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RESEARCH PAPER

Growth, yield and economic performance of Ashwagandha (*Withania somnifera* Dunal) under rainfed conditions of district Sonbhadra, Uttar Pradesh

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Abstract : *Withania somnifera* Dunal commonly known as Ashwagandha, is an important medicinal plant of family Solanaceae. Its roots, seeds and leaves are used in Ayurvedic and Unani medicines. Ashwagandha root drug finds an important place in treatment of human ailments and it is also used as an important herbal tonic. It is a drought hardy crop which grows well in dry parts of India. Vindhyan region of Uttar Pradesh is one of the best suited location for the Ashwagandha cultivation. It is also found as wild in the forest of Vindhyan region and other areas of central India. Keeping these points in view, Krishi Vigyan Kendra, Sonbhadra has conducted front line demonstration on cultivation of Ashwagandha crop continuously for six years (2005- 2011) at several sites of the district Sonbhadra. A higher range of growth and yield parameters were recorded during the study period. Average root yield during the study period was found 4.14 q/ha which gives an average net return of Rs. 31359 with a benefit cost ratio of 4.02. On the basis of six year performance of the crop it can be concluded that the crop is best suited for district Sonbhadra in terms of growth, yield and economics.

Key Words : Ashwagandha, *Withania somnifera*, Medicinal Plant, Profitability, Sonbhadra

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INTRODUCTION

Ashwagandha (*Withania somnifera*) is an important medicinal plant, popularly known as Indian Ginseng. The roots of this plant, occasionally its leaves and seeds are used in Ayurvedic and Unani medicines. Its roots are commonly prescribed for cough, bronchitis, dropsy, female disorders, lung inflammation and spine diseases etc. (Sangwan *et al.*, 2013). Its roots are categorized as rasayanas, and have been used as antioxidant, adaptogen, aphrodisiac, liver tonic, anti-inflammatory agent, astringent, hepato-protective, growth promoter, anti stress agent and more recently to treat ulcers, bacterial infections, venom toxins and senile dementia (Kumar *et al*., 2011; Bharadwaj *et* al; 2012, Bhattacharya and Ghosal, 1994). Ashwagandha roots is an ingredient in many formulations prescribed for a variety of musculoskeletal conditions (e.g., arthritis, rheumatism), and as a general tonic to increase energy, improve overall health and longevity, and prevent diseases in athletes, the elderly, and during pregnancy. Ashwagandha contains very high concentration of metabolites like steroidal lactones, alkaloids and flavonoides, so it is used in more than 90 commercial Ayurvedic formulations (Sreerekha *et al.*, 2004). Due to above valuable uses, its national and international demand is increasing day by day, but in comparison to this its supply is very poor, which require large scale cultivation.

Withania somnifera Dunal (Winter cherry or Ashwagandha or Asgandh) belongs to family Solanaceae, is a small woody shrub that grows usually 30 to 50 cm height (maximum of 150 cm). It is an erect growing dicotyledonous plant with fleshy long tap roots. The stem and branches are covered with minute star shaped hairs. Leaves are simple up

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to 10 cm long, ovate, pedicillate and alternate. Plant bears small (1 cm long), greenish or yellow flowers borne together in short axillary clusters. The fruits or berries are smooth, spherical, red coloured with 6 mm diameter enclosed in an inflated and membranous calyx. The fruit has small kidney shaped yellow coloured seeds (Nigam and Kandalkar, 1995).

Ashwagandha is a drought hardy crop, which requires dry climate for better development and winter low temperatures are known to improve the root quality and yield (Kahar *et al.*, 1991). Therefore, it grows well in dry parts of Rajasthan, Punjab, Haryana, Uttar Pradesh, Gujarat, Maharashtra and Madhya Pradesh. Vindhyan Region of Uttar Pradesh is one of the best suited locations for the Ashwagandha cultivation. It is also found as wild in the forest of Vindhyan region and other areas of central India. Its cultivation is very easy and requires very lesser cost and skill. It grows well in the field having low fertility gradient and less irrigation facility. Due to its increasing demand Ashwagandha is gaining popularity among the farmers for cultivation. Ashwagandha is cultivated over an area of 10,780 ha with a production of 8429 tones in India (Kumar *et al.*, 2007). While the annual demand increased from 7028 tones (2001-02) to 9127 tones (2004- 05) necessitating the increase in its cultivation and higher production (Tripathi *et al.*, 1996).

