Indian Journal of Agronomy **58** (2): 182–186 (June 2013)

Research Paper

Evaluation of microbial culture (*Jeevamrit*) preparation and its effect on productivity of field crops

C.S. AULAKH[1], HARGOPAL SINGH[2], S.S. WALIA[3], R.P. PHUTELA[4] AND GURMINDER SINGH[5]

Punjab Agricultural University, Ludhiana, Punjab 141 004

Received : June 2012; Revised accepted : March 2013

ABSTRACT

Jeevamrit, a microbial culture, prepared especially from dung and urine of Indian cow is generally advocated for use in organic farming to meet the nutritional requirement of crops. Laboratory studies and field experiments were conducted to know the microbial composition and nutrient content of *jeevamrit* and its effect on the performance of rice (*Oryza sativa* L.)–wheat {*Triticum aestivum* (L.) emend. Fiori & Paol} and maize (*Zea mays* L.)–wheat cropping systems. The pH of *jeevamrit* prepared from buffalo, Indian cow and hybrid cow decreased from 8.32, 7.89 and 7.71 at the start to 3.86, 3.65 and 3.56, respectively after 5 days of incubation. The microbial count increased from its initial values in all the cultures. The bacterial count *of jeevamrit* prepared from Indian cow's dung and urine was highest followed by hybrid cow and buffalo, where as the fungal count was highest in *jeevamrit* prepared from hybrid cow's dung and urine followed by Indian cow and buffalo. *Jeevamrit* prepared from Indian cow and hybrid cow's dung and urine did not differ much in the microbial count (bacteria and fungi). The nutrient contents were 0.22, 0.04 and 0.60 g nitrogen, 0.11, 0.04 and 0.06 g phosphorus, 1.09, 0.28 and 0.75 g potassium and 0.46, 0.43 and 0.39 g sulphur in each litre of *jeevamrit* prepared from buffalo, Indian cow and hybrid cow's dung and urine, respectively; showing relatively higher contents of these nutrients in case of buffalo. The carbon content was more in *jeevamrit* prepared from dung and urine of Indian cow followed by buffalo and hybrid cow. The field application of *jeevamrit* over two years (2009–10 and 2010–11) neither alone nor in combination with chemical fertilizers or farmyard manure influenced the grain yield of rice, maize and wheat in rice–wheat and maize–wheat cropping systems indicating its inability to supply nutrients to the crops in needed quantities either directly or indirectly through mobilization of native nutrients from the soil.

***Key words*:** Cow dung and urine, *Jeevamrit*, Maize, Organic farming, Rice, Wheat

Organic farming is gaining importance in Indian agriculture on account of sustainability and quality of the crops being produced. It is being practiced on 37.2 million ha area in 160 countries of the world, which constitutes about 0.9% of the world's agricultural land (Willer and Kilcher, 2011). The area under certified organic crops has increased from 42000 ha in 2003–04 to 1.08 m ha in 2010 (Yadav, 2010). The organic cultivation of crops has been recommended by substituting chemical fertilizers and pesticides with organic manures and biopesticides, respectively (PAU, 2012). The commonly used organic manures like farmyard manure, green manures, composts, vermicompost and non–edible cakes are required in large quantities to meet the nutritional requirement of crops. The limited availability of these bulky organic manures demands their integration with other available options. The combined use of organic manures and specially prepared organics (*jeevamrit*, *panchgavya*) helped in sustaining soybean and wheat yields in organic nutrient management system (Shwetha *et al.*, 2009). Combined application of green manures, crop residues and composts along with liquid manures like *beejamrut*, *jeevamrit*, *panchgavya*, *sasyamrut* and vermiwash *etc.* can release the nutrients in a more synchronized manner as per the need of the crop (Kanwar *et al.*, 2006). *Jeevamrit* enhances microbial activity in soil and helps in improvement of soil fertility (Joshi, 2012).

