Effect of various organic manure sources on the performance of *Valeriana jatamansi* in Hill Zone of West Bengal

ABSTRACT

The organic source of nutrient application would be the promising practices for *V. jatamansi* cultivation which maintain its curative value. Therefore, a set of experiment was conducted at Hill Zone of West Bengal, Kalimpong for two consecutive cycles to standardize organic nutrient management in *Valeriana jatamansi* for optimum growth and economic yield (i.e. rhizome). Different sources of organic source of nutrient like FYM, bio-fertilizer and vermicompost were applied at various doses along with recommended dose of chemical fertilizer for comparison. The treatment applied in the present study involve T_1: FYM @ 5 t ha^{-1}; T_2: vermicompost @ 2 t ha^{-1}: T_3: FYM @ 5 t ha^{-1} + vermicompost @2 t ha^{-1}; T_4: FYM @ 5 t ha^{-1} + PSB; T_5: vermicompost @ 2 t ha^{-1} + PSB; T_6: FYM @ 5 t ha^{-1} + vermicompost @2 t ha^{-1} + PSB; T_7: Control; T_8: RDF through inorganic fertilizers (50:25:25 kg ha^{-1} as N, P_2O_5 and K_2O). The use of organic manures and PSB significantly increased the rhizome yield and soil available macronutrents in *V. jatamansi* due to the release of nutrients from decomposition of organic manures. Among different treatments, the addition of FYM @ 5 tonnes ha^{-1} + vermicompost @2 tonnes ha^{-1} + PSB resulted maximum canopy height (18.28 cm), plant fresh biomass (16.42 t/ha), dry biomass (3.19 t/ha), rhizome fresh weight (3.16 t/ha) and dry weight (1.16 t/ha) as well as highest organic carbon content (0.75%), soil available nitrogen content (221 kg ha^{-1}), available phosphorus content (46.70 kg ha^{-1}) and available potassium content (201 kg ha^{-1}). Thus the study concluded that applying FYM, vermicompost, and PSB together would be a promising strategy for growing *V. jatamansi* because it enhance soil fertility.

Keywords: Valerian *jatamansi*, FYM, vermicompost, bio-fertilizer and nutrient availability.

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INTRODUCTION

More than 250 species of the genus *Valeriana* are members of the Valerianaceae family. In terms of its geographic range, it lives in temperate parts of the planet. There are around 16 species in India, of which 2 subspecies and 5 species are found in the high-altitude area of the central Himalayas. According to Patan *et al.* (2018), the herbaceous Valerian *jatamansi* is also known as Indian Valerian, Sugandhbala, and Tagar in Hindi and Sanskrit, respectively. Since ancient times, it has been utilized in Indian health care systems (Prakash, 1999).

The importance of *V. jatamansi* became apparent due to its many uses. More than 50% of the use reports were intended for basic health care. The results of past studies support the use of these herbs to treat respiratory conditions as well as pain and inflammation. (Dahal *et al.*, 2017 and Malla *et a*l., 2015). In India, *V. jatamansi* is used locally to treat high blood pressure, laxative, carminative, aphrodisiac, and mental disorders (Kamboj, 2000). According to Zhang and Ding (2015), it has been used in China to treat dermatitis, eye problems, sleeplessness, obesity, epilepsy, mental disorders, and snake poisoning. According to Bhattacharyya *et al*. (2007) and Ali *et al*. (2012), it is used in Pakistan to lessen stress, anxiety, and depression.

The enormous pharmacological importance of *V. jatamansi* and its widespread use in numerous herbal formulations are factors contributing to its rising demand on a daily basis. Rhizomes and seeds are the conventional methods for propagating *V. jatamansi*. The traditional farming system has never produced enough plant material to satisfy industrial demands and is time-consuming. Nevertheless, approximately 80% of Indians continue to use herbal medications. As a result, with an expanding population, there is an increasing concern about herb production and sustainable use. Currently, there is a 40,000 tonnes estimated gap between the supply and demand for medicinal plants, and by 2025, that imbalance is predicted to grow to 1,52,000 tonnes. As a result of increasing demand, plant cultivation under ex-situ conditions can meet growing demand.

