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RESEARCH ARTICLE

Effect of inorganic fertilizers and organic manures on growth, quality and yield of ashwagandha (*Withania somnifera* Dunal) cv. Jawahar Ashwagandha-20

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ABSTRACT

A field experiment was conducted at the Research plot, Dhanvantari upwan, Department of Dravyaguna Vigyan, National Institute of Ayurveda, Jaipur during *Rabi* season of the year 2011-2012 to the study the effect of inorganic fertilizers and organic manures on ashwagandha cv. JA-20 with respect to growth, quality and yield attributing parameters. The experiment was carried out in Randomized Block Design with factorial concept. The experiment consisting of six treatment combinations, comprising of two inorganic fertilizer level *viz.*, control (A_0) and 20-20-00 kg NPK/ha (A_1) and three organic manures level *viz.*, control (B_0), FYM @ 2 kg/m^2 (B_1). All the combinations were replicated four times. All growth, quality and yield attributing characters under study were significantly affected by inorganic fertilizers and organic manures. Plant height, Number of leaves, length and width of leaves and number of branches, root length, root diameter, Fresh and dry weight of root and seeds weight were recorded in application of 20:20:00 NPK kg/ha (A_1). Tallest plant was recorded in treatment B_1 (FYM @ 2 kg/m^2). The application of vermicompost @ 1.3 kg/ha (B_2) significantly increased the number of leaves, leaf length, number of branches, root length and diameter. Maximum fresh weight and dry weight root and seeds weight were recorded in treatment B_2 (vermicompost @ 1.3 kg/ha). The interaction effect of inorganic fertilizers and organic manures (A × B) for the various characters studied was non significant except number of branches and fresh weight of root. The treatment combination of A_1 l B_2 showed synergistic effect and gave maximum number of branches and fresh weight of root per plant.

Key words : Ashwagandha, Inorganic, Organic, FYM, Vermicompost

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INTRODUCTION

Ashwagandha of Winter cherry (*Withania somnifera* Dunal) belongs to the Solanaceae family and is a small woody shrub or herb that grows usually 30 to 50 cm height. It is a native of Mediterranean region and it occurs naturally in arid and semi-arid parts of India. It is one of the important medicinal plants and its use in ayurvedic and unani extends back cover 3000 to 4000 years (Atal and Schwarting, 1961). In Ayurveda, the roots of Ashwagandha are known to possess health

maintenance and restoration properties which are similar to Ginseng roots; hence it is called as Indian Ginseng. Seven types of alkaloids are found in this plant, out of which withanine and somniferine are important. These are mainly used in Ayurvedic and Unani preparations. Ashwagandha and its extracts are used in the preparation of herbal tea, powders, tablets and syrups (Nigam and Kandalkar, 1995).

In India, Ashwagandha is grown in the states of Madhya Pradesh, Rajasthan, Punjab, Uttar Pradesh, Haryana, Gujarat and Maharashtra, in an area of about 10,780 ha with a production of 8429 tones. Ashwagandha root contains 0.4–1.2 per cent alkaloids, 40-65 per cent starch, 40-65 per cent fibres and minor quantity of oil. The important chemical constituents are alkaloids (Withanolides) that are present in roots, leaf and berries (Gupta *et al.*, 1996). 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. 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. Nutrients play a pivotal role in Ashwagandha production. Nutrient supply system is considered as one of the basic factor. It has been established beyond doubt that there is a positive correlation between fertilizer use and crop productivity. Farmers are using excessive chemical fertilizers lead to decline in organic carbon. The excessive use of chemical fertilizers spoils the structure and texture of the soil. The application of an integrated supply system of plant nutrient is becoming popular as it is scientifically sound and assures sustainable development in agriculture. The use of judicious combination of organic and inorganic fertilizer source is essential not only to maintain soil health but also sustain productivity (Malewar *et al.*, 1998). Cultivation of Ashwagandha organically also serves as a safe mode of medicine. Considering the medicinal value of the crop, its growing demand, and paucity of information on scientific production technology, the present investigation was undertaken during 2011-12 at Dhanvantari Upwan, Dept. of Dravyaguna Vigyan, National Institute of Ayurveda, Jaipur, Rajasthan.

