Internat. J. agric. Sci. Vol.2 No.2 July 2006 : (626-628)

Site specific nutrient management for *Withania somnifera* at subtropical belt of Uttaranchal

Sunita T Pandey*, Pankaj Singh and Pooja Pandey
Department of Agronomy, G.B. Pant University of Ag. and Tech., PANTNAGAR, U.S. NAGAR (U.A.) INDIA

ABSTRACT
To study the effect of various nutritional package (balanced fertilizer application), the effect of 16 treatment combinations of various nutrients on yield & quality was studied in randomized block design during 2004-2005. The maximum root yield (14q/ha) was found in T_2 treatment ($N_{100}+P_{50}+K_{100}+Mg_{20}\ S_{25}\ B_5\ Zn_{20}$) which was at par to T_1, T_6 & T_9 treatments. Minimum root yield (6.5 q ha^{-1}) was found under Control treatment (T_{16}) which was at par with T_{15}, T_{14}, T_{13} & T_{12}. Therefore it is suggested that to get higher root yield higher doses of nutrients should be applied, however the total alkaloid content under various treatments is yet to be measured to assess the quality of roots.

Key words : Ashwagandha, Nitrogen, Phosphorus, Potash, Maganesium.

INTRODUCTION

Ashwagandha (*Withania somnifera*) known as Indian Zing Seng, belongs to the family Solanaceae is an important cultivated medicinal crop of India and has been mentioned as an important drug in ancient ayurvedic literature. The root is the usable part (raw drug) having number of alkaloids, out of which withanine and somniferine are important. Total alkaloid content varies between 0.13% to 0.31%. This raw drug has been receiving a good deal of attention because of its antibiotic and antitumour properties. The roots are basically used for curing general and sexual debility.

MATERIALS AND METHODS

Present study was conducted in sub tropical areas of Uttaranchal (Tarai) situated, between longitude & latitude of 79^0 30'E to and 29^0 N at an elevation of 243.83m above msl. The experiment was conducted at Medicinal Research & Development centre, of GBPUA&T Pantnagar, during late kharif season of 2003-2004 laid out in randomized block design with 3 replications having net plot size of 1x1 m^2. The treatment included 16 combinations of various nutrients viz., $N_{100}+P_{100}+K_{100}\ Mg_{20}S_{25}B_5Zn_{20}$ (T_1); $N_{100}+P_{50}+K_{100}\ Mg_{20}S_{25}\ B_5Zn_{20}$ (T_2); $N_{100}+P_0+K_{100}\ Mg_{20}S_{25}\ B_5\ Zn_{20}$ (T_3); $N_{100}+P_{100}+K_{50}\ Mg_{20}S_{25}B_5\ Zn_{20}$($T_4$);$N_{100}+P_{100}+K_0Mg_{20}S_{25}B_5Zn_{20}$($T_5$);$N_{100}+P_{100}+K_{100}Mg_{20}S_{25}B_5Zn_{20}$ (T_6); $N_{100}+P_{100}+K_{100}Mg_{20}S_{25}B_0Zn_{20}$ (T_7); $N_{100}+P_{100}+K_{100}Mg_{20}S_0B_5Zn_{20}$ (T_8); $N_{100}+P_{100}+K_{100}Mg_0S_{25}B_5Zn_{20}$ (T_9); $N_{100}+P_{100}+K_{100}$ (T_{10}); $N_{25}+P_{40}+K_{30}$ (RDF) (T_{11}); V.C @5t/ha (T_{12}) ; FYM@ 5t/ha (T_{13}); $N_{25}+P_{40}+K_{30}$ (RDF)+V.C@ 5t/ha(T_{14}); $N_{25}+P_{40}+K_{30}$ +FYM @ 5t/ha (T_{15}); Control (No Nutrient) (T_{16}). The half dose of N & full dose of P, K, Mg, S, B, & Zn were applied as basal before sowing as per treatment. Rest of the half dose of nitrogen was applied at 45 DAS. The sources of N, P, K, Mg, B, S & Zn were Urea, DAP, Muriate of Potash, Magnesium Chloride ($MgCl_2$), Boric acid (H_3BO_3), Sulphur powder and Zinc Chloride ($ZnCl_2$) respectively. The variety Jawahar -20 was sown in the last week of September in lines at R-R 30cm & P-P 10cm distance. The seed was soaked in water for 24 hours & treated with fungicide thiram @ 3 g / kg of seed to protect from fungal diseases. All intercultural operations were preformed for growing a good crop. Data on plant height, number of branches, number of leaves, root length, root diameter, were recorded in 10 randomly selected tagged plants. Where as data on herbage weight, (fresh & dry), root weight (fresh & dry), number of berries were recorded from 1 meter row length. Seed weight / berry was computed by randomly selecting 50 berries from each plot after threshing them & 1000 seed weight (g) was estimated by weighing 1000 seeds taken randomly from selected berries for each plot separately. Root yield & herbage yield was recorded from net plot harvested.

