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ORIGINAL ARTICLE **OPEN ACCESS**

Impact of Organic Manure Amendment on Growth of *Withania somnifera* (L.) Dunal var JA-134

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ABSTRACT
There is an increased demand for organic and safe products of Ashwagandha roots, leaves and seeds which are used in formulation of various Ayurvedic and unani medicines. As the quality of root is an important parameter for its marketability, the factors affecting its quality need to be studied and optimized for making Ashwagandha cultivation the most remunerative. Thus study was carried out to see the impact of organic manure treatments on Ashwagandha (T_1-vermicompost, T_2-vermicompost+goat manure T_3- goat manure and control- no manure added). The results obtained from the study revealed that Withania somnifera (L.) Dunal responded well to the application organic manures (T_1> T_2> T_3) as compared to the control. Based on the finding, it is recommended that application of vermicompost and goat manure could be used to minimize cost of production as this will improve soil organic matter and nutrient availability of soil. The new approaches to the use of organic amendments in farming have proven to be effective means of improving soil structure, enhancing soil fertility and increasing crop yields.
Key words: Ashwagandha, vermicompost, goat manure, soil organic matter

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INTRODUCTION

Farm crops remove large quantity of plant nutrients from soil, particularly the removal of NPK nutrients. The regular recycling of organic wastes in the soil is the most efficient method to maintain optimum levels of soil organic matter. Organic matter is a complex mixture of chemical substances such as carbohydrates, proteins, organic acids, lignin, alkaloids etc. These materials serve as precursors of soil humus. On the other hand chemical fertilizers provide only short term nutrient supply to crops. Use of only nitrogenous and phosphatic fertilizers also create nutrient imbalance in soil. They do not feed soil life and nor do they add organic matter to the soil. Excessive use of chemical fertilizers and other agro chemicals, which are the important inputs in modern farming, creates depletion in soil fertility and pollution in surface water bodies. Beyond the economical and political issues, the increase of soil salinity and the eutrophication of groundwater are among the most dangerous environmental problems related to intensive chemically fertilization of the fields [1].

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 [2].

Vermicompost, which are produced by the fragmentation of organic wastes by earthworms, have a fine particulate structure and contain nutrients in forms that are readily available for plant uptake. Vermicompost contain nutrients in forms that are readily taken up by the plants such as nitrates, exchangeable phosphorus, and soluble potassium, calcium, and magnesium.

The droppings of goats contain higher nutrients than farmyard manure and compost. Goat manure is easy to transport and store as dried pellets and has less odour than other animal manures like farmyard manure [3].

Some of the main forces behind the growth of organic agriculture include reduced input costs and diversification of market opportunities. Moreover the organically produced products are sustainable and getting premium price in the market and also have good export potential.

Withania somnifera (L.) Dunal is one of the most important herbs of traditional system of medicine in India. The word Ashwagandha in Sanskrit literally translates to odour of a horse; the ground root has an aroma that is reminiscent of horse. Among the 23 species of genus Withania (Solanaceae) *Withania somnifera* L. Dunal (Ashwagandha or Indian ginseng) is the most important medicinal plant of Indian traditional systems of medicine such as Ayurveda, Unani and Siddha. The important medicinal properties of *W. somnifera* have been attributed to the presence of unique classes of steroidal lactones called withanolides.

Ashwagandha root find an important place in Ayurveda for the treatment of rheumatic pain, inflammation of joints, nervous disorders, impotence and immature ageing [4]. It also has anti-inflammatory and immunosuppressive properties, whereas sitoindosides IX and X are immunostimulatory [5]. Withanolide D has antitumour activity [6].

Owing to the increased demand for organic and safe products in the market it is prudent to cultivate this crop with an application of organic manure. As the quality of root is an important parameter for its marketability, the factors affecting its quality need to be studied and optimized for making ashwagandha cultivation most remunerative and safe.

MATERIALS AND METHODS

Experimental site

The present field experiment was conducted at Department of Botany, University of Rajasthan, Jaipur. The soil has pH 8.6, organic carbon (0.14%), phosphate (24 kg/Hec) and potash (290 kg/hec) [3]. The experiment was carried out in a Randomized Block Design (RBD) with three replicates. The land was ploughed and blocks of same size of 1 m^2 were made. Stubbles and weeds were removed from the experimental site and the land was levelled.

