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Effect of Organic Manures and Microbial Inoculants on Root Yield Attributes of Ashwagandha

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ABSTRACT

A field experiment was conducted during late kharif season of 2010-2011 at College of Horticulture, Venkataramannagudem, West Godavari Dist (Andhra Pradesh) to identify a suitable source of organic nutrients and their optimum combination with bionutrient sources on, root yield attributes and root yield in ashwagandha. There were 14 treatments consisting of organic manures *viz.,* poultry manure, vermicompost, Neem cake and Farm yard manure and biofertilizers *viz., Azospirillum* and PSB. Results indicated that application of poultry manure in combination with biofertilizers produced higher root length, root diameter, fresh root yield, dry root yield and seed yield of 21.00 cm, 1.59 cm, 1524 Kg ha^{-1}, 739 Kg ha^{-1} and 186.40 Kg ha^{-1} respectively and it was on par with VC + Biofertilizers and recommended dose of fertilizers.

Key words : Ashwagandha, Dry root yield, Fresh root yield,Root diameter, Root length, Seed yield.

Ashwagandha or Asgandh (*Withania somnifera* Dunal.*)* popularly known as 'Indian Ginseng' belongs to the family Solanaceae. In India it is mainly cultivated in Mandsaur district of Madhya Pradesh, adjoining villages of Kota district of Rajasthan, Punjab and Karnataka. Due to increasing demand for roots in recent times and considering its future demand, there exists much scope for extensive cultivation of the crop in India. Ashwagandha roots and seeds are used in ayurvedic and unani medicines preparations. The roots are prescribed in medicines for hiccup, several female disorders, bronchitis, rheumatism, dropsy, and stomach and lung inflammation and skin diseases. They are mostly used for curing general and sexual debilities. Roots are also having anti aging property (Savitha *et al.,* 2009). Though ashwagandha is an oldest known medicinal crop limited success has been achieved so far in increasing root yield in this crop, mainly because of inadequate information on nutrient requirement and source of nutrients to be used in ashwagandha for improving yield. Until now, maximization of yield had been the main object of modern agriculture and the intensive cultivation demanded the use of inorganic fertilizers. In the changing scenario, the technology based primarily on continuous use of chemical inputs with only a meager supplementation of organic manures is thought to be not sustainable since the productivity of soils is fast deteriorating. In international trade, the herbal medicines and products produced through organic forms command premium price and in much demand. Information on organic farming practices in ashwagandha is scanty and hence the present investigation was undertaken.

MATERIAL AND METHODS

The field experiment was conducted at College of Horticulture, Venkataramannagudem, West Godavari Dist (Andhra Pradesh) under irrigated conditions during late *kharif* seasons of 2010-11. The soil of the experimental site was sandy loam in texture, neutral in reaction, low in organic carbon, low in available nitrogen (192 kg ha^{-1}), high in available phosphorus (28.5 kg ha^{-1}) and medium in available potassium (255 kg ha^{-1}). The studies were carried out using ashwagandha cv. Poshita with 14 treatments *viz.,* neem cake 4 t ha^{-1} (NC 4 t ha^{-1}: T_1), vermicompost 5 t ha^{-1}(VC 5 t ha^{-1}: T_2), poultry manure 5 t ha^{-1} (PM 5 t ha^{-1}: T_3), farm yard manure 12 t ha^{-1} (FYM 12 t ha^{-1} : T_4), *insitu* green manuring with sunnhemp (GM : T_5), NC 4 t ha^{-1} + BF (T_6), VC 5 t ha^{-1} + BF (T_7), PM 5 t ha^{-1} + BF (T_8), FYM 12 t ha^{-1} + BF (T_9), GM + BF (T_{10}), bio-fertilizers consisting of *Azospirillum* and Phosphate solubilizing bacteria (BF: T_{11}), recommended dose of fertilizers (RDF : T_{12}), 50 per cent recommended dose of fertilizers (50 per cent RDF : T_{13}) and control (T_{14}). The