Jeevamrit is claimed to be a panacea for organic farming to fulfill the nutritional requirement of crops as well as for pest management. The *jeevamrit* should be prepared from dung and urine of Indian cow only and dung and urine of one cow is sufficient for organic cultivation of 12 ha (Palekar, 2009). A large number of organic growers primarily depend upon *jeevamrit* for organic farming

[1]**Corresponding author Email:** csaulakh@rediffmail.com
[1 & 3]Agronomist, [5]Research Fellow, Department of Agronomy, [2]Senior Soil Scientist, Department of Soil Science, [4]Senior Microbiologist, Department of Microbiology, PAU Ludhiana, Punjab

(Joshi, 2008; Singh, 2009). Therefore, laboratory studies were conducted to know the chemical and biological composition of *jeevamrits* prepared from the urine and dung of different species of farm animals. Further, since rice–wheat and maize–wheat are the prominent cropping systems in Punjab and thus field experiments were conducted to evaluate the potential of *jeevamrit*, prepared from dung and urine of Indian cow, to supply nutrition to these crops.

MATERIALS AND METHODS

Laboratory studies

Three sets of *jeevamrit*, one each from the dung and urine of Indian cow, hybrid cow and buffalo were prepared by using 1 kg dung, 1 litre urine, 200 g jaggery, 200 g chickpea flour and 100 g virgin soil from a canal bank. The final volumes of the mixtures were made to 20 litres with water in plastic containers. The mixtures were kept for incubation under shade for 5 days and stirred vigorously for 10–15 minutes three times a day with a wooden stick. The average minimum and maximum temperatures during the study period were 13.4 and 31.1ºC, respectively. Total carbon, nitrogen and sulphur contents of these culture solutions were determined by using CHNS Analyzer (Elementar Vario ELIII). Total phosphorous was determined by vanadomolybdophosphoric yellow colour method after digestion of the sample with diacid and potassium was determined by flame photometer (Jackson, 1967).

The bacterial and fungal populations were estimated by the serial dilution and pour plate techniques using soil extract agar and Rose Bengal agar media, respectively (Lochhead and Chase, 1943; Martin, 1950). The media were prepared and sterilized in an autoclave at 15 psi for 20 minutes, while pre–sterilized agar plates were used for plating of diluted samples in triplicates. The agar plates for bacteria and fungi were incubated at 30 ± 1^{o}C in an inverted position for 5 to 7 days until countable colonies were developed. The respective colonies were counted on the basis of their morphological characteristics and growth pattern. The results were expressed as colony forming units (cfu)/ml.

Field studies

The field evaluation of *jeevamrit* was done on rice, maize and wheat in rice–wheat and maize–wheat cropping systems during 2009–10 and 2010–11 in a split plot design with three replications. The main plots consisted of recommended doses of chemical fertilizers (chemical fertilizer), farmyard manure to supply 100 kg N/ha (FYM_{100}), farmyard manure to supply 200 kg N/ha (FYM_{200}) and unfertilized control.

The sub–plots consisted of soil application of *jeevamrit* (soil), soil and foliar application of *jeevamrit* (soil+foliar) and control. The soil of the experimental field having rice–wheat system was loamy sand having normal pH (7.12) and EC (0.2 dS/m), low soil organic carbon (0.39%), low in available nitrogen (193 kg/ha), high in available phosphorus (78 kg/ha) and medium in available potassium (193 kg/ha). The soil of the experimental field having maize–wheat system was loamy sand having normal pH (7.08) and EC (0.2 dS/m), medium soil organic carbon (0.44%), low in available nitrogen (194 kg/ha), high in available phosphorus (90 kg/ha) and medium in available potassium (188 kg/ha). The recommended agronomic practices, except the nutrition and pest management practices, were followed to raise the crops. Rice 'PAU 201' was transplanted on July 3 during both the years at a plant density of 33 hills/m^2 and harvested on November 3 and October 20 during 2009–10 and 2010–11, respectively. Water was kept ponded in the rice field continuously for 15 days and subsequently irrigations were given 2 days after the ponded water receded completely. Wheat 'PBW-550' was sown, at a row spacing of 20 cm by using 112.5 kg/ha seed, on November 19 and 12 and harvested on April 9 and 12 during 2009–10 and 2010–11, respectively. Maize 'PMH-1' was sown, at a row to row spacing of 60 cm and plant to plant spacing of 22 cm by using 20 kg/ha seed, on July 7 and June 21and harvested on October 7 and 11 during 2009–10 and 2010–11, respectively.