For its cultivation, there is no specific package of programme has been developed. It would be preferable to cultivate the crop organically rather than using chemical fertilizers

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because they may cause it's therapeutic value to decline. Applying organic manures increases soil fertility by giving vital plant nutrients, which promotes crop growth. Manures can replace mineral fertilizer in ways that benefit the environment, soil structure, productivity, and carbon sequestration. The physicochemical and biological characteristics of the soil, such as pH, bulk density, enzymatic activity, soil aggregation, soil organic carbon, and both macro and micronutrients, were previously well-reported to be greatly improved by manure fertilization (Tarafder *et al.*, 2017; Bandyopadhyay *et al.,* 2010; Manure fertilization can enhance the physical structure of the soil, enabling it to hold more water and nutrients, increasing crop productivity and having a lasting impact on succeeding crops (Six *et al*., 2002). Vermicompost, poultry manure, and farmyard manure have all been shown to increase crop yield and concentrations of essential nutrients in Indian soil when used in various cropping systems. Since the development of the organic farming package of practices, there has been lack of research on organic cultivation of *V. jatamansi*. Therefore, in order to maximize its productivity, we have conducted the experimental trial with the available organic sources.

MATERIALS AND METHODS

Experimental site description

The experiment was conducted at experimental farm at Regional Research Station (Hill Zone), Uttar Banga Krishi Viswavidyalaya, Kalimpong, West Bengal (latitude 27°31' N, longitude 88°28' E, and altitude 1097 m) in the year 2017-20. The climate of the area belongs to subtropical, humid and the soils are moderately shallow to moderately deep (80–120cm), dark yellowish brown to yellowish brown. The details of the soil nutrient status before starting of the experiment is given in Table 1. The region receives an average annual rainfall of 2231mm. The monthly mean air

Table 1: Soil nutrient status before the start of the Experiment.

Properties	Characteristic value

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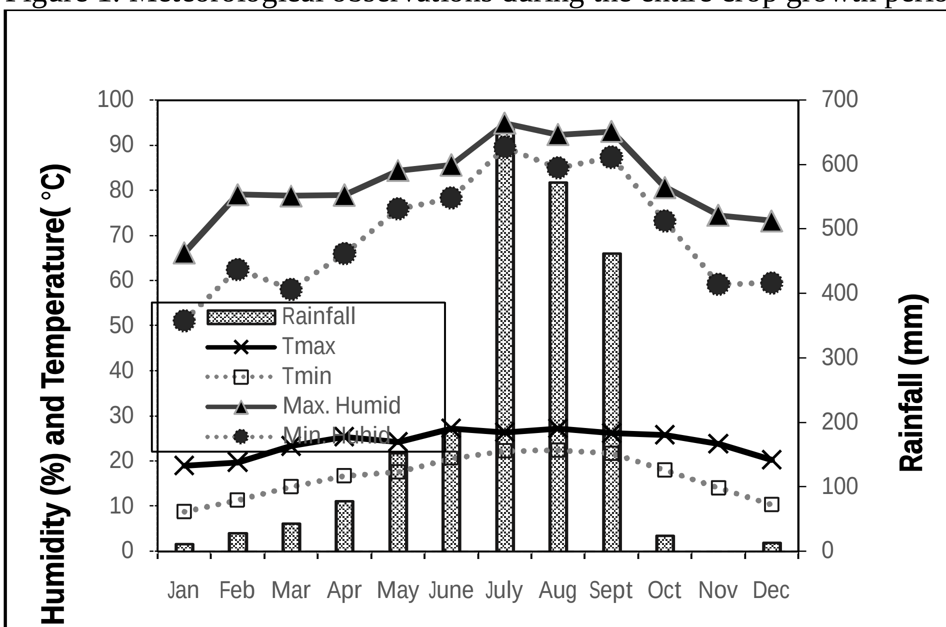
Soil type	Sandy loam
Soil pH	Acidic (Value 5.32)
EC (d S m^{-1})	0.012
Available N (Kg ha^{-1})	210
Available phosphorus (Kg ha^{-1})	54.7
Available potassium (Kg ha^{-1})	183.5
Soil organic carbon (%)	0.72

temperature varies between 8 and 27°C. Mean monthly weather parameters for the study region are presented in Figure 1.

Figure 1. Meteorological observations during the entire crop growth period.



Treatment details

A Randomized Block design was used to construct eight treatment combinations with four replications. i.e. T_1: FYM @ 5 t ha^{-1}; T_2: vermicompost @ 2 t ha^{-1}: T_3: FYM @ 5 t ha^{-1} + vermicompost @ 2 t ha^{-1}; T_4: FYM @ 5 t ha^{-1} + PSB; T_5: vermicompost @ 2 t ha^{-1} + PSB; T_6: FYM @ 5 t ha^{-1} + vermicompost @ 2 t ha^{-1} + PSB; T_7: Control; T_8: RDF through inorganic fertilizers (50:25:25 kg ha^{-1} as N, P_2O_5 and K_2O). At the time of the land preparation, FYM and vermicompost were applied. Rhizome seed treatment was used to apply bio-fertilizer at the time of sowing. Two ploughings and one harrowing were used to prepare the field. Chemical fertilizers like urea, SSP, and MoP were employed. Rhizomes were sown with a spacing of 30 cm × 30 cm in each experimental plot (6 m × 2 m).