experiment was laid out in a randomized block design with three replications. Sunnhemp seeds were broadcasted at 40 kg ha^{-1} and it was incorporated at the age of 53 days by tractor drawn rotavator and left for ten days to decompose. The organic manures *viz.,* farm yard manure, vermicompost, poultry manure and neem cake were applied as per the treatments and incorporated into the soil a week before seed sowing. *Azospirillum* and PSB @ 5 kg ha^{-1} were incorporated in FYM separately a week before application in the field and thoroughly incorporated in soil before sowing of seed. Seed inoculation with *Azospirillum* and PSB was also done. The crop was sown at 30x10cm spacing and was thinned at 15 DAS to retain one seedling per hill. At harvest *i.e.,* 180 DAS five plants were randomly selected in each treatment for recording yield attributes *Viz.,* root length and diameter. The plants from each net plot were uprooted at harvest and the roots were separated and dried under sun. The root yield was recorded as kg per plot and expressed in kg per hectare.

RESULTS AND DISCUSSION

Significant differences in yield attributes and yield of ashwagandha due to different nutrient sources and their combination with biofertilizers were observed at harvest (Tables 1 and 2). The variation in yield due to treatments could be attributed to variation in yield attributing parameters. The main yield attributes in ashwagandha are root length and root diameter. The results indicated that application of PM 5 t ha^{-1} + BF produced the longest root (21.00 cm) and widest diameter (1.59cm) but was on par with VC 5 t ha^{-1} + BF and RDF (Table 1). The higher values of yield attributes of ashwagandha were mainly due to better growth of the plant which can be related to higher values of growth parameters recorded at 180 DAS. The results corroborate the findings of Jayalakshmi (2003) in coleus. The increased root length and root diameter might also be due to the improvement of soil physical characters with the application of poultry manure and vermicompost which in turn helped in better absorption of nutrients by the roots. This is in accordance with findings of Awad *et al.,* (2000) in grape.

The fresh, dry root yield and seed yield were significantly influenced by the application of different nutrient sources and their combination with biofertilizers. At harvest, the combination of PM 5 t ha^{-1} + BF produced the highest fresh root yield (1524 kg ha^{-1}), dry root yield (739 kg ha^{-1}) and seed yield (186.40 kg ha^{-1}) but was on a par with VC 5 t ha^{-1} + BF and RDF (Table 2). The maximum root yield observed in the plants was due to increased length and diameter of roots. The increase in fresh and dry root yield could be attributed to availability of more nutrients continuously through poultry manure and biofertilizer inoculation over a long period thus favouring the growth and development of better root system resulting in better uptake of nutrients. Similar results were also reported with poultry manure + *Azospirillum* + phosphobacteria in Bhumyamalaki (Chezhiyan *et al.,* 2003). Increased seed yield with poultry manure @ 5 t ha^{-1} + BF could be due to positive correlation of seed yield to root length and root diameter as reported by Pol *et al.,* (2003) in ashwagandha. Increased seed yield with application poultry manure in maize (Chandrasekhar, 2000) were also reported. The treatments, PM 5 t ha^{-1} + BF and VC 5 t ha^{-1} + BF had recorded yield attributes and yield on par with RDF indicating the scope for complete substitution of inorganic fertilizers with these treatments in ashwagandha. Similar findings were also reported by Vennila and Jayanthi (2008) in coleus.

The organic treatments with a combination of biofertilizers (NC + BF, VC + BF, PM + BF, FYM + BF and GM + BF) had recorded yield attributes and yield significantly higher than organic treatments (NC, PM, VC, FYM and GM) alone indicating the need of biofertilizers for improving yield attributes and yield for sustainable crop productivity with organic manures and biofertilizers combination. Similar findings with combination of vermicompost and biofertilizers in mint (Suresh *et al*., 2008), poultry manure and biofertilizers in Bhumyamalaki (Chezhiyan *et al.,* 2003), neem cake and biofertilizers in *Brassica juncea* (Irfan Khan *et al.,* 2010), green manuring and biofertilizers in senna (Rao, 2008) were also reported.

