

## Effect of various organic manure sources on the performance of *Valerianajatomansi* in Hill Zone of West Bengal Concerning Manure Sources

### ABSTRACT

The organic source of nutrient application would be the promising practices for *Valerianajatomansi* cultivation which maintains its curative value. Therefore, a set of experiments was conducted at Hill Zone of West Bengal, Kalimpong for two consecutive cycles to standardize organic nutrient management in *Valeriana-V.jatomansi* for optimum growth and economic yield (i.e. rhizome). Different organic sources of organic source of nutrient like such as farm yard manure (FYM), bio-fertilizer (BF), and vermicompost (VC) were applied at various doses along with a recommended dose of chemical fertilizer for comparison. We applied the treatment applied in the present study involve the treatments as follows: T<sub>1</sub>: FYM @ (5 t.ha<sup>-1</sup>), T<sub>2</sub>: vermicompost VC @ (2 t.ha<sup>-1</sup>), T<sub>3</sub>: FYM @ (5 t.ha<sup>-1</sup>) + vermicompost VC @ (2 t.ha<sup>-1</sup>), T<sub>4</sub>: FYM @ (5 t.ha<sup>-1</sup>) + PSB, T<sub>5</sub>: vermicompost VC @ (2 t.ha<sup>-1</sup>) + PSB, T<sub>6</sub>: FYM @ (5 t.ha<sup>-1</sup>) + vermicompost VC @ (2 t.ha<sup>-1</sup>) + PSB, T<sub>7</sub>: Control, T<sub>8</sub>: RDF through inorganic fertilizers (50:25:25 kg.ha<sup>-1</sup> as N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O). The use of organic manures and PSB significantly ( $P < 0.05$ ) increased the rhizome yield and soil-soil-available macronutrients in *V. jatamansi* due to the release of nutrients from the decomposition of organic manures. Among different treatments, the addition of T<sub>6</sub> FYM @ 5 tonnes ha<sup>-1</sup> + vermicompost @ 2 tonnes ha<sup>-1</sup> + PSB resulted in a maximum canopy height (18.28 cm), plant fresh biomass (16.42 t.ha<sup>-1</sup>/ha), dry biomass (3.19 t.ha<sup>-1</sup>), rhizome fresh weight (3.16 t.ha<sup>-1</sup>/ha), and dry weight (1.16 t.ha<sup>-1</sup>/ha), as well as highest organic carbon content (0.75%), soil available-nitrogen content (221 kg.ha<sup>-1</sup>), available-phosphorus content (46.70 kg.ha<sup>-1</sup>), and available-potassium content (201 kg.ha<sup>-1</sup>). Thus the study concluded that applying FYM, vermicompost, and PSB together combination would be a promising strategy for growing *V. jatamansi* because it enhance soil fertility.

**Keywords:** Bio-fertilizer, FYM, Nutrient availability, *Valerianajatomansi*, FYM, Vermicompost, bio-fertilizer and nutrient availability.

### INTRODUCTION

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More than 250 species of the genus *Valeriana* ~~are members of~~ belong to the Valerianaceae family. ~~In terms of its~~ Concerning the geographic range, it lives in temperate parts of the planet. There are around 16 species in India, of which ~~2~~ two subspecies and ~~5~~ five 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 healthcare ~~systems~~ (Prakash, 1999).

~~The importance of~~ *V. jatamansi* became apparent due to its ~~many various~~ uses. More than 50% of the use ~~reports were as intended~~ for basic healthcare. The results of past studies support ~~the its use of these herbs~~ to treat respiratory conditions, as well as pain and inflammation. (Daha *et al.*, 2017 and Malla *et al.*, 2015). In India, *V. jatamansi* is used locally ~~to treat high blood pressure as an antihypertensive~~, laxative, carminative, aphrodisiac, and ~~for~~ 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~~ daily. 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 1,520,000 tonnes. ~~As a result of increasing demand, Thus~~ plant cultivation under ex-situ conditions can meet growing demand.