Applications of treatment

Following manure treatments were given to each plot

C – Control (No manure added)

T_1– Vermicompost only

T_2 – Mixture of vermicompost and goat manure

T_3 - Goat manure only

Manures at the rate of 15 t/ha were thoroughly mixed with soil of different blocks and the blocks were labelled according to the treatment. After 15 days seeds were sown in the blocks.

Seed collection

Seeds of variety of *W. somnifera* namely Jawahar Asgand 134 were obtained from Directorate of Medicinal Plant Research, Anand, Gujarat, India.

Measurements of growth parameters

After 120 days, five plants were randomly selected and tagged in each treatment for recording growth parameters such as stem height (cm), stem diameter (cm), number of primary branches per plant, leaf area (cm^2) [7], number of seeds per berry. At harvest tagged plants from each block were uprooted to record main root length (cm), root diameter (cm), fresh root weight per plant (gm), dry root weight per plant (gm), fresh stem weight (gm) and dry stem weight (gm). The root and shoot after recording fresh weight were cut into pieces of 5 cm length and oven dried at 60°C to calculate the dry weight of root and shoot.

Statistical analysis

All data were expressed as mean ± standard error. The statistical significance was evaluated by one-way analysis of variance (ANOVA). When there was a significant difference, differences between treatment mean values were compared using the Least Significant Difference (LSD) at 5% level of probability.

RESULTS AND DISCUSSION

Effect on growth parameters of plant

The application of various organic manures significantly ($P \leq 0.05$) influenced the stem height and diameter in Ashwagandha (Table 1). The maximum stem height (27.67 cm) and diameter (1.1cm) was recorded in the treatment T_1. The next better treatment in this regard was T_2 (Vermicompost + Goat manure) (25.33 cm). The minimum plant height (17.67 cm) and diameter (0.47 cm) was recorded in the treatment control. In our previous work on Jawahar ashgandh 20 we found treatment T_2 and T_3 better for stem height [3]. The highest number of primary branches per plant was recorded with the treatment T_1 (Table 1). Application of vermicompost had shown significant ($P \leq 0.05$) effect on number of seeds per berry while treatment T_2 and T_3 does not differ significantly ($P \leq 0.05$). This may be attributed to gradual availability of nutrient through decomposition throughout the growth phase. An examination of the data presented in (Table 1) revealed that the application of organic manures showed a beneficial effect on leaf

area but not significant (P≤0.05). [8] reported significant increased growth and yields of field tomatoes (*Lycopersicon esculentum*) and peppers *(Capsicum anuum grossum*) when vermicomposts, produced commercially from cattle manure, food waste or recycled paper, were applied to field plots at rates of 20 t/ha and 10 t/ha in 1999 and at rates of 10 t/ha and 5 t/ha in 2000 compared with those receiving equivalent amounts of inorganic fertilizer. [9] Also reported significant increase in growth parameters in cumcumber with goat and poultry manure at the rate of 20 t/ha

The highest root length (18.87 cm) was recorded by the treatment T_1 at harvest followed by treatment T_2 (16.47 cm). Treatment T_1 and T_2 had also shown significant (P≤0.05) effect on root diameter. These findings were in line with our previous finding [3]. Root growth and proliferation are dependent upon soil "physical properties". Improvements in soil physical properties such as aggregate stability (tilth), porosity, infiltration, drainage, water holding capacity, bulk density, and resistance to crusting and compaction minimize constraints to root growth. A root system that occupies more soil volume has access to more soil moisture and nutrients. It may be due to increased availability of nutrient and other growth promoting substances supplied by organic manure. The results obtained were in agreement with the findings of [10] in which they reported higher yield response of crop due to organic manure application.

Effect on fresh and dry weight of plant

Application of organic manure had shown significant (P≤0.05) effect on stem fresh weight in comparison to control while manure treatments does not differ significantly (P≤0.05). Highest stem fresh weight was recorded in plants treated with vermicompost (30.04 gm) followed by combination of vermicompost and goat manure (26.1 gm). Similar effect was recorded in stem dry weight (table 2). These findings were in line with results observed in a study conducted to see the effect of organic manures on *Withania somnifera* (L.) Dunal var J A-20 [3]. Root fresh weight was also significantly (P≤0.05) influenced by application of organic manures. Plants treated with vermicompost had shown highest root fresh weight (7.66 gm) followed by treatment T_2. Treatment T_3 had also shown significant (P≤0.05) effect compared to control. Similar trend was also noticed in root dry weight. The present study has created an interesting data with respect to plant growth parameters. As evidenced from the work of [11] and [12], this may be due to effective micro-organism enhances the production of phytohormones like auxins and gibberellins that might have stimulated the growth by increasing the plant height, number of branches and other growth parameters. Humic acid influences plant growth through modifying the physiology of plants and by improving the physical, chemical and biological properties of soil [13]. [14] had also recorded an increase in growth parameters of Ashwagandha using farm yard manure. In southeast Nigeria, [15] found that goat manure increased soil pH, N and yield of plantation.

