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Innovation in traditional organic nutrient management practices for better soil health and higher productivity of brahmi (*Bacopa monnieri* L.)

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This study was conducted at Medicinal Plants Research and Development Centre (MRDC) of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, District Udham Singh Nagar, India, to examine the effect of *Jeevamrit* (Bioenhancer) on soil health and herbage yield of brahmi crop (var. CIM- Jagriti) and to optimise its rate of application. The experiment was laid out in randomised block design (RBD), replicated trice. The experimental soil was sandy clay loam in texture, neutral in reaction, having pH 6.9, medium in organic carbon (0.64%), low in available nitrogen (180.78 kg ha^{-1}) and medium in both available phosphorus (20.14 kg ha^{-1}) and potassium (200.64 kg ha^{-1}). *Jeevamrit* enhances soil nutrient content, improve bulk density and biodiversity by increasing beneficial soil microbes which mineralise the nutrients present in soil and increase their availability. *Jeevamrit* 4000 l ha^{-1} can be used as a nutrient source in place of chemical fertilisers and expensive bulky organic manures under organic nutrient management.

Keyword: Brahmi crop, Bulk density, *Jeevamrit*, Organic manures, Soil microbes, Soil nutrient

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India is one of the 12-mega biodiversity centres and could be termed as botanical garden of the world with a wealth of about 8000 species of medicinal plants. The developing countries are the leading suppliers of medicinal plants to the world and India is one among them[1]. Recently, the interest in the use of herbal products has grown dramatically in the western world as well as in developed countries[2]. *Bacopa monnieri* commonly known as brahmi or water hyssop is one of the potent plants belonging to family Scrophulariaceae. The genus *Bacopa* includes over 100 species of aquatic herbs distributed throughout the warmer regions of the world.

The herb has been mentioned in several ancient Ayurvedic treatises including the 'Charaka Samhita' since sixth century AD, in which it is recommended in formulations for the management of a range of mental conditions including anxiety, poor cognition and lack of concentration, as a diuretic and as an energizer for the nervous system and the heart[3]. Specific uses include the treatment of asthma, insanity and epilepsy[4]. The plant has been utilised extensively as a nootropic, digestive aid and to improve learning, memory and respiratory functions[5]. Other pharmacological properties of the extracts include sedation and cardio tonic, vasoconstriction and anti-inflammatory activity.

Despite, wide ranges of medicinal properties, not much agronomical studies have been conducted to explore the potential of this plant in a sustainable manner. Plant nutrient management is one of the important agronomic practices which influence the growth and development of the plant and ultimately affect the herb yield and alkaloid content of the plant. We are also aware that the modern agriculture largely depends on the continuous and imbalanced use of fertilisers which adversely affects the sustainability of agricultural production besides causing environmental pollution. Improvement and maintenance of soil fertility, environment quality and sustaining crop production is a worldwide concern.

Heavy use of chemicals in agriculture has weakened the ecological base in addition to degradation of soil, water resources and quality of the food. At this juncture, a keen awareness has sprung on the adoption of "organic farming" as a remedy to cure the ills of modern chemical agriculture[6]. It is very much essential to develop a strong workable and compatible package of nutrient management through organic resources for

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various crops based on scientific facts, local conditions and economic viability.

All the nutrients present in the soil do not remain in available form for the plants. They first need to be transformed into the available form through the action of microorganisms that are normally present in the soil. But excessive use of chemicals has disturbed the flora including the population of micro-organisms. It is thus necessary to conserve and activate the population of various species of microorganisms through innovation in traditional methods like application of *desi* cow dung, cow urine, vermicompost and organic waste etc. *Jeevamrit* is one of the options under organic crop production.

Jeevamrit is a rich bio-formulation which contains a number of beneficial microbes, prepared by fermenting cow dung, cow urine, jaggery, pulse flour and virgin forest soil. The basic philosophy behind the application of *Jeevamrit* as a bio-resource is to supplement essential plant nutrients in economic and eco-friendly manner for improvement of the soil health[7].

