 18000 ₹/ha in comparison to no spray of jeevamrut (Table 2). The maximum benefit-cost ratio of wheat was recorded under the 10% jeevamrut during 2017-18, 2018–19 and on pooled basis (2.04, 2.12 and 2.08, respectively) as compared to control and other doses of jeevamrut (Table 2). The higher net return could be explained on the basis of increased seed and straw yield under the 10% jeevamrut in the present investigation. The lowest net return during 2017–18, 2018–19 and on pooled basis (78208 ₹/ha, 82537 ₹/ha and 80373 ₹/ha) was recorded under control. It was observed that application of jeevamrut is one of the cheap and efficient organic supplements to organic cultivation for high crop yield and profitability (Kasbe *et al.* 2009). These results are in conformity with the findings of Boraiah (2013), Deshmukh *et al.* (2010).

Hence, it has been concluded from the research study that maximum net return was recorded with the application of jeevamrut twice at 75 and 90 DAS followed by application of jeevamrut twice at 60 and 75 DAS. The higher net return due to application of jeevamrut at 75 and 90 DAS could be explained on the basis of increased seed and straw yield under the application of jeevamrut at 75 and 90 DAS in the present investigation.

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