Harvesting and plant data collection

Five randomly chosen plants were used to determine the yield-attributing characteristics, such as canopy height (cm), whole fresh weight (t/ha), whole dry weight (t/ha), rhizome fresh weight (t/ha), and rhizome dry weight (t/ha).

Soil analysis

Soil sample was collected from each experimental plot (15 cm soil depth) after harvesting of crop in each season. Soil was then air dried in shed and passed through 2 mm sieve for soil chemical analysis. Soil pH was determined by glass electrode method in 1:2.5 soil water suspension using a Systronics pH meter as described by Jackson (1973). Soil organic carbon was determined by wet digestion method of Walkley and Black (1934) as described by Jackson (1973). The available phosphates of soils were extracted with Bray and Kurtz No. 1 extractant (Bray and Kurtz, 1945). Soil available potassium was determined buy neutral normal ammonium acetate method (Jackson, 1973).

Results and discussion

Effect of organic manure on yield attributing characters

The effect of different organic manure on yield attributing characters are presented in table 2. It was found that there was a significant difference in canopy height achieved due to different types and of organic application. A significantly highest canopy height (18.28 cm) was found with

Table 2: Effect of organic practices on growth parameters of *Valeriana jatamansi*

Treatments	Canopy height (cm)	Plant fresh wt. (t/ha)	Plant dry wt. (t/ha)	Rhizome fresh wt. (t/ha)	Rhizome dry wt. (t/ha)
T1	16.15	13.45	2.40	2.28	0.81
T2	17.44	14.59	2.64	2.84	0.95
T3	17.94	16.13	3.03	3.09	1.02
T4	16.91	14.91	2.55	2.83	0.87
T5	17.73	15.11	2.82	3.03	1.03
T6	18.28	16.42	3.19	3.16	1.16
T7	14.83	11.83	2.02	2.04	0.67
T8	16.70	15.13	2.58	2.72	0.89
SEm(±)	0.44	1.45	0.19	0.27	0.8
CD (0.05%)	1.30	NS	0.6	0.8	0.23

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T6 (FYM @ 5 tonnes ha^{-1} + vermicompost @2 tonnes ha^{-1} + PSB) and lowest canopy height (14.83 cm) was achieved with T3 (control). Plant fresh weight and plant dry was also observed. Among the different organics application highest whole fresh (16.42 t ha^{-1})) and dry biomass (3.19 t ha^{-1}) was recorded with the T6 treatment *i.e* FYM @ 5 tonnes ha^{-1} + vermicompost @2 tonnes ha^{-1} + PSB). The lowest whole fresh (11.83 t ha^{-1})) and dry biomass (2.02 t ha^{-1}) was recorded with the T7 treatment i.e control where no organic were applied.

Rhizome is the main economic part and its fresh was recorded highest (3.16 t ha^{-1}) with T6 treatment *i.e* FYM @ 5 tonnes ha^{-1} + vermicompost @2 tonnes ha^{-1} + PSB and it is at par with the T3 (3.09 t ha^{-1}) *i.e* FYM @ 5 t ha^{-1} + vermicompost @2 t ha^{-1} and T5 treatment (3.03 t ha^{-1}) *i.e* vermicompost @ 2 t ha^{-1} + PSB. The lowest rhizome fresh weight was recorded with T7 treatment (2.04 t ha^{-1}) *i.e* control. The highest rhizome dry weight was achieved with highest (1.16 t ha^{-1}) with T6 treatment *i.e* FYM @ 5 tonnes ha^{-1} + vermicompost @2 tonnes ha^{-1} + PSB and it is at par with the T3 (1.02 t ha^{-1}) *i.e* FYM @ 5 t ha^{-1} + vermicompost @2 t ha^{-1} and T5 treatment (1.03 t ha^{-1}) *i.e* vermicompost @ 2 t ha^{-1} + PSB. The lowest rhizome fresh weight was recorded with T7 treatment (0.67 t ha^{-1}) *i.e* control.

Effect of organic manure on soil chemical properties

The performance of any crop depends on nutrient supplying capacity of soil as well as quality and quantity of added nutrient sources. In this experiment different combinations of organic source of nutrients were applied for the performance of *Valeriana jatamansi*. The changes in soil chemical properties and nutrient availability due of various combinations of organic manure are presented in table 3.