MATERIALS AND METHODS

The present investigation was carried out at the Research Plot, Dhanvantari Upwan, Department of Dravyaguna Vigyan, National Institute of Ayurveda, Jaipur (Rajasthan) during 2011-12. The experiment was carried out in Randomized Block Design with factorial concept. The experiment consisting of six treatment combinations, comprising of two inorganic level *viz.*, control (A_0) and 20-20-00 kg NPK/ha (A_1) and three organic manures level *viz.*, control (B_0), FYM @ 2 kg/m^2 (B_1) and Vermicompost @ 1.3 kg/m^2 (B_2) and no application of inorganic fertilizer and organic manure *i.e.* control. Six combinations were A_0B_0 (No application of chemical fertilizers and organic manure *i.e.* control), A_0B_1 (application of FYM), A_0B_2 (application of Vermi Compost), A_1B_2 (application of chemical fertilizers and Vermi compost). All the combinations were replicated four times. The cultivar Jawahar Ashwagandha-20 was used for the experiment. The land was ploughed, harrowed and leveled to bring the soil to fine tilth after receiving pre-monsoon rains. The field was divided into plots for different treatments. Quantity of inorganic fertilizers and organic manure to be applied to ashwagandha was calculated as per the treatments. Nitrogen and phosphorus were applied in the form of urea and DAP, respectively. Inorganic fertilizers and organic manures were applied and well mixed with the soil of respective plots before the sowing of the seeds. Certified seeds were sown in line on 19th August 2011. Organically growing seeds were treated with Tricoderma and inorganically growing seeds were treated with Bavisting at the time of sowing. Total five rows per plot and seven plants per row were maintained. The fully matured crop was harvested on 29th March, 2012 when the leaves were drying out and berries yellow red in colour. The data of all the characters studied were subjected to statistical analysis.

RESULTS AND DISCUSSION

The date pertaining to the results of different treatments for plant height, number of branches/plant, number of leaves, leaf length and width (cm), root length and diameter (cm), root fresh weight and dry weight (g) and seed yield/plant (g) are depicted in Table 1.

Growth attributes :

The application of various inorganic fertilizers and organic manures significantly influenced the growth in terms of plant height, number of leaves, length and width of leaves and number of branches in Ashwagandha. The maximum plant height (41.83 cm), Number of leaves (19.33), length and width of leaves (6.33 cm and 2.73 cm, respectively) and number of branches per plant (9.33) were noticed in treatment A_1 (application of 20:20:00 NPK kg/ha) as compared to A_0 *i.e.* control at harvest. The increase in growth parameters at harvest with inorganic fertilizers were due to the presence of readily available from the nitrogen and phosphorus that might have resulted in increase in vegetative growth of plants. The results are in conformity with the findings of Maryada *et al.* (2001) in ashwagandha and Sailaja *et al.* (2007) in coleus. Organic manure treatment significantly increased the vegetative growth of Ashwagandha (Table 1). Maximum plant height (45.33 cm) was recorded in treatment B_1 (FYM @ 2 kg/m^2) which was at per with treatment B_2 (Vermicompost @ 1.3 kg/m^2) while minimum plant height recorded in control. The application of vermicompost significantly increased the

number of leaves (18) leag length (7 cm) and number of branches per plant (9) as compared to control. The increase in number of branches per plant might be due to greater plant height. The interaction effect of inorganic fertilizers and organic manures was significant for this trait. The treatment combination of $A_1 \times B_2$ showed synergistic effect and gave maximum number of branches per plant (11). The reason for increased growth is attributed to solubilisation effect of plant nutrients by the addition of FYM and vermicompost as evidenced by increasing in uptake of N, K, P, Ca and Mg (Subbiah *et al.,* 1982).

Quality paramters :

Inorganic fertilizers and organic manures affect the quality attributes in terms of root length and root diameter of Ashwagandha (Table 1). Significantly maximum root length (32.27 cm) and root diameter (4.38 cm) were obtained in treatment A_1 (20:20:00 Kg/ha NPK) as compare to control (4.32 cm). Organic manures significantly influenced the root length and root diameter. Maximum root length (35.14 cm) and diameter (5.16 cm) were observed in treatment B_2 *i.e.* vermicompost @ 1.3 kg/ha.

