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Effect of spacing and fertilizer levels on growth, yield and quality of Ashwagandha (*Withania somnifera* Dunal) cv. JA-20

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ABSTRACT

A field experiment was conducted to study the effect of spacing and fertilizer levels on growth, yield and quality of ashwagandha. Among different fertilizer levels the highest level of fertilizer F_3 (25-25-0 NPK kg/ha) recorded the significantly maximum plant height (58.11 cm), number of primary branches per plant (4.53), maximum fresh root weight per plant (5.43 g), dry root weight per plant (2.13 g). Whereas, plant spacing with S_2 (45 cm x 15 cm) significantly influenced the various yield attributes viz., dry root yield per hectare (214.05 kg), seed yield (216.70 kg/ha) and quality parameters like total withanolide yield (1.19 kg/ha).

Keywords : Ashwagandha, spacing, fertilizers, yield, quality

INTRODUCTION

Withania somnifera or Indian winter cherry is one of the most important herbs in Ayurvedic system of medicine and one of the most widely used Indian medicinal plant throughout the world. The use of ashwagandha in Ayurvedic medicine extends back over 3000 to 4000 years to the teachings of an esteemed Rishi (sage) Punarvasu Atriya. It has been described in the sacred texts of Ayurveda, including the Charaka and Sushrutha Samhitas where it is widely extolled as a tonic especially for emaciation in people of all ages including babies, enhancing the reproductive function of both men and women.

W. somnifera is erect, evergreen, tomentose shrub, between 30 and 75 cm high under domestication and it is grown for its roots, which are stout, fleshy, cylindrical but not thicker 1 to 2 cm diameter, whitish-brown in colour. Leaves are simple, ovate, glabrous, opposite. The flowers are inconspicuous, greenish or dull yellow in colour, in axillaries, umbellate cymes thicker. The fruit is small berry, globose, orange/red when matures and is enclosed in persistent calyx. The seeds are yellow, small, flat in shape and very light in weight (Desai and Dumber 2003).

Mainly, ashwagandha does not require any fertilizer and experimental evidences show that indigenous cultivars do not respond to fertilizer application. But considering the need to augment the production of the dry roots to meet the trade requirements, this factor also needs to be attempted. Information pertaining to research work on its commercial cultivation in India is limited and in south Gujarat no work has been done on ashwagandha. Therefore ,the present experiment was undertaken to study the response of different spacing along with different fertilizers on growth, yield and quality of ashwagandha.

MATIRIALS AND METHODS

A field experiment was conducted during the *Kharif* season of 2011-12 at the Instructional Farm, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari. The soil pH of the experiment plot was 7.4 which was poor in organic carbon and available nitrogen, medium in phosphorus and high in potash. Treatment consistd of three spacing (S_1 : 30 cm X 30 cm,S_2 : 45 cm X 15 cm,S_3 : 45 cm X 30 cm) and three Fertilizer dose combinations, *viz* (F_1 :15-15-0 NPK kg/ha, F_2 :20-20-0 NPK kg/ha, F_3 :25-25-0 NPK kg/ha). The experiment was laid out in randomized block design with spacing as first factor and fertilizer as second factor and replicated thrice. All the recommended cultural and plant protection operation were followed to raise healthy crop. Data were recorded on plant height, number of leaves, canopy spread, primary branches per plant, root length, Root diameter, weight of fresh root, weight of dry root , dry root yield, seed yield. Harvest index was calculated by using formula root yield divided by biological yield multiply by 100. withanolide

Table 1. Effect of spacing and fertilizer levels on growth and root character of ashwagandha

Parameter	Growth character						Root character	
	Plant Height (cm)	No. of Primary branches per plant	Canopy (cm)	No. of leaves per plant	Root length (cm)	Root diameter (cm)	Weight of fresh root (g)	Weight of dry root (g)
	Spacing (S)							
S_1	49.28	3.87	22.73	263.20	24.49	0.90	4.72	1.92
S_2	45.69	3.96	24.72	243.69	24.47	0.82	4.91	1.92
S_3	48.46	4.20	29.47	268.24	26.10	0.82	5.14	2.06
C.D. (5 %)	2.50	0.23	2.03	14.50	1.11	0.04	0.26	0.09
	Fertilizer (F)							
F_1	40.33	3.71	19.91	238.35	23.83	0.76	4.54	1.80
F_2	44.98	3.78	21.50	261.13	24.46	0.82	4.80	1.97
F_3	58.11	4.53	26.97	275.64	26.77	0.97	5.43	2.13
C.D. (5 %)	2.50	0.26	2.35	16.75	1.28	0.05	0.30	0.11
	Interaction (S X F)							
C.D. (5 %)	NS	NS	NS	NS	NS	NS	NS	NS