Table 1: Effect of manure treatment on different growth parameters of plant

Growth parameters	Treatments (mean ± Standard error)				
	Control	T1	T2	T3	LSD (5%)
Stem height (cm)	17.67±0.88a	27.67±3.18b	25.33±0.88 b	23±0.58 b	5.67
Stem diameter (cm)	0.47±.09 a	1.1±0.06 b	0.97±0.09 b	0.9±0.06 b	0.25
No. of primary branches per plant	3±0 a	4.33±0.33 b	2.33±0.33 c	3±0.58 ad	1.23
Leaf area (cm2)	20.36±3.09 a	25.54±2.94 a	22.67±2.15 a	26.36±1.93 a	NS (8.43)
No. of seeds per berry	21.33±1.86 a	36±3.61 b	28.33±1.20bc	25.33±2.18 c	7.79
Root length (cm)	8.87±0.27 a	18.87±0.47 b	16.47±0.75 c	13.5±0.53 d	1.79
Root diameter (cm)	0.6±0.09 a	1.3±0.06 b	1.03±0.03 bc	0.97±0.12 c	0.26

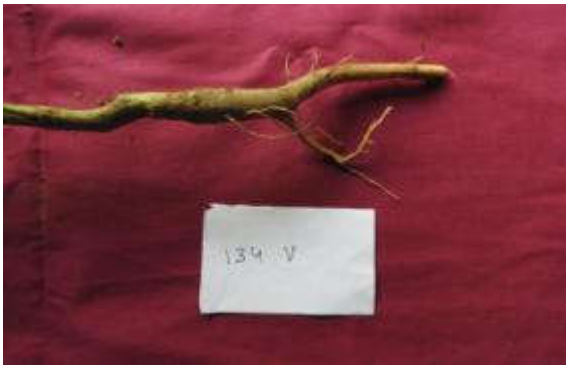
Mean values designated with different superscripts indicate that differences between treatments are significant according to the Fishers Least Significant Difference (LSD) at 5% level of probability.

Table : 2 Effect of manure treatments on fresh and dry weight of plant

Weight (gm)	Treatments (mean ± Standard error)				
	Control	T_1	T_2	T_3	LSD (5%)
Stem fresh weight (gm)	9.98±0.91[a]	30.04±7.04[b]	26.1±1.5 [b]	23.49±0.51[b]	11.91
Stem dry weight (gm)	3.75±0.8 [a]	14.31±3.3 [b]	12.09±0.9 [b]	10.12±0.27[b]	5.77
Root fresh weight (gm)	0.99±0.31 [a]	7.66±1.04 [b]	6.04±0.39 [bc]	5.54±0.36 [c]	1.9
Root dry weight (gm)	0.23±0.06 [a]	3.58±0.19 [b]	2.33±0.16 [c]	1.42±0.26 [d]	0.6

Mean values designated with different superscripts indicate that differences between treatments are significant according to the Fishers Least Significant Difference (LSD) at 5% level of probability.