Yield :

Yield parameters in terms of fresh weight of root, dry weight of root and seed weight of per plant significantly influenced by inorganic fertilizers and organic manure treatments (Table 1). Data showed that maximum fresh weight of root (29.23 g/plant), dry weight of root (8.81 g/plant) and seed weight (12.33 g/plant), dry weight of root (8.81 g/plant) and seeds weight (12.33 g/plant) were recorded in treatment A_1 (20:20:00 kg/ha NPK) as compared to control at harvest. Application of vermicompost (B_2) significantly increased all the parameters over the control. Maximum fresh weight of root (27.68 g/plant), dry weight of root (8.83 g/plant) and seeds weight (12.88 g/plant) were observed in treatment B_2 (vermicompost @ 1.3 kg/m^2) whereas minimum fresh weight, dry weight and seed weight (20.63 g, 6.68 g and 10.50 g per plant, respectively) were observed in case of treatment B_0 (control) at harvest. This could be due to improved physical and chemical condition of soil and increased population of microorganisms by incorporation of organic manures which gave synchronized effect and enhanced uptake of nutrients which resulted into better plant growth and increased productive part. Interaction effect between inorganic fertilizers

Table 1 : Effect of inorganic fertilizers and organic manures on growth, quality and yield of ashwagandha (*Withania somnifera* Dunal) cv. JA-20

Treatments	Plant height (cm)	No. of leaves	Leaf length (cm)	Leaf width (cm)	No. of branches	Root length (cm)	Root diameter (cm)	Root fresh wt. (g)	Root dry wt. (g)	Seed yield (g/plant)
Factor-1										
A_0	38.33	13.00	5.67	2.71	7.33	29.55	4.32	20.17	6.68	11.17
A_1	41.83	19.33	6.83	2.73	9.33	32.27	4.38	29.23	8.61	12.33
S.E.	1.36	0.24	0.34	0.16	0.30	1.10	0.18	0.71	0.33	0.45
C.D. (P=0.05)	4.09	0.73	1.01	NS	0.91	3.32	NS	2.15	1.01	1.37
	S	S	S	NS	S	S	NS	S	S	S
Factor-2										
B_0	37.43	13.50	5.25	2.35	7.50	26.40	3.45	20.63	6.68	10.75
B_1	45.33	17.00	6.50	2.93	8.50	31.19	4.43	25.93	7.95	11.63
B_2	37.50	18.00	7.00	2.88	9.00	35.14	5.16	27.68	8.30	12.88
S.E.	1.11	0.20	0.27	0.13	0.25	0.90	0.15	0.58	0.27	0.37
C.D. (P=0.05)	3.34	0.59	0.83	0.39	0.75	2.71	NS	1.75	0.82	1.12
	S	S	S	S	S	S	NS	S	S	S
Interaction (A×B)										
A_0B_0	33.65	10	5	2.38	7	24.85	3.18	14.20	5.00	10.50
A_0B_1	43.85	14	6	2.93	8	24.65	4.58	22.90	7.25	11.25
A_0B_2	37.50	15	6	2.83	7	34.15	5.20	23.40	7.78	11.75
A_1B_0	41.20	17	5.50	2.33	8	27.95	3.73	27.05	8.35	11.00
A_1B_1	46.80	20	7	2.93	9	32.73	4.29	28.95	8.65	12.00
A_1B_2	37.50	21	8	2.93	11	36.15	5.13	31.95	8.83	14.00
S.E.	1.92	0.34	0.47	0.23	0.43	1.56	0.26	1.07	0.47	0.64
C.D. (P=0.05)	NS	NS	NS	NS	1.29	NS	NS	3.04	NS	NS

NS=Non-significant

and organic manures is significant for fresh weight of root, Maximum fresh weight of root (3195 g/plant) was recorded in treatment combination A_1B_2. Similar findings were also reported by Maheshwari *et al.,* (2000) in ashwagandha.

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