Well decomposed FYM (having 1.0% N) was used to supply the nutrients as per the treatments. The entire quantity of FYM was applied before sowing or transplanting the crops. Chemical fertilizers (urea, DAP and MOP) were used to supply 120–30–30 kg N-P_2O_5-K_2O/ha to rice, maize and wheat in chemical fertilizer plots. The 1/3rd N and whole P and K to rice were applied at the time of puddling and the remaining N was applied in 2 splits at 3 weeks and 6 weeks after transplanting. In maize, the 1/3rd N and whole P and K were applied at the time of sowing and the remaining N was applied in 2 splits at knee high stage and at tasseling. Half of recommended N and whole P and K to wheat were applied at the time of sowing and the remaining N was applied at the time of 1st irrigation. Weed control in all the crops was done manually. The insect–pest management in organic manured plots and unfertilized control plots in rice and maize was done by using *Trichogramma*–cards @ 100 cards/ha. The cards were used as one time application in maize after 15 days of sowing and in rice they were applied 5 times starting from 30 days after transplanting at weekly interval. The insect–pest management in chemical fertilizer plots of rice was done by using two sprays of monocil 36 SL @ 1400 ml/ha and one spray of dursban 20 EC @ 2.5 l/ha and in maize it was done with decis 2.8 EC @ 200 ml/ha. Two sprays of tilt @ 500 ml/ha were also given to rice at flowering. The aphid management in wheat in organic manured plots and unfertilized control was done by econeem @ 500 ml/ha. In chemical fertilizer plots, one spray of rogar @ 375 ml/ha was done to control the aphid attack.

The *jeevamrit* @ 500 l/ha was applied four times along with irrigation water and foliar spray as per the treatments and was prepared afresh every time before its application. The microbial population was studied in the soil taken from 0–15 cm depth of the plots receiving *jeevamrit* as soil + foliar application and control after the 4^{th} application of *jeevamrit* to each crop.

The data on crop yields and soil microbial population were pooled and statistically analyzed by using statistical methods described by Gomez and Gomez (1984) and the software used was CPCS1 developed by the Department of Statistics, Punjab Agricultural University, Ludhiana.

RESULTS AND DISCUSSION

Chemical composition of jeevamrits

The pH of *jeevamrits* prepared from dung and urine of buffalo, Indian cow and hybrid cow decreased progressively with time from 8.32, 7.89 and 7.71 at the start to 3.86, 3.65 and 3.56, respectively after 5 days of incubation (Table 1, Fig 1) and this is ascribed to the increased activity of acid producing microorganisms. The *jeevamrit* solutions from the excreta of buffalo, Indian cow and hybrid cow contained 0.22, 0.04 and 0.60 g nitrogen, 0.11, 0.04 and 0.06 g phosphorus, 1.09, 0.28 and 0.75 g potassium and 0.46, 0.43 and 0.39 g sulphur/litre, respectively. The nitrogen, phosphorus and potassium contents were relatively higher in *jeevamrit* prepared from buffalo excreta followed by that of hybrid cow and Indian cow. The chemical composition of dung and urine is reported to be influenced by the factors like cattle species, type and age of the animal, nutrient composition of the feed and climate of the region (Van Fassen and Van Dijk, 1987).

The nitrogen content decreased with time from its initial value in all the preparations of *jeevamrit* (Fig. 2). The sulphur content was highest in the *jeevamrit* prepared from buffalo excreta followed by Indian cow and hybrid cow *jeevamrits*. The carbon content was more in *jeevamrit* prepared from Indian cow excreta followed by that of buffalo and hybrid cow. The overall content of nutrients in the *jeevamrit* irrespective of the source was very low (Table 1). Joshi (2012) reported 0.1–0.5% N, 0.02–0.04% P and 0.2–0.4% K in *jeevamrit*. Reddy (2009) also reported low concentrations of nitrogen, phosphorus and potassium in the *jeevamrit* solutions.