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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 because they may cause ~~a decline in~~ its therapeutic value ~~to decline~~. Applying organic manures ~~might~~ increases soil fertility by ~~giving providing~~ vital ~~plant~~ nutrients, which promotes crop growth. Manures can replace mineral fertilizer ~~in ways that and~~ 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~~ increased 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 ~~a~~ lack of research on ~~the~~ organic cultivation of *V. jatamansi*. Therefore, ~~in order~~ to maximize its productivity, we have conducted the experimental trial with the available organic sources. We carried out a set of experiments at Hill Zone of West Bengal, Kalimpong for two consecutive cycles to standardize organic nutrient management in *V.jatamansi* for optimum growth and economic yield. We used different organic sources of nutrients such as farm yard

[manure \(FYM\), bio-fertilizer \(BF\), and vermicompost\(VC\) that were applied at various doses along with a recommended dose.](#)

## MATERIALS AND METHODS

### *Experimental site description*

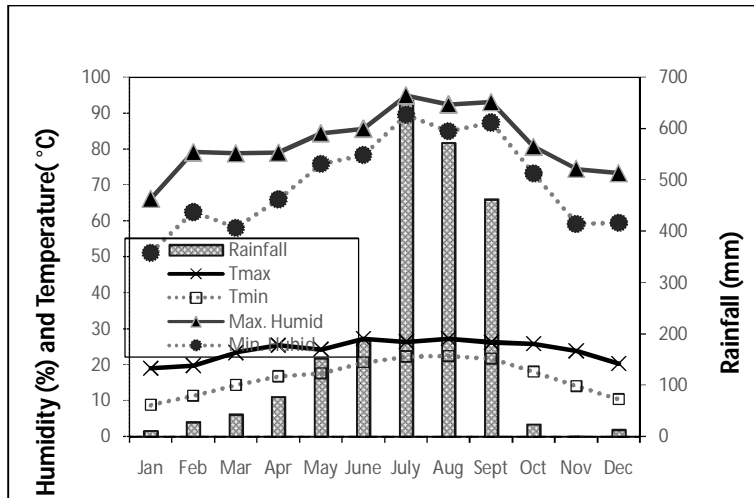
The experiments ~~was~~ were conducted at [the](#) experimental farm at Regional Research Station (Hill Zone), Uttar BangaKrishiViswavidyalaya, Kalimpong, West Bengal (latitude 27°31' N, longitude 88°28' E, and altitude 1097 m) ~~in the year during~~ 2017-20. The climate of the area belongs to subtropical, ~~and~~ 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 ~~sis~~ were given ~~listed~~ in Table 1. The region receives an average annual rainfall of 2231mm. The ~~monthly mean~~ air [temperature varies between 8 and 27°C. Mean monthly weather parameters for the study region are presented in Figure 1.](#)

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

Properties	Characteristic value
Soil type	Sandy loam
Soil pH	Acidic (Value 5.32)
EC (d S m <sup>-1</sup> )	0.012
Available N (Kg ha <sup>-1</sup> )	210
Available phosphorus (Kg ha <sup>-1</sup> )	54.7
Available potassium (Kg ha <sup>-1</sup> )	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<sub>1</sub>: FYM @ (5 t<sub>2</sub>.ha<sup>-1</sup>); T<sub>2</sub>: vermicompost VC @ (2 t<sub>2</sub>.ha<sup>-1</sup>); T<sub>3</sub>: FYM @ (5 t<sub>2</sub>.ha<sup>-1</sup> + vermicompost VC @ (2 t<sub>2</sub>.ha<sup>-1</sup>); T<sub>4</sub>: FYM @ (5 t<sub>2</sub>.ha<sup>-1</sup> + PSB); T<sub>5</sub>: vermicompost VC @ (2 t<sub>2</sub>.ha<sup>-1</sup> + PSB); T<sub>6</sub>: FYM @ (5 t<sub>2</sub>.ha<sup>-1</sup> + vermicompost VC @ (2 t<sub>2</sub>.ha<sup>-1</sup> + PSB); T<sub>7</sub>: Control; and T<sub>8</sub>: RDF through inorganic fertilizers (50:25:25 kg ha<sup>-1</sup> as N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O). At the time of the land preparation, FYM and vermicompost VC 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 such as 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).