RESULTS AND DISCUSSION

Effect of different treatments on plant height was found to be significant. Maximum plant height was recorded in T_5 (37.3 cm) which was at par with T_1, T_2, T_3, T_6, T_8 & T_9. Minimum plant height was recorded under Control (22.73cm). Effect of different treatments on number of branches per plant, number of leaves per plant, herbage weight (Fresh & Dry) and herbage yield was found significant. Maximum number of leaves per plant (191.9), number of branches per plant (17.7), herbage fresh (1181.4) as well as dry weight (357.8) gram per metre row length and herbage yield (12466.6 Kg ha^{-1}) was found in T_2 ($N_{100}\ P_{50}\ K_{100}\ Mg_{20}\ S_{25}\ B_5\ Zn_{20}$) treatment. All the said parameters performed significantly superior from the treatments, which do not have combination of micronutrients.

Effect of different treatments on fresh & dry weight of root (per meter row length), length & root diameter per plant and root yield per net plot (Kg ha^{-1}) was found significant. Maximum fresh (105.9 g/m row length) & dry weight (28.83 g/m row length) of root, root length (26.68cm), root diameter (1.46mm) & maximum root yield (1400 Kgha^{-1}) was found under T_2 treatment ($N_{100}+P_{50}+K_{100}\ Mg_{20}S_{25}\ B_5Zn_{20}$). It is important to mention here that root is the most important usable part of the plant for all medicinal purposes.

Thousands seed weight & Number of berries were also affected significantly by different treatment. Maximum 1000 seed wt was found under T_8 ($N_{100}+P_{100}+K_{100}+Mg_{20}\ S_0\ B_5\ Zn_{20}$) which was at par with T_2 , T_6 & T_{14} and superior from rest of the treatments. Number of berries were found again maximum under T_2 treatment which was at par with T_1, T_3, T_6, T_7, T_8, & T_9 however, superior to rest of the treatments.

The results are contrary to the results reported by Farooqi (2001) that Ashwagandha is a crop of residual fertility & does not give

***Author for correspondence**

Table 1 : Effect of various treatments on various components of herbage yield of Ashwagandha.