Microbial population

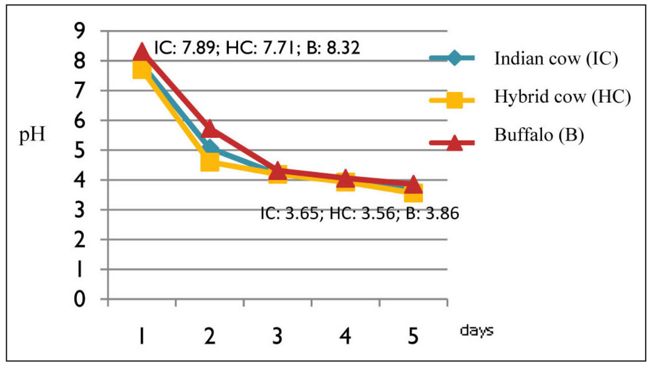

Fig. 1. pH changes in *jeevamrit*

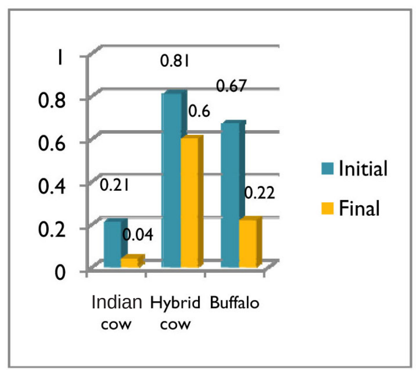

Fig. 2. Nitrogen (g/l) content in *jeevamrit*

Table 1. Microbial population and nutrient content in *jeevamrit*

Parameter	*Jeevamrit* preparations		
	Buffalo	Indian cow	Hybrid cow
*Microbial counts (cfu/ml)**			
Bacterial count	2.6×10^6 (1.9×10^3)	8.9×10^6 (1.8×10^3)	8.6×10^6 (1.8×10^3)
Fungal	1.10×10^4 (1.6×10^3)	1.30×10^4 (1.8×10^3)	1.35×10^4 (1.7×10^3)
Nutrient content (g/l)			
Carbon	5.99	7.19	5.47
Nitrogen	0.22	0.04	0.60
Phosphorus	0.11	0.04	0.06
Potassium	1.09	0.28	0.75
Sulphur	0.46	0.43	0.39

*The figures in parentheses are at the start of the preparation of *jeevamrit*

The initial microbial population (bacteria and fungi) was less in all the *jeevamrit* solutions at the start of their preparation and it increased with time as the incubation progressed. Joshi (2012) also reported 5–7 times increase in nitrogen fixing and phosphate solublising bacteria in *jeevamrit* as compared to original count in cow's urine and dung. The bacterial count was the highest in the *jeevamrit* prepared from excreta of Indian cow followed by hybrid cow and buffalo (Table 1). But the fungal count was the highest in the *jeevamrit* prepared from excreta of hybrid cow (1.35×10^4 cfu/ml) followed by Indian cow (1.30×10^4 cfu/ml) and buffalo (1.10×10^4 cfu/ml). Thus, there was not much difference between Indian cow and hybrid cow with respect to microbial count of *jeevamrit* solutions. Hence, it can be concluded that the nutrient content of the *jeevamrits* irrespective of the source is very low to meet the nutritional requirement of crops in needed quantities. Though the bacterial population was less in buffalo culture, there was not much difference in the *jeevamrit* solutions from the Indian cow and hybrid cow excreta. The bacterial and fungal count increased from the initial value in all the *jeevamrits.*

Effect on crop productivity

In rice–wheat system, a significant reduction was observed in rice grain yield with FYM_{200} and FYM_{100} than that with chemical fertilizer in 2009–10 but these differences were non–significant in 2010–11. This can be attributed to the more availability of nutrients to rice in 2010–11 due to the residual effect of FYM. A significant reduction of 34.6 and 40.5 and 18.6 and 36.2% in wheat grain yield was observed with FYM_{200} and FYM_{100}, respectively as compared to the chemical fertilizer in 2009–10 and 2010–11 respectively. In maize–wheat system, the maize and wheat grain yields were significantly less with FYM_{200} and FYM_{100} than that with chemical fertilizer during both the years.