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#### 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<sub>2</sub>.ha<sup>-1</sup>), whole dry weight (t<sub>2</sub>.ha<sup>-1</sup>/ha), rhizome fresh weight (t<sub>2</sub>.ha<sup>-1</sup>/ha), and rhizome dry weight (t<sub>2</sub>.ha<sup>-1</sup>/ha).

#### Soil analysis

A soil sample was collected from each experimental plot (15 cm soil depth) after harvesting of the crop in each season. The soil was then air-dried in a shed and passed through a 2mm

Comment [es1]: Define the total number of samples collected?

sieve for soil-chemical analysis. Soil pH was determined by the 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 the 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 by the neutral normal ammonium acetate method (Jackson, 1973).

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## Results and discussion

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### Effect of organic manure on yield attributing characters

The effects of different organic manure on yield-attributing characters are presented in Table 2. It was found that there was a significant ( $P < 0.05$ ) difference recorded in canopy height achieved due to different types and of organic application. The significantly ( $P < 0.05$ ) highest canopy height (18.28 cm) was found with

Table 2: Effect of organic practices on growth parameters of *Valerianajatomansi*

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

T6 (FYM @ 5 tonnes  $ha^{-1}$  + vermicompost @ 2 tonnes  $ha^{-1}$  + PSB) and the lowest canopy heights (14.83 cm) were achieved with T3 (control). Plant fresh weight and plant dry weight were also observed. Among the different organic treatments, the application highest whole fresh (16.42  $tha^{-1}$ ) and dry biomass (3.19  $tha^{-1}$ ) were recorded with the T6 treatment i.e. FYM @ 5 tonnes  $ha^{-1}$  + vermicompost @ 2 tonnes  $ha^{-1}$  + PSB. The lowest whole fresh (11.83  $tha^{-1}$ ) and dry biomass (2.02  $tha^{-1}$ ) were 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 ( $3.16 \text{ t ha}^{-1}$ ) with the T6 treatment *i.e* FYM @ 5 tonnes  $\text{ha}^{-1}$  + vermicompost @ 2 tonnes  $\text{ha}^{-1}$  + PSB and it is was at par with the T3 ( $3.09 \text{ t ha}^{-1}$ ) *i.e* FYM @ 5  $\text{t ha}^{-1}$  + vermicompost @ 2  $\text{t ha}^{-1}$  and T5 treatments ( $3.03 \text{ t ha}^{-1}$ ) *i.e* vermicompost @ 2  $\text{t ha}^{-1}$  + PSB. The lowest rhizome fresh weight was recorded with the T7 control treatment ( $2.04 \text{ t ha}^{-1}$ ) *i.e* control. The highest rhizome dry weight was achieved with the highest ( $1.16 \text{ t ha}^{-1}$ ) with T6 treatment *i.e* FYM @ 5 tonnes  $\text{ha}^{-1}$  + vermicompost @ 2 tonnes  $\text{ha}^{-1}$  + PSB and it is was at par with the T3 ( $1.02 \text{ t ha}^{-1}$ ) *i.e* FYM @ 5  $\text{t ha}^{-1}$  + vermicompost @ 2  $\text{t ha}^{-1}$  and T5 treatments ( $1.03 \text{ t ha}^{-1}$ ) *i.e* vermicompost @ 2  $\text{t ha}^{-1}$  + PSB. The lowest rhizome fresh weight was recorded with the T7 treatment ( $0.67 \text{ t ha}^{-1}$ ) *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 the quality and quantity of added nutrient sources. In this experiment different combinations of organic sources of nutrients were applied for the performance of *Valeriana V. jatamansi*. The changes in soil chemical properties and nutrient availability due of various combinations of organic manure are presented in table Table 3.