Sl. No	Treatments	Plant height (cm)	No. of branches Per plant	No. of leaves per plant	Herbage Fresh wt. (g/m row length)	Herbage Dry wt (g/m row length)	Herbage yield (Kg ha^{-1})
1.	$N_{100}+P_{100}+K_{100}$ $Mg_{20}S_{25}B_5$ Zn_{20}	36.1	16.6	172.0	841.1	254.6	11318.3
2.	$N_{100}+P_{50}+K_{100}$ $Mg_{20}S_{25}$ B_5 Zn_{20}	33.1	17.7	191.9	1181.4	357.8	12466.6
3.	$N_{100}+P+K_{100}$ $Mg_{20}S_{25}$ B_5 Zn_{20}	33.0	14.4	160.3	860.2	266.2	10633.3
4.	$N_{100}+P_{100}+K_{50}$ $Mg_{20}S_{25}B_5$ Zn_{20}	30.7	13.75	155.7	624.06	186.3	10833.3
5.	$N_{100}+P_{100}+K_0$ $Mg_{20}S_{25}B_5$ Zn_{20}	37.3	14.8	153.5	902.73	235.4	10800.0
6.	$N_{100}+P_{100}+K_{100}$ $Mg_{20}S_{25}B_5$ Zn_{20}	34.16	15.5	185.6	973.13	284.26	11600.0
7.	$N_{100}+P_{100}+K_{120}$ $Mg_{20}S_{25}B_5$ Zn_{20}	36.40	16.46	143.8	838.2	218.6	10133.3
8.	$N_{100}+P_{100}+K_{100}$ $Mg_{20}S_0B_5$ Zn_{20}	34.4	16.5	190.4	1175.26	293.33	11833.3
9.	$N_{100}+P_{100}+K_{100}$ $Mg_0S_{25}B_5$ Zn_{20}	34.00	14.2	175.8	918.86	279.4	10933.3
10.	$N_{100}+P_{100}+K_{100}$	31.20	9.6	148.0	841.13	206.9	8733.3
11.	$N_{25}+P_{40}+K_{30}$ (RDF)	25.20	9.7	94.1	365.9	188.5	7333.3
12.	V.C @5t/ha	23.7	9.1	100.2	505.26	186.4	6033.3
13.	FYM@ 5t/ha	29.10	10.4	137.7	632.86	185.5	7066.6
14.	$N_{25}+P_{40}+K_{30}$ +V.C@ 5t/ha	27.0	9.4	112.8	469.33	150.3	5966.6
15.	$N_{25}+P_{40}+K_{30}$ +FYM @ 5t/ha	26.70	10.4	142.7	650.46	170.1	6533.3
16.	Control (No Nutrient)	22.73	9.9	107.4	329.26	169.1	6553.3
	CD at 5%	5.05	2.96	23.8	131.53	56.6	2657.1

Table 2: Effect of various treatments on root yield and root yield attributing characters.

Sl. No.	Treatments	Root Fresh wt. (g/m root length)	Root Dry wt. (g/m row length)	Root length per plant (cm)	Root Diameter per plant (mm)	Root yield (Kg ha^{-1})
1.	$N_{100}+P_{100}+K_{100}$ $Mg_{20}S_{25}B_5$ Zn_{20}	85.8	21.62	23.14	1.37	1233.3
2.	$N_{100}+P_{50}+K_{100}$ $Mg_{20}S_{25}$ B_5 Zn_{20}	105.9	28.83	26.68	1.46	1400.0
3.	$N_{100}+P+K_{100}$ $Mg_{20}S_{25}$ B_5 Zn_{20}	87.5	20.03	20.12	1.22	1000.0
4.	$N_{100}+P_{100}+K_{50}$ $Mg_{20}S_{25}B_5$ Zn_{20}	80.9	20.39	20.02	1.24	1133.3
5.	$N_{100}+P_{100}+K_0$ $Mg_{20}S_{25}B_5$ Zn_{20}	91.7	20.70	21.72	1.31	1166.0
6.	$N_{100}+P_{100}+K_{100}$ $Mg_{20}S_{25}B_5$ Zn_{20}	88.7	25.60	25.61	1.4	1233.3
7.	$N_{100}+P_{100}+K_{120}$ $Mg_{20}S_{25}B_5$ Zn_{20}	89.9	20.95	18.76	1.3	1033.3
8.	$N_{100}+P_{100}+K_{100}$ $Mg_{20}S_0B_5$ Zn_{20}	82.4	27.59	23.06	1.4	1166.6
9.	$N_{100}+P_{100}+K_{100}$ $Mg_0S_{25}B_5$ Zn_{20}	88.0	24.63	23.94	1.4	1200.0
10.	$N_{100}+P_{100}+K_{100}$	88.5	21.67	18.86	1.3	1100.0
11.	$N_{25}+P_{40}+K_{30}$ (RDF)	46.2	10.19	20.68	1.0	633. 3
12.	V.C @5t/ha	54.9	14.56	20.83	0.86	800.0
13.	FYM@ 5t/ha	62.3	16.74	18.30	1.0	733.3
14.	$N_{25}+P_{40}+K_{30}$ +V.C@ 5t/ha	58.3	13.20	21.86	1.0	966.6
15.	$N_{25}+P_{40}+K_{30}$ +FYM @ 5t/ha	77.0	13.99	20.94	0.9	866.6
16.	Control (No Nutrient)	42.6	10.54	18.24	1.0	650.3
	CD at 5%	17.2	5.81	2.93	0.12	242.0

Table 3: Effect of treatments on components of seed yield.