Materials and Methods

Experimental site

The experiment was carried out during *Kharif* season of 2016 at Medicinal Plants Research and Development Centre of G.B. Pant University of Agriculture and Technology, Pantnagar, District U.S. Nagar (Uttarakhand), India. It is situated at 29^{o} N latitude, 79^{0}3'E longitude and at an altitude of 243.84 m above mean sea level. The average rainfall of the region is 140 cm per annum. The soil of the experimental site was sandy clay loam in texture, having pH 6.9, medium in organic carbon (OC) 0.64%, low in available nitrogen (N) 180.78 Kg ha^{-1}, medium in available phosphorus (P_2O_5) 20.14 Kg ha^{-1} and potassium (K_2O) 200.64 Kg ha^{-1}.

Experimental design and treatment details

The experiment was laid out in Randomized Block Design (RBD) having ten treatments with three replications. Brahmi (Variety CIM- Jagriti) was taken as annual with only single harvest. 375 kg ha^{-1} fresh soft herbaceous cuttings were used for planting. The cuttings of about 5-10 cm length, containing 2-3 nodes were planted at a depth of 5 cm with a spacing of 20×10 cm. Irrigation was provided immediately for proper establishment of the cuttings. The different treatments used in the experiment were as follows: T_1- Recommended dose of fertilizers (RDF-100:60:40) kg ha^{-1}, T_2- *Jeevamrit* 500 l ha^{-1}, T_3- *Jeevamrit* 1000 l ha^{-1}, T_4- *Jeevamrit* 2000 l ha^{-1}, T_5- *Jeevamrit* 3000 l ha^{-1}, T_6- *Jeevamrit* 4000 l ha^{-1}, T_7- *Jeevamrit* 5000 l ha^{-1}, T_8-Vermicompost (VC)10 t ha^{-1}, T_9- Farmyard manure (FYM) 20 t ha^{-1}, T_{10}-Vermicompost 5 t ha^{-1} + Farmyard manure 10 t ha^{-1}. The doses of farmyard manures (FYM) and vermicompost were calculated and applied on the basis of recommended dose of fertilizer.

Nutrient content, preparation and application of *Jeevamrit*

Jeevamrit contains 4% total nitrogen, 155.3 ppm total phosphorus, 252 ppm total potassium, 2.96 ppm total zinc, 0.52 ppm total copper, 15.35 ppm total iron and 3.32 ppm total manganese. The *Jeevamrit* was prepared by adding desi cow dung (25 kg), desi cow urine (12.5 l), jaggery (5 kg), pulse flour (5 kg) and virgin forest soil (200 g) mix in a 200 l of water and allow fermenting for 48 h and stirring the solution for the uniform distribution of microbes regularly. After 48 h the fermented product was filtered and sprayed on the wet field. This mixture is sufficient for a hectare of land. The *Jeevamrit* was sprayed uniformly in the field by the use of sprayer at 30 days interval. Total 4 sprays were applied to the crop during experimental period, starting from the third day after planting up to the harvest of the crop.

Plant and soil sampling and analysis

The chemical studies were carried out using standard procedure and methods. 100 g plant sample from each plot was taken at the time of harvesting. Plant samples were oven dried and analyzed for nitrogen, phosphorus and potassium using standard procedures[8]. Soil samples were taken at 0-15 cm depth and analyzed for available nitrogen[9], 0.5 M $NaHCO_3$, extractable phosphorus and 1 N ammonium acetate extractable potassium[8].

Microbial analysis

Total microbial population (bacteria, fungi and actinomycetes) of the soil before initiation of the experiment and after the harvest of the crop was analyzed by sampling top 0-15 cm soil and analyzed by using standard procedures[10]. The microbes were calculated by using following formula:

Number of microbes (cfug^{-1} soil) =

$$\frac{\text{No. microbial count} \times \text{dilution factor}}{\text{weight of soil taken} \times \text{dilution per ml}}$$

Statistical analysis

The statistical analyses of the treatments were done by using standard statistical procedures. The difference between the treatment means were compared by critical difference at 5% level of significance[11].

Results and Discussion

The present study was conducted to understand the effect of different rates of *Jeevamrit* (Bioenhancer) application on soil health and yield of brahmi. The NPK contents of the plants were significantly affected by the different treatments (Table 1).