The pooled data analysis showed the highest grain yields of rice, maize and wheat with chemical fertilizer which were significantly higher than FYM_{100}, FYM_{200} and unfertilized control (Table 2) indicating inability of FYM to supply required quantities of nutrients to the crops. FYM application at both the rates was significantly better than unfertilized control. FYM_{200} was significantly better than FYM_{100} in wheat but statistically at par in rice and maize and that could be attributed to enhanced release of nutrients from the FYM and soil during *kharif* season. The application of *jeevamrit* had no significant influence on the grain yield of rice and wheat in rice–wheat system and maize and wheat in maize–wheat cropping system. It did not show any differential effect when applied alone or in combination with chemical fertilizers or farmyard manure thus indicating its inability to supply the required quantity of nutrients to the crop plants. Application of *jeevamrit* alone yielded 16 and 49% lower grain yields of rice and wheat, respectively as compared to the chemical fertilizer in rice–wheat cropping system. The corresponding yield reductions in maize–wheat were 56 and 48%, respectively. Shwetha *et al.* (2009) also reported significantly lower soybean yields with organic preparations alone than that with the recommended fertilizers. Kasbe *et al.* (2009) also reported that *jeevamrit* did not improve growth and yield parameters of aerobic rice.

Soil microbial population

The microbial population (bacteria and fungi) in soil was assayed after the 4th application of *jeevamrit*. The bacterial and fungal counts of soil in rice and wheat in rice–

Table 2. Effect of different nutrient sources and *jeevamrit* on grain yield of crops

Nutrient source	Grain yield (t/ha)											
	Maize–wheat system						Rice–wheat system					
	Maize			Wheat			Rice			Wheat		
	2009	2010	Pooled	2009	2010	Pooled	2009	2010	Pooled	2009	2010	Pooled
Chemical fertilizer	5.07	7.96	6.52	5.16	5.91	5.54	8.69	7.20	7.95	5.63	5.80	5.71
FYM_{100}	2.05	4.93	3.49	2.88	4.13	3.50	7.15	7.14	7.14	3.35	3.70	3.53
FYM_{200}	2.36	5.11	3.73	3.06	4.93	3.99	7.53	7.15	7.34	3.68	4.72	4.20
Unfertilized control	1.87	3.59	2.73	2.44	3.21	2.83	6.54	6.16	6.35	2.73	2.90	2.81
SEm±	0.13	0.21	0.15	0.13	0.16	0.09	0.18	0.13	0.12	0.07	0.21	0.13
CD (P=0.05)	0.46	0.73	0.50	0.44	0.55	0.30	0.60	0.44	0.40	0.24	0.74	0.45
Jeevamrit application												
Jeevamrit (soil)	2.83	5.39	4.11	3.46	4.52	3.99	7.43	6.94	7.19	3.92	4.26	4.09
Jeevamrit (soil+foliar)	2.98	5.40	4.19	3.35	4.59	3.97	7.62	7.03	7.33	3.80	4.35	4.08
Control	2.70	5.40	4.06	3.34	4.52	3.94	7.38	6.76	7.07	3.82	4.24	4.03
SEm±	0.11	0.20	0.12	0.10	0.14	0.09	0.15	0.13	0.08	0.09	0.06	0.05
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 3. Effect of different treatments on microbial population (pooled data)

Nutrient source	Microbial population (cfu*/g soil)							
	Rice–wheat				Maize–wheat			
	Rice		Wheat		Maize		Wheat	
	Bacteria ($\times 10^6$)	Fungi ($\times 10^3$)	Bacteria ($\times 10^6$)	Fungi ($\times 10^3$)	Bacteria ($\times 10^6$)	Fungi ($\times 10^3$)	Bacteria ($\times 10^6$)	Fungi ($\times 10^3$)
Chemical fertilizer	22.3	23.5	18.4	29.0	18.4	18.1	16.9	23.1
FYM_{100}	22.1	25.7	18.3	31.6	23.5	22.5	15.8	22.7
FYM_{200}	21.6	24.2	18.4	28.8	21.2	21.3	17.5	23.6
Unfertilized control	21.3	25.6	17.0	29.9	22.2	21.1	18.7	24.0
SEm±	0.53	1.11	1.02	1.25	0.78	0.40	0.73	1.58
CD (P=0.05)	NS	NS	NS	NS	3.3	1.7	NS	NS
Jeevamrit application								
Jeevamrit (soil+foliar)	23.2	27.6	20.5	33.7	24.5	23.4	20.5	26.6
Control	20.4	21.9	15.6	25.9	18.2	18.0	13.9	20.2
SEm±	1.35	1.52	0.99	1.46	1.20	0.61	1.29	0.99
CD (P=0.05)	NS	5.0	3.2	4.8	3.9	2.0	4.2	3.2

