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# IMPACT OF ORGANIC MANURE AMENDMENT ON GROWTH OF *WITHANIA SOMNIFERA* (L.) DUNAL VAR JA-20

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## ABSTRACT

*Withaniasomnifera* (L.) Dunal, also known as Indian ginseng, Indian Winter Cherry is one of the mostvalued plants in Ayurveda and is commonly used in Indiantraditional health care systems. The roots of this plant have been employed in Indian traditional systems of medicine, Ayurveda and Unani. A large number of withanolides have been identified in Withania roots and leaves. Rajasthan, Punjab, Haryana, Uttar Pradesh, Gujarat, Maharashtra and Madhya Pradesh are the major Ashwagandha producing states of the country. The organic cultivation of *Withaniasomnifera*, being a medicinal herb, is highly beneficial toboost the exports and to get premium price in the worldmarket. With this concept in view, the presentinvestigation was made to study the effect of organicamendments on growth in *Withaniasomnifera* variety J A-20. Four treatments namely C-control (no manure), $T_1$-Vermicompost only, $T_2$-combination of Vermicompost and Goat manure and $T_3$-Goat manure only were given to the plant. All the growth parameters increased significantly ($P \leq 0.05$) in treatment $T_1$, $T_2$ and$T_3$indicating the efficacy of these treatments.

**KEYWORDS:** *Withaniasomnifera*, Ashwagandha, Ayurveda, organicamendments, Vermicompost, Goat manure.

## 1. INTRODUCTION

*Withania somnifera* (L.) Dunal is commonly used in Indian traditional health care systems. The roots of this plant are exploited for its medicinal value. *Withania* has the potential property of pacifying 'Vata' in herbal drugs (Singh et al,. 2001; Dhuley, 2001). A large number of withanolides have been identified in *Withania* roots and leaves (Glotter et al., 1973; Eastwood et al., 1980; Nittala and Lavie, 1981). Some of these, like withaferin A have

been associated with anti-inflammatory (Sethi et al., 1970) and immunosuppressive (Shohat et al., 1978) properties, whereas sitoindosides IX and X are immunostimulatory (Ghosal et al., 1989). Withanolide D has antitumour activity (Leyon and Kuttan, 2004) and sitoindosides VII and VIII are antioxidants (Bhattacharya et al., 1997; Panda and Kar, 1997). Other withanolides, including their glycosylated products are reported to have immunomodulatory and other activities (Zhao et al., 2002). It grows in dry areas sub-tropical regions. Rajasthan, Punjab, Haryana, Uttar Pradesh, Gujarat, Maharashtra and Madhya Pradesh are the major Ashwagandha producing states of the country.

Nowadays farming has primarily focused on increasing productivity while reducing labour costs through technological advancements. The use of chemical fertilizers and pesticides has played a key role in helping farmers achieve higher crop yields. Despite higher yield achieved, there have been negative impacts including loss of soil and water quality, biodiversity and natural habitat (Matson et al., 1997). Other problems associated with increased mechanization and widespread use of certain agrochemicals has been linked to health problems faced by farmers and associated workers.

The human health impacts of fertiliser pollution are also serious. A study conducted by Greenpeace India, in Punjab, found that most wells were contaminated with nitrates; 20% of all sampled wells had nitrate levels above the safety limit of 50 mg per litre as established by the World Health Organisation. Such high levels are known to cause diseases like blue baby syndrome in infants and cancers of the digestive tract, bladder and ovaries (Kaur and Sinha, 2011). Fertilisers also release heavy metals and cause air pollution of various kinds. It is such health concerns and other factors including lower crop input costs, good environmental and soil management, and emerging diversified markets that have aroused interest in farmers shifting to agricultural production alternatives like organic farming (Entz et al., 2001) and adding beneficial microorganisms to soil to enhance productivity (Meena et al., 2016).

Cultivation of medicinal plants organically also serves as a safe mode of medicine. The balanced supply of plant nutrients is prerequisite for successful agriculture. Intensive cultivation and growing of exhaustive crops have made the soil deficient in macro as well as in micronutrients. Use of only nitrogenous and phosphatic fertilizers also create nutrient imbalance in soil. Organic manures not only supply the plant nutrients but also improve the soil health. Organic matter decomposes to release nutrients that are taken up by subsequent crops (Hendrix et al., 1986). The nutrients contained in organic manures are released more

slowly and are stored for a longer time in the soil, thereby ensuring a long residual effect. It has been observed that maintenance of soil structure especially improved in organic cropping systems. These improvements have been attributed to the fact that fresh organic matter from roots and manures were added regularly to the soil, thus helping to improve soil structure (Shepherd et al., 2002).