The highest nitrogen content was found in treatment T_8 (1.36%). The treatment T_8 was significantly superior to rest of the treatments; however, it was *at par* with T_6, T_7, T_{10} and T_1 (RDF). The treatment T_1 was significantly higher than lower doses of *Jeevamrit* (T_2, T_3 and T_4). The maximum dose of *Jeevamrit* (T_7) gave significantly higher nitrogen content (1.29%) than lower doses of *Jeevamrit* (T_2, T_3, T_4 and T_5) and *at par* with rest of the treatments. The treatment T_8 contained highest amount of phosphorus (0.35%) followed by treatment T_7 (0.34%) and T_6 (0.33%). The lowest phosphorus content was observed in treatment T_2 (0.24%). The treatment T_8 (vermicompost) and highest dose of *Jeevamrit* (T_7) both were significantly superior to lower doses of *Jeevamrit* (T_2, T_3 and T_4) and *at par* with rest of the treatments. The maximum K content was observed in treatment T_8 (1.46%) which was significantly higher than the lower doses of *Jeevamrit*, farmyard manure and mixture of vermicompost and farmyard manure. However, it was *at par* with the T_7 (1.46%). Both the treatment T_8 and T_7 were significantly superior to T_1 (RDF). The lowest content of potassium (1.29%) was recorded in treatment T_2.

The maximum nitrogen uptake (57.04 kg ha^{-1}) was recorded in treatment T_8 (Table 1) which was significantly higher over all the treatments however, it was *at par* with treatment T_7 and T_6. Treatment T_8 and T_7 (56.79 kg ha^{-1}) both were significantly higher over RDF (43.11 kg ha^{-1}). As the application rate of *Jeevamrit* increased the uptake of nutrient also increased. The lowest uptake was observed in treatment T_2 (16.97 kg ha^{-1}). The treatment T_7 was significantly superior in phosphorus uptake (14.98 kg ha^{-1}) than rest of the treatments and *at par* with treatment T_8 and T_6. After T_7 the treatment T_8 recorded highest (14.81 kg ha^{-1}) phosphorus uptake and it was significantly higher than lower doses of *Jeevamrit* (T_2 to T_5) and farmyard manure alone; however, it was *at par* with rest of the treatments. The lowest uptake was observed in treatment T_2 (5.70 kg ha^{-1}). Increased *Jeevamrit* application rate resulted in more P uptake as more population of phosphate solubilizing bacteria (PSB) helped to solubilize soil phosphorus from unavailable to available form. The potassium uptake was significantly higher in treatment T_7 (64.05 kg ha^{-1}) than in rest of the treatments and *at par* with the T_6 and T_8. Treatment T_8 (61.17 kg ha^{-1}) also gave similar response as T_7. Both the treatments were superior over organic sources of nutrients. The lowest amount of potassium uptake was recorded in treatment T_2 (30.62 kg ha^{-1}).

The studies revealed that higher bacterial population was recorded in *Jeevamrit* followed by N-fixers, P-solubilizers, fungi and actinomycetes. Due to the higher beneficial microbial load, it would mobilise more plant nutrients and provide plant growth promoting substances and also other micro nutrients required by the plants. Thus they help in more nutrient uptake. The increasing *Jeevamrit* amount leads to more microbial population which helped more uptakes of nutrients[12]. While in case of vermicompost and FYM it was estimated that earthworm could convert 50 percent of the nitrogen input from material in which they feed and 38% of the

Table 1 — NPK content and uptake in the plants as influenced by the different treatments.

Treatments	N (%)	P (%)	K (%)	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
T_1: RDF (100:60:40) kg ha^{-1}	1.16	0.34	1.43	43.11	12.76	53.32
T_2: *Jeevamrit* 500 l ha^{-1}	0.71	0.24	1.29	16.97	5.70	30.62
T_3: *Jeevamrit* 1000 l ha^{-1}	0.83	0.26	1.32	23.98	7.58	38.20
T_4: *Jeevamrit* 2000 l ha^{-1}	0.91	0.28	1.36	28.62	8.76	42.68
T_5 : *Jeevamrit* 3000 l ha^{-1}	1.00	0.31	1.39	35.04	10.88	48.73
T_6 : *Jeevamrit* 4000 l ha^{-1}	1.19	0.33	1.42	49.01	13.39	58.30
T_7: *Jeevamrit* 5000 l ha^{-1}	1.29	0.34	1.45	56.79	14.98	64.05
T_8 : Vermicompost (VC)10 t ha^{-1}	1.36	0.35	1.46	57.04	14.81	61.17
T_9 : FYM 20 t ha^{-1}	1.12	0.32	1.42	41.05	12.19	51.65
T_{10} : VC 5 t ha^{-1} + FYM 10 t ha^{-1}	1.24	0.33	1.42	48.44	12.64	55.65
CD at 5%	0.200	0.052	0.035	10.246	2.245	8.684

converted nitrogen uptake by plants[13]. An important feature of vermicompost is that they contain microbes which convert unavailable form of nutrients to available forms that are more readily taken up by plants, such as nitrate or ammonium nitrogen, exchangeable phosphorus and soluble potassium, calcium and magnesium[14]. Significant increase in the uptake of major and secondary nutrients such as N, P, K, Ca, and Mg was found under vermicompost treatment than FYM[15].