Further, the treatment with *Azospirillum* + PSB (BF) had recorded yield attributes and yield on a par with 50 per cent RDF offering an opportunity of reducing inorganic fertilizers by 50 per cent with the inoculation of these biofertilizers in ashwagandha. The synergistic interaction among the inoculated microbes might have enhanced the activity of nitrogen fixation, phophorus availability and production of growth promoting substances (Anandan, 2000) leading to the fresh and dry root yields on a par with 50 percent RDF. Gopal and Paramaguru (2006) in senna also reported similar findings. The yield attributes and yield parameters recorded with control were, however, the lowest at harvest. This could be

Table 1. Root length (cm) and root diameter (cm) as influenced by different nutrient sources and their combination with biofertilizers in ashwagandha.

Treatments	Root length (cm)	Root diameter (cm)
T1: NC 4 t ha^{-1}	16.12	1.07
T_2: VC 5 t ha^{-1}	17.40	1.20
T_3: PM 5 t ha^{-1}	17.56	1.24
T_4: FM 12t ha^{-1}	16.10	1.05
T_5: GM	15.86	1.04
T_6: Neem cake 4 t ha^{-1} + BF	19.03	1.32
T_7: vermicompost 5 t ha^{-1} + BF	20.70	1.52
T_8: Poultry manure 5 t ha^{-1} + BF	21.00	1.59
T_9: Farm yard manure 12t ha^{-1} + BF	18.76	1.29
T_{10}: Green manure (*Crotolaria juncea*) + BF	18.46	1.26
T_{11}: *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1} (BF)	14.20	0.83
T_{12}: 100% RDF	20.00	1.48
T_{13}: 50% RDF	14.73	0.89
T_{14}: Absolute control	13.13	0.71
Mean	17.36	1.17
SEm ±	0.43	0.05
CD (0.05)	1.26	0.14

Table 2. Fresh root yield (kg ha^{-1}), Dry root yield (kg ha^{-1}) and Seed yield (kg ha^{-1}) as influenced by different nutrient sources and their combination with biofertilizers in ashwagandha.

Treatments	Fresh root yield (kg ha^{-1})	Dry root yield (kg ha^{-1})	Seed yield (kg ha^{-1})
T1: NC 4 t ha^{-1}	1150	540	154.60
T_2: VC 5 t ha^{-1}	1247	592	159.16
T_3: PM 5 t ha^{-1}	1289	612	160.43
T_4: FM 12t ha^{-1}	1134	532	143.30
T_5: GM	1121	526	141.26
T_6: Neem cake 4 t ha^{-1} + BF	1411	677	176.36
T_7: vermicompost 5 t ha^{-1} + BF	1484	719	184.60
T_8: Poultry manure 5 t ha^{-1} + BF	1524	739	186.40
T_9: Farm yard manure 12t ha^{-1} + BF	1348	647	174.40
T_{10}: Green manure (*Crotolaria juncea*) + BF	1295	621	171.50
T_{11}: *Azospirillum* 5 kg ha^{-1} + PSB 5 kg ha^{-1} (BF)	1049	487	134.60
T_{12}: 100% RDF	1473	714	183.36
T_{13}: 50% RDF	1054	490	135.03
T_{14}: Absolute control	0984	447	113.60
Mean	1254.5	595.92	158.47
SEm ±	21.00	9.50	1.45
CD (0.05)	62.00	27.8	4.26

attributed to inadequate availability of nutrients resulting in reduced growth and yield attributes thus leading to lowest fresh and dry root yields.

Based on the results of the study it can be concluded that poultry manure @ 5 t ha^{-1} + BF and vermicompost @ 5 t ha^{-1} + BF are the optimum combination of organic and bio nutrient sources for complete substitution of inorganic nutrients in ashwagandha culture.

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