Table 2. Effect of spacing and fertilizer levels on yield and quality of ashwagandha

Parameter	Yield and quality parameters				
	Dry root yield (kg/ha)	Harvest index (%)	Seed yield (kg/ha)	Total with anolide content (%)	Total with anolide yield (kg/ha)
	Spacing (S)				
S_1	159.15	9.84	177.36	0.55	0.83
S_2	214.05	10.78	216.70	0.53	1.19
S_3	101.63	10.07	124.24	0.51	0.51
C.D. (5 %)	13.57	0.65	11.14	0.03	0.11
	Fertilizer (F)				
F_1	147.76	9.50	157.35	0.49	0.72
F_2	153.28	9.81	174.57	0.53	0.82
F_3	173.79	11.38	189.38	0.57	1.00
C.D. (5 %)	15.67	0.75	12.87	0.03	0.13
	Interaction (S X F)				
C.D. (5 %)	NS	NS	NS	NS	NS

content was estimated by modified spectrophotometer method developed by (Mishra,1994). Recorded data were analyzed by the method advocated by Panse and Sukhtme (1967).

RESULTS AND DISCUSSION

Effect of different spacing and fertilizer levels had influenced the vegetative growth and yield of ashwagandha (Table 1) Different spacing and fertilizer significant influenced vegetative growth parameter like plant height, number of leaves per plant, canopy, number of primary branches per plant. Among various spacing a closer spacing of 30cm x 30cm produced significantly higher plant height at harvest (49.28 cm) as compared to other spacing. This was due to competition among the plants for sun light. While the reverse trend was observed in number of leaves per plant (268.24), Canopy (4.20 cm), primary branches per plant(24.90 cm) were recorded in wider spacing (45 cm X 30 cm). The more number of primary branches, Canopy, leaves/plant were due to availability of more space, soil moisture and nutrients to individual plants. Similar findings were reported by Agarwal *et al*., (2003) Among fertilizer levels, F_3 recorded higher plant height (58.11 cm), number of leaves per plant (275.64), Canopy (26.97 cm), primary branches per plant (4.53 cm), it was vice-versa with lower fertilizer dose. Higher fertilizer dose was responsible for increased growth character. Statistical analysis revealed that interaction effect of spacing and fertilizer was found non- significant for growth character.

All the yield parameters taken in this study were significantly affected by the spacing and fertilizer level. Interaction effect of spacing with fertilizer was found non-significant for yield parameters. The average root length (26.10 cm), fresh root weight (5.14 g), dry root weight (2.06 g) were recorded in wider spacing at 45 cm X 30 Cm. It is due to higher photosynthesis rate and the higher fertilizer doze gives a maximum root length (26.77 cm), root diameter (0.97 cm), fresh root /plant(5.43 g), dry root/plant(2.13g).The availability of more quantity of N and P nutrients to the plant resulted in the better performance with growth at higher fertility levels (25-25-0 NPK). These results were in conformity with the findings of Patel *et al.* (2004) in ashwagandha.

While the dry root yield (214.05 kg/ha), Harvest index (10.78%), seed yield 216.70 kg/ha), withanolide yield (1.19 kg/ha) were recorded in closer spacing at 45 cm x 15 cm due to more number of plants per area (Table 2). These results are in accordance with Kubsad *et al*. (2008). Application of N and P increased significantly to highest fertilizer levels due to more vegetative growth on account of availability of sufficient nutrients. Though the application of 25-25 kg $N:P_2O_5$/ha produced significantly highest root yield (173.7 kg/ha), seed yield(189.30 kg/ha), harvest Index (11.38 %) and withanolide yield (1.0 kg/ha). Similar results were also observed by Maheshwari *et al.* (2000).

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