Soil fertility status

The soil fertility is dependent on nutrient uptake by the crop and the amount of nutrient which we add in the soil. To evaluate the fertility status of the experimental soil, organic carbon content, available nitrogen, available phosphorus and potassium were examined (Table 2).

The treatments comprising organic sources (T_8, T_9 and T_{10}) had significantly higher organic carbon content as compared to *Jeevamrit* treatments. Treatments T_9 (0.952%) and T_{10} (0.921%) which received maximum organic compost had significantly higher organic carbon percent over rest of the treatments. All the *Jeevamrit* treatments were lower in organic carbon percentage but as the application rate increased, the organic carbon percentage was also increased. The maximum organic carbon percentage among *Jeevamrit* treatments were recorded in treatment T_7 (0.726) and lowest was recorded in treatment T_1 (0.650%).

Vermicompost has a great potential to increase the soil organic carbon in the soil. It has much higher content of soil organic carbon and nutrients than the other organic sources[16]. On addition of farmyard manure and vermicompost, the soil organic carbon increased as they are rich in organic matter which on decomposition release organic acids and help in sequestration of organic carbon in the soil[17].

The treatment T_8 had maximum available nitrogen (219.14 kg ha^{-1}) which was significantly higher than rest of the treatments except recommended dose of fertilizer (209.76 kg ha^{-1}). The treatment T_1 was significantly superior to lower doses of *Jeevamrit* treatment (T_2, T_3, T_4 and T_5). Among the different *Jeevamrit* treatments, the amount of available nitrogen increased with increased application rate of *Jeevamrit*. The lowest available nitrogen was found in treatment T_2 (182.88 kg ha^{-1}). The maximum phosphorus was observed in treatment T_8 (27.24 kg ha^{-1}) which was significantly higher than lower doses of *Jeevamrit* (T_2, T_3 and T_4) and *at par* with rest of the treatments. All the organic sources of nutrients had considerably higher amount of available phosphorus than the lower doses of *Jeevamrit*. Among different *Jeevamrit* treatments, T_7 had the maximum (24.55 kg ha^{-1}) available phosphorus which was significantly higher than lower dose of *Jeevamrit*. The lowest available phosphorus was recorded in treatment T_2 (15.79 kg ha^{-1}). The treatment T_8 had maximum available potassium (208.49 kg ha^{-1}), which was significantly higher than most of the treatments. However, it was *at par* with treatments T_1 (202.62 kg ha^{-1}) and T_{10} (203.08 kg ha^{-1}). Among the different *Jeevamrit* treatments, maximum available potassium was observed in treatment T_7 (196.30 kg ha^{-1}). All the treatment consisting of organic sources were rich in available potassium as compared to different *Jeevamrit* treatments. The treatment T_2 had minimum amount of available potassium (187.15 kg ha^{-1}).

Vermicompost and farmyard manure improved the available N, P and K status of the soil. Higher available N, P, K under organic treatments may be due to better physical, chemical and biological

Table 2 — Organic carbon, Available NPK (kg ha^{-1}) and Bulk density of the soil (g cc^{-1}) in soil as influenced by the different treatments.

Treatments	% OC	N	P	K	Bulk Density
T_1 : RDF (100:60:40) kg ha^{-1}	0.650	209.76	27.08	202.62	1.65
T_2 : *Jeevamrit* 500 l ha^{-1}	0.652	182.88	15.79	187.15	1.65
T_3 : *Jeevamrit* 1000 l ha^{-1}	0.673	187.92	17.50	189.99	1.64
T_4 : *Jeevamrit* 2000 l ha^{-1}	0.686	190.77	18.90	191.24	1.63
T_5 : *Jeevamrit* 3000 l ha^{-1}	0.690	194.44	20.95	193.88	1.61
T_6 : *Jeevamrit* 4000 l ha^{-1}	0.710	199.64	22.12	195.25	1.59
T_7 : *Jeevamrit* 5000 l ha^{-1}	0.726	203.52	24.55	196.30	1.58
T_8 : Vermicompost (VC)10 t ha^{-1}	0.891	219.14	27.24	208.49	1.49
T_9 : FYM 20 t ha^{-1}	0.952	204.23	21.88	199.73	1.41
T_{10} : VC 5 t ha^{-1} + FYM 10 t ha^{-1}	0.921	205.32	24.49	203.08	1.46
CD at 5%	0.028	10.14	7.10	11.12	0.02417