*cfu–colony forming units

wheat cropping system and wheat in maize–wheat system were statistically at par among different nutrition treatments including the unfertilized control (Table 3). However, in maize, the number of bacterial and fungal counts in soil was less in chemical fertilizer plots as compared to organic manured plots and unfertilized control plots.

The *jeevamrit* application resulted in significantly higher counts of bacteria and fungi in soil under all the crops (Table 3). It appears that the microbial population build–up in the *jeevamrit* solution caused increased counts of bacteria and fungi in plots receiving *jeevamrit*. However, the non–significant differences in crop yields with its application pointed to the fact that the microbes present in the *jeevamrit* were purely saprophytic and devoid of specific characteristics like nitrogen fixation, solublization of phosphorous and uptake of sulphur, hence unable to contribute nutritionally to the crop plants.

REFERENCES

Gomez, K.A. and Gomez, A.A. 1984. *Statistical Procedures for Agricultural Research*. John Wiley and Sons, New Delhi.

Jackson, M. L. 1967. *Soil Chemical Analysis*, New Delhi, India: Prentice Hall of India Pvt. Ltd. pp 498.

Joshi, M. 2008. Studies on organic farming practices in Karnataka. *Project Report*. University of Agricultural Sciences, Bangalore, India, pp 12–14.

Joshi, M. 2012. *New Vistas of Organic Farming*. Scientific Publishers, New Delhi. pp140.

Kanwar, K., Paliyal, S.S. and Bedi, M.K. 2006. Integrated management of green manure, compost and nitrogen fertilizer in a rice–wheat cropping sequence. *Crop Research* **31**(3): 334–38.

Kasbe, S.S., Joshi, M. and Bhaskar, S. 2009. Characterization of Farmers' *Jeevamruta* Formulations with Respect to Aerobic Rice. *Mysore Journal of Agricultural Sciences* **43**(3): 570–73.

Lochhead, A.G. and Chase, F.E. 1993. Qualitative studies of soil micro–organisms IV. Nutritional requirements of the predominant bacterial flora. *Soil Science* **55**: 185–95.

Martin, J.P. 1950. Use of acid, rose Bengal and streptomycin in the plate method for estimating soil fungi. *Soil Science* **69**: 215–32.

PAU. 2012. *Package of Practices for Crops of Punjab (Kharif)*. Punjab Agricultural University, Ludhiana, Punjab, India. pp 129–34.

Palekar, S. 2009. *How to Practice Natural Farming?* All India Pingalwara Charitable Society. pp 22–27.

Reddy, J. 2009. A model organic farm and holistic approach for sustainable agriculture. *Proceedings of International seminar on India Organic–Strategies to Surge Ahead*, International Competence Centre for Organic Agriculture, Sept. 10–11, Bangalore.

Shwetha, B.N., Babalad, H.B. and Patel, R.K. 2009. Effect of combined use of organics, soybean–wheat cropping system. *Journal Soils and Crops* **19**(1): 8–13.

Singh, J. 2009. Going green. *The Tribune*, Feb. 7, 2009.

Van Fassen, H.G. and Van Dijk, H., 1987. Manure as a source of nitrogen and phosphorus in soils. In: Van der Meer H.G., Unwin, R.J., Van Dijk T.A., Ennik, G.C. (Eds.), *Animal Manure on Grassland and Fodder Crops: Fertilizer or Waste?* Martinus Nijhoff, Dordrecht. pp 27–45.

Willer, H. and Kilcher, L. 2011. *The World of Organic Agriculture: Statistics and Emerging Trends*, IFOAM, Bonn and FiBL, Frick.

Yadav, A.K. 2010. Status of organic agriculture in India. *Organic Farming Newsletter* **6**(4): 3–10.