Table 3: Soil chemical properties after completion of the Experiment

Treatments	**pH**	**EC(d S m^{-1})**	**Organic Carbon (%)**	**Available N(Kg ha^{-1})**	**Available P (Kg ha^{-1})**	**Available K(Kg ha^{-1})**
T1	5.39	0.01	0.69	211	51.40	184
T2	5.40	0.01	0.66	212	52.06	183
T3	5.33	0.01	0.74	218	54.20	196
T4	5.41	0.01	0.71	213	56.80	195
T5	5.44	0.01	0.68	217	52.70	188
T6	5.37	0.01	0.75	221	58.40	201
T7	5.64	0.01	0.61	207	46.70	182
T8	5.46	0.01	0.64	215	47.30	184
Sem (±)	0.3	0.001	0.08	2.38	3.18	3.36

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CD(0.05%)	NS	NS	NS	7.39	10.01	9.73

Result showed that there was no significant response of organic manures on pH of the soil. However results showed that a little decrease in pH were associated with organic manure application over control. These might be due to organic acid production from vermicompost and FYM which decrease the soil pH. The electrical conductivity of soil generally expressed the salt concentration in the soil and there was no significant changes in soil electrical conductivity.

Organic carbon content of soil acts as an indicator of soil structure, stability, nutrient retention and soil erosion (Carter, 2002). It is used as a proxy for soil fertility and nutrient availability. Results showed a significantly higher organic carbon content in the soil under organics application over control as well as chemical fertilizer treatment. Results also revealed that highest organic carbon content (0.75%) application of T6 i.e. *i.e* FYM @ 5 tonnes ha^{-1} + vermicompost @2 tonnes ha^{-1} + PSB among the treatments. The lowest organic carbon were found in both in control (0.61%) and T8 *i.e* RDF (6.4%). FYM and vermicompost application had the modifying influence of local edaphic environment like reducing bulk density, enhancing pore size distribution and alteration of water and air regime that might also restrict soil organic carbon biodegradation.

But the soil available nitrogen, phosphorus and potassium content among the different treatments varied significantly. The highest soil available nitrogen (221 kg ha^{-1}) was found in with T6 treatment *i.e* FYM @ 5 tonnes ha^{-1} + vermicompost @2 tonnes ha^{-1} + PSB. The highest available N content in T6 treatment was probably due to both application of FYM and vermicompost and its mineralization. Beside this decomposition of FYM and vermicompost produces some organic ligands which helps to increase its availability to plants and at the same time due to mineralization of such organics, N is released in the soil. The lowest available nitrogen content found in control (207 kg ha^{-1}).

Highest (58.40 kg ha^{-1}) and lowest content of available phosphorus (46.70 kg ha^{-1}) were associated with T6 i.e FYM @ 5 tonnes ha^{-1} + vermicompost @2 tonnes ha^{-1} + PSB and T7 i.e control respectively. Organic amendments on decomposition released organic acids which increased the P availability by blocking P adsorption sites on soils or through anion exchange phenomenon (Nambiar, 2002) and the organic acid produced through application of PSB cause dissolution of P bearing minerals in soil and thus cause an increase in P availability.

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Results also revealed that application of T6 i.e FYM @ 5 tonnes ha^{-1} + vermicompost @2 tonnes ha^{-1} + PSB significantly increased the available K (201 kg ha^{-1}) over T7 i.e control (182 kg ha^{-1}) and T8 i.e RDF (184 kg ha^{-1}). This might be due to application of FYM and vermicompost increase the cumulative non exchangeable potassium release and could maintain large amount of potassium in soil solution and on exchange sites be re-establishing the equilibrium among different forms of potassium. Many researchers reported that a significant increase in available K content in soil upon continuous application of FYM with inorganic fertilizer.

Conclusion

The release of nutrients from the breakdown of organic manures led to a considerable increase in the rhizome yield and soil accessible macronutrients in V. jatamansi when organic manures and PSB were used. The addition of FYM @ 5 tonnes ha^{-1} + vermicompost @ 2 tonnes ha^{-1} + PSB resulted in the highest organic carbon content (0.75%), the highest plant fresh biomass (16.42 t/ha), the highest plant dry biomass (3.19 t/ha), the highest rhizome fresh weight (3.16 t/ha), and the highest soil available nitrogen (221 kg ha^{-1}), phosphorus (46.70 kg ha-1), and potassium (201 kg ha^{-1}) contents. Thus the study concluded that applying FYM, vermicompost, and PSB together would be a promising strategy for growing *V. jatamansi* because it enhance soil fertility.

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