Sl. No	Treatments	Seed wt/ berry (g)	1000 seed wt (g)	No.of Berries per plant
1.	$N_{100}+P_{100}+K_{100}$ $Mg_{20}S_{25}B_5$ Zn_{20}	0.053	1.98	1949.9
2.	$N_{100}+P_{50}+K_{100}$ $Mg_{20}S_{25}$ B_5 Zn_{20}	0.050	2.58	2392.1
3.	$N_{100}+P+K_{100}$ $Mg_{20}S_{25}$ B_5 Zn_{20}	0.033	2.02	1962.0
4.	$N_{100}+P_{100}+K_{50}$ $Mg_{20}S_{25}B_5$ Zn_{20}	0.053	1.94	1546.6
5.	$N_{100}+P_{100}+K_0$ $Mg_{20}S_{25}B_5$ Zn_{20}	0.053	1.92	1707.20
6.	$N_{100}+P_{100}+K_{100}$ $Mg_{20}S_{25}B_5$ Zn_{20}	0.050	2.38	2059.2
7.	$N_{100}+P_{100}+K_{120}$ $Mg_{20}S_{25}B_5$ Zn_{20}	0.040	2.16	1969.0
8.	$N_{100}+P_{100}+K_{100}$ $Mg_{20}S_0B_5$ Zn_{20}	0.043	2.68	2137.6
9.	$N_{100}+P_{100}+K_{100}$ $Mg_0S_{25}B_5$ Zn_{20}	0.050	2.21	2373.8
10.	$N_{100}+P_{100}+K_{100}$	0.040	1.76	2021.06
11.	$N_{25}+P_{40}+K_{30}$ (RDF)	0.050	1.90	1127.8
12.	V.C @5t/ha	0.040	1.78	1048.6
13.	FYM@ 5t/ha	0.050	1.92	1647.8
14.	$N_{25}+P_{40}+K_{30}$ +V.C@ 5t/ha	0.060	2.38	1248.8
15.	$N_{25}+P_{40}+K_{30}$ +FYM @ 5t/ha	0.050	1.65	1300.2
16.	Control (No Nutrient)	0.040	2.19	1237.0
	CD at 5%	0.001	0.3	470.7

response to higher level of nitrogen. This is very clear from the data that high dose of nitrogen provide significantly higher root yield with required high dose of K (100 Kg ha^{-1}) and other secondary & micronutrients (Mg, S, B, Zn,).

Roots having more diameter (> 1.5 cm) are of low quality from pharmaceutical point of view. With the combination of micronutrients, even if at higher doses of nitrogen there is significant high yield of quality roots were obtained (dia <1.5cm >1.0cm). This proves the impact of balanced nutrients on phenotypic quality root production, however their withanolide & somniferin content (alkaloid content to decide quality) has not been measured.

Increase in root yield due to increase in N, P, K inclusive of micronutrients has also been reported by Pakkiyanathan *et al*., 2004.

ACKNOWLEDGEMENT

The authors are grateful to Potash & Phosphate Institute of Canada for providing assistance to GBPUA and T Pantnagar for carrying out this investigation.

REFERENCES

Farooqi A.A. and Sreeramu B.S. (2001). *Cultivation of medicinal and aromatic crops*. p:518

Pakkiyanathan K. and Pasha Y.N. (2005). Effect of spacing & phosphorus levels on growth and root yield of Ashwagandha. *Indian Journal of Horticulture* p: 195-197 Vol. 61(2).

Received : February, 2006; Accepted : May, 2006