Table 3: Soil chemical properties after completion of the Experiment

Treatments	pH	EC( $\text{d S m}^{-1}$ )	Organic Carbon (%)	Available N( $\text{Kg ha}^{-1}$ )	Available P ( $\text{Kg ha}^{-1}$ )	Available K( $\text{Kg ha}^{-1}$ )
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 ( $\pm$ )	0.3	0.001	0.08	2.38	3.18	3.36
CD(0.05%)	NS	NS	NS	7.39	10.01	9.73

Result The results showed that there was no significant response of organic manures on the soil 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 VC and FYM which decrease the soil pH. The electrical

conductivity of soil generally expressed the salt concentration in the soil and there was revealed no significant changes in soil electrical conductivity.

Organic The 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 ( $P < 0.05$ ) higher organic carbon content in the soil under organics application over control as well as and chemical fertilizer treatment. Results also revealed that the highest organic carbon content was obtained with the (0.75%) application of T6 i.e. FYM @ 5 tonnes ha<sup>-1</sup> + vermicompost @ 2 tonnes ha<sup>-1</sup> + PSB among the treatments. The lowest organic carbon were was found in both in control (0.61%) and T8 i.e. RDF (6.4%). FYM and vermicompost VC applications had the a modifying influence of on the 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 contents among the different treatments varied significantly ( $P < 0.05$ ). The highest soil-available nitrogen (221 kg ha<sup>-1</sup>) was found in with the T6 treatment i.e. FYM @ 5 tonnes ha<sup>-1</sup> + vermicompost @ 2 tonnes ha<sup>-1</sup> + PSB. The highest available N content in T6 treatment was probably due to both application of FYM and vermicompost VC and its mineralization. Beside this d The decomposition of FYM and vermicompost VC produces some organic ligands which helps to increase its their 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 was found in the control (207 kg ha<sup>-1</sup>).

Highest The highest (58.40 kg ha<sup>-1</sup>) and lowest contents of available phosphorus (46.70 kg ha<sup>-1</sup>) were associated with the T6 i.e. FYM @ 5 tonnes ha<sup>-1</sup> + vermicompost @ 2 tonnes ha<sup>-1</sup> + 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 the anion exchange phenomenon (Nambiar, 2002), and the organic acid produced through the application of PSB caused the dissolution of P-P-bearing minerals in the soil and thus cause an increase in P availability.

Results also revealed that the application of T6 i.e. FYM @ 5 tonnes ha<sup>-1</sup> + vermicompost @ 2 tonnes ha<sup>-1</sup> + PSB significantly ( $P < 0.05$ ) increased the available K (201 kg ha<sup>-1</sup>) over T7 i.e. control (182 kg ha<sup>-1</sup>) and T8 i.e. RDF (184 kg ha<sup>-1</sup>). This might be due to the application of FYM and vermicompost VC increase increasing the cumulative non-exchangeable potassium

release and could maintain a large amount of potassium in soil solution and on exchange sites by 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 t. ~~tonnes~~ ha<sup>-1</sup>) + vermicompost VC @ (2 t. ha<sup>-1</sup>) + PSB resulted in the highest organic carbon contents (0.75%), the highest plant fresh biomass (16.42 t. ha<sup>-1</sup>/ha), the highest plant dry biomass (3.19 t. ha<sup>-1</sup>/ha), the highest rhizome fresh weight (3.16 t. ha<sup>-1</sup>/ha), and the highest soil available nitrogen (221 kg. ha<sup>-1</sup>), phosphorus (46.70 kg. ha<sup>-1</sup>), and potassium (201 kg. ha<sup>-1</sup>) contents. Thus the study concluded that applying FYM, vermicompost, and PSB together would be a promising strategy for growing *V. jatamansi* because it enhances soil fertility.

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