Vermicomposts are finely divided peat-like materials with high porosity, aeration, drainage, water-holding capacity (Edwards and Burrows, 1988). It is a product of biodegradation and stabilization of organic materials by interaction between earthworms and microorganisms (Raja and Veerakumari, 2013).

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. Use of animal manure is even more cost effective for farmers. The application of the manures significantly raised the soil pH, organic matter content, total N, available P and exchangeable K, Ca and Mg status of the soil. Goat manure had superior responses for all other chemical properties than Poultry manure. The 15 t/ha rate of both manures maximized sweet maize growth attributes, total dry matter (TDM) and grain yields (Uwah et al., 2014).

The estimated production of Ashwagandha roots in India is more than 1500 tonnes and the annual requirement is about 7000 tonnes necessitating the increase in its cultivation and higher production. The organic cultivation of *Withania somnifera,* being a medicinal herb, is highly beneficial to boost the exports and to get premium price in the world market. Therefore the present investigation was made to study the effect of organic amendments on growth of *Withania somnifera* (L.) Dunal variety J A 20.

## 2. MATERIALS AND METHODS

### 2.1. 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). The experiment was carried out in a Randomized Block Design (RBD) with three replicates. The land was ploughed and blocks of same size were made. Stubbles and weeds were removed from the experimental site and the land was levelled.

**2.2. 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.

**Table: 1…….**

**2.3. Seed collection**

Seeds of variety of *W. somnifera* namely Jawahar Asgand 20 were obtained from Directorate of Medicinal Plant Research, Anand, Gujarat, India.

**2.4. 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 ($cm^2$) (Patidar et al., 1990) , number of berries per plant, 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.

**2.5. 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.

**3. RESULTS AND DISCUSSION**

In the present field experiment conducted on one variety of *Withania somnifera* (L.) Dunal data presented in the following tables clearly indicates that the different organic manures had significant ($P \leq 0.05$) influence on different growth parameters. Virtually all the measurable

parameters such as stem height, stem diameter, main root length, root diameter, fresh root weight per plant, dry root weight per plant, fresh stem weight and dry stem weight increase significantly (P≤0.05) compared to control.

**Table 2…..**

Data presented in Table 2 reveals that use of organic manure had significantly (P≤0.05) increased the stem height as compared to the control. Almost similar pattern was also observed for stem diameter and number of branches per plant. This observation was in line with results observed in a study conducted to see the impact of different type of vermicompost on *Withania somnifera* (L.) Dunal (Raja and Veerakumari, 2013). Increase in growth parameters of Sweet Maize using goat manure has also been observed (Uwah and Eyol, 2014). No significant (P≤0.05) difference was observed on leaf area while maximum leaf area was recorded with treatment $T_1$. Number of seeds per berry was observed significantly (P≤0.05) higher with treatment $T_2$. There was significant (P≤0.05) difference in root length and root diameter observed for different treatments. Highest root length (20.1cm) and diameter (1.07cm) was observed in plots containing vermicompost treatment.

**Table: 3….**

According to data presented in table 3 it is concluded that there was a significant (P≤0.05) increase in stem fresh weight in treated plants. Stem fresh weight was significantly higher in treatment $T_1$, $T_2$ and $T_3$. Treatment $T_2$ had significantly (P≤0.05) increased the stem dry weight in comparison to treatment $T_1$, $T_3$ and control. There was no significant (P≤0.05) difference on root fresh weight in treatment $T_1$, $T_2$ and $T_3$, but the manure treatment had a significant (P≤0.05) effect in comparison to control. Increased root dry weight was significant (P≤0.05) in treatment $T_1$ while treatment $T_2$, and $T_3$ were not significantly (P≤0.05) different. These results were also supported by studies done by various researchers on assessment of organic manure on growth and yield in a variety of medicinal plants including, *Chlorophytum borvallianum* (Paturd et al., 2002), *Ocimum basilicum* (Munnu et al., 2002), *Phyllanthus amarus* (Annamalai et al., 2004), *Aloe vera* (Saha et al., 2005).

The observed significant (P≤0.05) difference due to vermicompost could be due to very rich and diverse microbial populations present in vermicompost. Their applications to soils may have added to the indigenous soil microorganism populations, resulting in much larger, richer and diverse soil microbial populations. Some microorganisms can form synergistic relationships in plant rhizospheres, by acting as root extensions, thereby increasing the

capacity of plants to utilize soil moisture and nutrients, and at the same time they benefit from plant root exudates. Other byproducts of microbial activities known to promote plant growth includes producing antibiotics, disease antagonists and plant growth influencing substances such as hormones and humates (Edwards, 1983; Arancon, 2004).