a b



c d

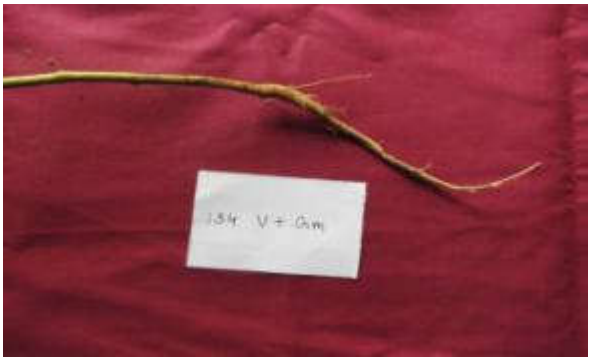
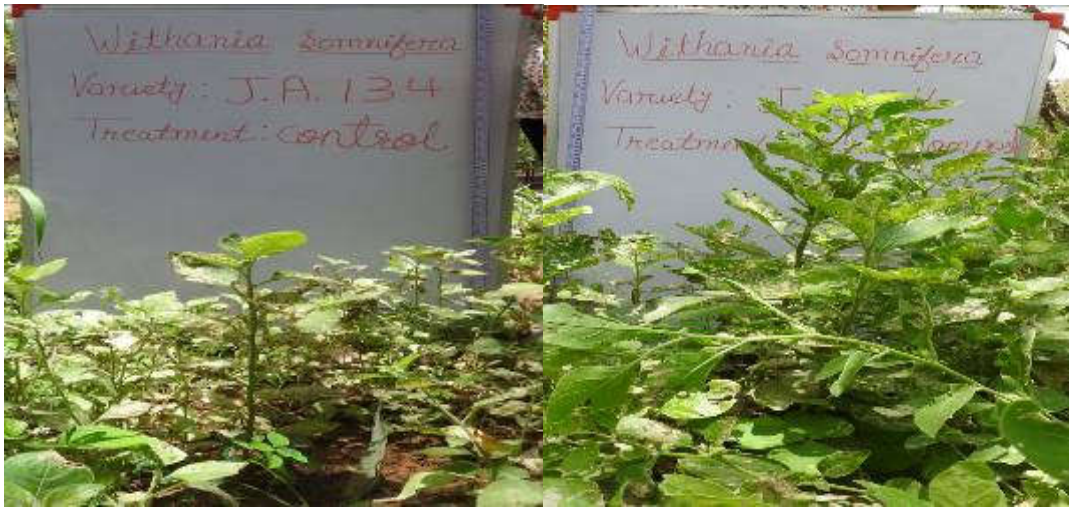
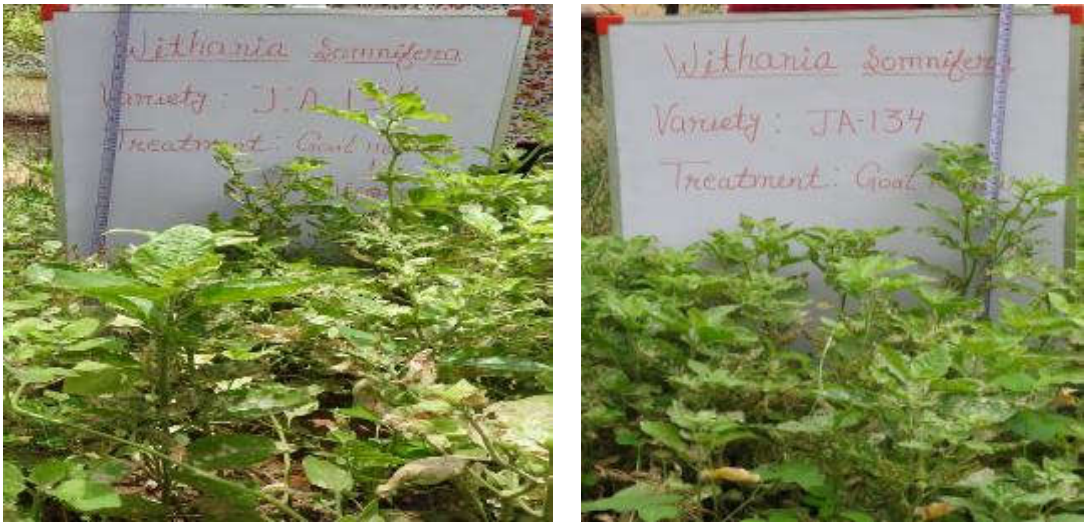


Figure 1 Images showing roots of plants of different treatments (a) C-control plants, (b) T_1 - Vermicompost (c) T_2 – Vermicompost + Goat manure (d) T_3- Goat manure.



(a) (b)



(c) (d)

Figure 2: (a) C-control plants, (b) T_1 - Vermicompost treated plants (c) T_2 – Vermicompost + Goat manure treated plants (d) T_3- Goat manure treated plants

CONCLUSION

The results obtained from the study revealed *Withania somnifera* (L). Dunal responded well to the application organic manures (T_1>T_2>T_3) in comparison to control. No significant difference reported in between different organic manures. Based on the finding, it may be recommended that application vermicompost and goat manure could be used to minimize cost of production as this will improve soil organic matter and nutrient availability and high. The effects of organic manure on plants are not solely attributed to the quality of mineral nutrition it provides but also to its other growth regulating components such as plant growth hormones and humic acids. Organically produced *Withania* roots which are used in Ayurvedic medicine also have more economic value.

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