condition of the soil. Addition of organic matter helps to increase water holding capacity of the soil, decrease the bulk density of the soil and maintain the favorable temperature in the soil. Microbes help to mineralise the nitrogen by converting it into nitrates which is the available form for the uptake of plants[18]. During decomposition of organic manures, various phenolic and aliphatic acids are produced with phosphate bearing minerals and thereby lower the phosphate fixation and increase its availability[19]. Availability of potassium was increased by the application of organic manure due to solubilising action of organic acids produced during decomposition of organic matter and its higher capacity to hold K in available form[20].

Jeevamrit contains all the beneficial microbes which help in nitrogen fixation and mineralisation of nutrients. It releases organic acids and enzymes which support plant growth. Phosphorus solubilising bacteria which are present in *Jeevamrit* help in phosphorus solubilisation. Thus *Jeevamrit* provide all the essential micro and macro nutrients for plant growth by changing them from unavailable to available form and increase the availability of nutrients in the soil[21].

Soil bulk density

On addition of organic manure, the bulk density of the soil decreased significantly (Table 2). The treatments T_1 and T_2 had highest bulk density (1.65 g cc^{-1}) which is significantly higher than all the treatments except treatment T_3 and T_4 which were otherwise *at par*. The treatment T_9 had lowest bulk density (1.41 g cc^{-1}) which was significantly lower than all the treatments. All the treatment of organic manure had significantly lower bulk density as compared to all the *Jeevamrit* treatments and RDF (T_1). In different *Jeevamrit* treatments, treatment T_7 (1.58 g cc^{-1}) had lowest bulk density followed by treatment T_6 (1.59 g cc^{-1}).

On addition of farmyard manure and vermicompost, the bulk density of the soil decreased due to more pore space. The microbes which feed on the carbon evolved carbon dioxide which create air space and make the soil more porous which decrease the bulk density of soil[22,23].

Microbiological studies

The microbial observations recorded before initiation of experiment and after harvest of the crop were represented as cfu (colony forming unit g^{-1} soil). The microbial population of the field before initiation of experiment was much lower viz., Bacteria (2.42×10^4 cfu g^{-1}), Fungi (3.56×10^2 cfu g^{-1}) and Actinomycetes (0.23×10^4 cfu g^{-1}) than that of normal soil (Table 3), this may be due to the presence of medium organic carbon, gravel and predominance of sand fraction. However, it is observed that there is a significant increase in microbial population at the time of harvest. The total microbial population was significantly higher in treatment T_8 (9.82×10^4 cfu g^{-1}) than all the treatments followed by treatment T_{10} (9.29×10^4 cfu g^{-1}) and T_9 (7.97×10^4 cfu g^{-1}). All the three treatments also significantly differed among themselves and all the treatments were significantly superior to all the doses of *Jeevamrit* at the time of harvest. Among the *Jeevamrit* treatments T_7 had highest microbial count (6.16×10^4 cfu g^{-1}) followed by T_6 (5.93×10^4 cfu g^{-1}). The treatment T_7 is significantly superior to lower doses of *Jeevamrit* (T_2, T_3, T_4 and T_5) and recommended dose of fertilizer (T_1) however, it was *at par* with treatment T_6. The lowest microbial population was present in treatment T_1 (3.10×10^4 cfu g^{-1}).

Table 3 — Total microbial population of the soil (cfu g^{-1}), fresh and dry biomass yield as influenced by the different treatments.