The improvement in the growth of Ashwagandha variety J A 20 could be attributed in part to the ability of the manure to increase soil organic matter content and chemical composition thereby increasing crop yield in line with the observations of Haynes and Beare (1994). Yield increase results from the addition of organic manure, increase in cation exchange capacity and to increase in water holding capacity (Leng, 2006). When organic manure is applied in sufficient quantity to the soil, it can supply all the necessary primary and secondary nutrient required for crop growth (Cooke, 2002). Goat manure was also found to be an efficient source of N, P, K, Ca, Mg and organic matter for pepper, cassava and okra (Awodun et al., 2007; Odedina et al., 2011; Nweke et al., 2013). Studies by Smith and Ayenigbara (2001) and Ojeniyi and Adegboyega (2003) indicated that goat manure improved N, P, K, Ca and Mg status of soil. Application of goat manure to P fixing soils in South Africa was reported to have reduced the adsorption of added P and this effect was largely attributed to the liming potential of goat manure (Gichangi and Mnkeni, 2009).

**Table: 1 Nutritional value of manure used**

| Name of manure | N % | P% | K% | Ca% | Mg% | O.C. % |
|---|---|---|---|---|---|---|
| Goat manure | 2.2-3.4 | 0.3-0.7 | 1.5-2.5 | 1.5-2.4 | 0.4-0.8 | 17-20 |
| vermicompost | 1-1.5 | 0.6-0.8 | 1.2-1.5 | 0.4-0.8 | 0.3-0.6 | 20-25 |

**Table 2: Effect of manure treatment on different growth parameters of plant**

| Growth parameters | Treatments (mean ± Standard error) | | | | |
|---|---|---|---|---|---|
| | Control | $T_1$ | $T_2$ | $T_3$ | LSD (5%) |
| Stem height (cm) | 15.33±1.45[a] | 21±1.52[b] | 24.33±0.67[b] | 24.33±2.33[b] | 5.25 |
| Stem diameter (cm) | 0.53±.09[a] | 0.93±0.09[b] | 0.9±0.058[b] | 0.83±0.03[b] | 0.23 |
| No. of primary branches per plant | 1.67±0.33[a] | 2.67±0.33[a] | 3.33±0.67[b] | 3.33±0.33[b] | 1.44 |
| Leaf area ($cm^2$) | 18.9±2.79[a] | 23.77±0.59[a] | 22.47±1.48[a] | 20±0.88[a] | NS |
| No. of seeds per berry | 21.67±2.02[a] | 29.33±1.20[b] | 36.33±1.85[C] | 27.67±2.85[b] | 5.75 |
| Root length (cm) | 10.4±0.46[a] | 20.1±0.66[b] | 15.73±1.48[C] | 15.6±0.49[C] | 2.88 |
| Root diameter (cm) | 0.67±0.12[a] | 1.07±0.07[b] | 1±0.07[b] | 0.97±0.05[b] | 0.83 |

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: 3 Effect of manure treatments on fresh and dry weight of plant**