Treatments	Total count (cuf × 10^4)	Fresh biomass yield (q ha^{-1})	Dry biomass yield (q ha^{-1})
T_0: Initial microbial population	2.68		
T_1: RDF (100:60:40) kg ha^{-1}	3.10	186.10	37.25
T_2: *Jeevamrit* 500 l ha^{-1}	3.68	126.68	23.80
T_3: *Jeevamrit* 1000 l ha^{-1}	4.60	148.93	28.94
T_4: *Jeevamrit* 2000 l ha^{-1}	5.08	157.00	31.31
T_5 : *Jeevamrit* 3000 l ha^{-1}	5.46	169.69	35.05
T_6 : *Jeevamrit* 4000 l ha^{-1}	5.93	205.31	41.07
T_7: *Jeevamrit* 5000 l ha^{-1}	6.16	216.69	43.89
T_8 : Vermicompost (VC)10 t ha^{-1}	9.82	207.84	41.98
T_9 : FYM 20 t ha^{-1}	7.97	185.25	36.44
T_{10} : VC 5 t ha^{-1} + FYM 10 t ha^{-1}	9.29	195.30	39.12
CD at 5%	0.42	14.16	5.95

Higher microbial population in soil might be due to enormous amount of microbial load in the *Jeevamrit* which multiplies in the soil and enhance the microbial activity of the soil[24,25]. The presence of cow dung in the *Jeevamrit* acts as a medium, for the growth of beneficial microbes[26]. Microbes feed on carbon content of the organic manure as the application rate of farmyard manure is highest among all treatments thus highest microbial load was observed in treatment consisting of farmyard manure 20 t ha^{-1}[27]. All the essential amino acids which are required for the microbial growth are present in vermicompost. Addition of vermicompost increases the microbial population either because of earthworm casts which is rich in enzymes, amino acids and sugar or due to organic acids which is secreted by earthworms to help multiplication of microbes in soil[28].

Crop yield

The maximum fresh biomass yield (216.69 q ha^{-1}) was recorded in treatment T_7, which was significantly superior to all the treatment except T_6 and T_8, which was otherwise *at par* (Table 3). The treatment T_8 recorded second highest fresh biomass yield (207.84 q ha^{-1}) which was also significantly higher than all the treatment except treatment comprising of combination of vermicompost and farmyard manure (T_{10}) and treatment containing maximum *Jeevamrit* application rate (T_7). The lowest biomass was observed in treatment T_2 (126.68 q ha^{-1}), followed by T_3, T_4, T_5 and T_9.

In case of dry biomass yield of the crop (Table 3) treatments, T_7 had the maximum dry biomass yield (43.89 q ha^{-1}). The treatment T_7 was significantly superior to all the treatments; however, it was *at par* with treatments T_6, T_8 and T_{10}. The treatments T_8 and T_6 were equally effective and gave similar results. Both the treatments were significantly superior over lower doses of *Jeevamrit* and farmyard manner application alone, except recommended dose of fertiliser (37.25 q ha^{-1}). The lowest dry biomass yield was recorded in treatment T_2 (23.80 q ha^{-1}). A combination of vermicompost and farmyard manure (FYM) gave higher yield than RDF and FYM alone and it was also better than lower doses of *Jeevamrit*.

The result obtained in the investigation indicates significant increase in fresh and dry biomass yield. *Jeevamrit* is rich in microbial consortia which help in mineralisation of nutrients to available form thus steady supply of nutrients is maintained during crop growth. The results on increase in yields were also reported in finger millet, lady finger, rice and, field bean[29-31]. *Jeevamrit* is rich in phosphate solubilising bacteria, free living nitrogen fixing bacteria, amino acids supplied through pulse flour and plant growth promoting substances which help in more nutrient uptake and more growth of the plants[32,33]. Vermicompost and FYM provide better physical condition to the soil by increasing water holding capacity and porosity which proliferate root density. More root growth leads to more uptake of nutrients and thus more yield is obtained by applying vermicompost[34].

Conclusion

On the basis of present investigation, it is concluded that *Jeevamrit* can be a better substitute for chemical fertilisers without loss of yield in brahmi. The *Jeevamrit* culture is rich in microbial population in comparison to vermicompost and farmyard manure which helps in multiplication of microorganisms in the treated fields. Enhanced population of microbes increases mineralisation of nutrients and thus increases the availability of nutrients. *Jeevamrit* @4000 l ha^{-1} is sufficient to supply nutrients for a hectare of land and produce better yield over chemical fertilisers, vermicompost and farmyard manure.

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Conflict of Interest

The authors declare that there is no conflict of interest.

Authors' Contributions

The study was conducted under the guidance of STP and the basic idea of the research was given by STP & AK PG and MSN verified the analytical methods and research work was carried out by A. All the authors contributed to the preparation of final manuscript.

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