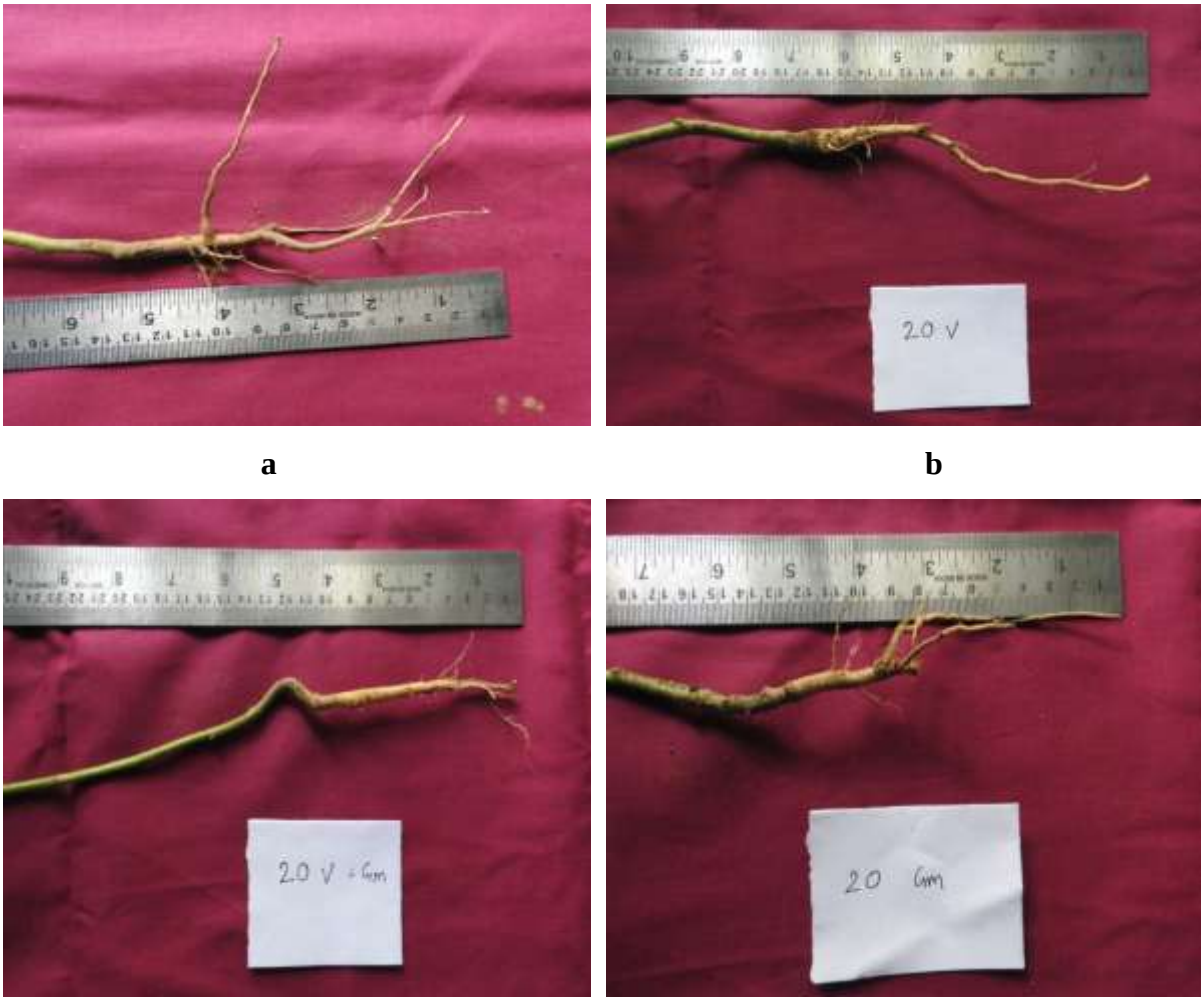
| Weight (gm) | Treatments (mean ± Standard error) | | | | |
|---|---|---|---|---|---|
| | Control | $T_1$ | $T_2$ | $T_3$ | LSD (5%) |
| Stem fresh weight (gm) | 3.62±1.37[a] | 19.96±2.34[b] | 18.53±2.84[b] | 12.55±0.68[c] | 5.51 |
| Stem dry weight (gm) | 1.47±0.43[a] | 4.24±0.48[b] | 5.66±1.72[b c] | 3.64±0.13[bd] | 2.003 |
| Root fresh weight (gm) | 0.94±0.19[a] | 3.29±0.68[b] | 3.44±0.09[b] | 2.59±0.33[b] | 1.29 |
| Root dry weight (gm) | 0.31±0.08[a] | 0.94±0.27[b] | 0.69±0.05[c] | 0.51±0.04[c] | 0.20 |

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


**a** **b**

**c** **d**

**Figure 1: (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.**




**a** **b**

**c** **d**

**Figure 2: Images showing roots of plants of different treatments (a) C-control plants, (b) $T_1$– Vermicompost only (c) $T_2$ – Vermicompost + Goat manure (d) $T_3$- Goat manure only.**

## 4. CONCLUSION

From the result of the study, it can be concluded that the use of organic manure in medicinal plant production is desirable as it is safe and showed variable impacts on the growth of *Withania somnifera* (L.) Dunal. The use of organic manure improves soil organic matter status and nutrient availability. It ensures good crop yield, is healthy and also ensures stability of soil structure. Organic manures are cheap, more easily accessible and available. It is a good alternative to chemical fertilizer and has sustainability effects on soil. Therefore it is advisable to use vermicompost or combination of vermicompost and goat manure for the production of Ashwagandha for better health of humans, soil health and also to increase farmer's yield and income.

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