Therefore, during 2006-07 to 2011-12 Krishi Vigyan Kendra, Sonbhadra has done 60 front line demonstrations on farmer's field to test the suitability of the crop in terms of growth, yield and economic under rain fed conditions of district Sonbhadra, Uttar Pradesh.

MATERIAL AND METHODS

Due to the high value and increasing demand, Ashwagandha crop got attention of the scientist of Krishi Vigyan Kendra, Sonbhadra during 2006, at that time scientist has encouraged the farmers of the district Sonbhadra by giving training and special advice to them. As a result of this, some farmers of the district agreed to cultivate the crop at their field. In this regard, Krishi Vigyan Kendra, Sonbhadra has provided Ashwagandha seed and agro techniques of the crop to the innovative farmers under the front line demonstration programme. During the six year of study period (2006-07 to 2011-12), total 60 demonstrations in 12 hectares area were conducted at different places of Robertsganj, Ghorawal, Chopan, Duddhi and Meurpur block of district Sonbhadra, which lies in between 23.52^0 to 25.32^0 northern latitude and 82.72^0 to 83.33^0 eastern longitudes. The area is characterized by warm and humid climate from June to September and dry and cool weather from October to February-March. April to June is characterized by hot winds. The mean maximum and minimum temperature recorded during the above period was 45.8^0C and 2.8^0C, respectively. The average rainfall received in the district during the study period was much below from the normal average of 997mm. Most of the demonstration sites were having red laterite soil with exception of black soil at few places.

Ashwagandha crop was sown in between 25 July to 20 August at each year. Broadcast sowing was done with 12 kg/ hectare seed rate. J A - 20 and Nagauri varieties were used for the cultivation during 2006-07 and 2007-08, respectively, Whereas, J A- 134 variety was used continuously during next four years (2008-09 to 2011-12). Manual weeding and thinning was done to control the plant population and weeds. Harvesting was done in between 25 Jan to 15 Feb. During 2006 harvesting was done at early stage *i.e.* between 20-25 January. Harvesting was done with the help of spade (Fawra/ Kudal). Some farmer harvested the crop with the help of tractor mounted cultivator. Roots were separated from the shoot just after the harvesting and dried for 5-7 days in the partial shade. After that, grading of roots was done on the basis of length and diameter of roots and roots were graded in to four categories. Shoots were also dried to harvest seed. No any insecticides and pesticides were applied on the crop. Growth parameters were recorded on 10 sample plant in each demonstration and overall average was calculated from the average of each demonstration during a year. The yield of root and seed was also recorded from each demonstration and average was calculated from all the demonstrations during a year. Product (dried root and seed) was sold in local market. Some farmer sold it in the Varanasi medicinal plant market. The market price of Ashwagandha roots during the study period ranged from Rs. 58/kg to Rs. 120/kg and seed price ranged from Rs. 80/kg to Rs. 110/kg. Average cost of cultivation, gross return, net return and B: C ratio were calculated to know the profitability of the crop in the area. In addition to this farmers reaction was also recorded to know the social acceptance of the crop among the farmers.

RESULTS AND DISCUSSION

Results of the demonstrations conducted during 2006-07 to 2011-12 on Ashwagandha cultivation are presented in Table 1 and 2. It revealed from the Table 1 that plant height ranged form 29.65 – 45.30 cm with a average of 36.90 cm. Average collar diameter, dried root diameter, primary shoot and root branches were observed 1.39 cm, 0.73 cm, 3.21 and 0.64, respectively. The root length ranged from 15.36cm to 27.10 cm with an average of 21.89 cm. Average root - shoot ratio of the plant during the study period was recoded 0.59 with a range of 0.52 to 0.62. The data related to plant height, root length and root diameter are in line with the Ram *et al.* (2010) and Sangwan *et al.* (2013). All the growth parameters except number of primary shoot and root branches were recorded very low during 2008-09 which may

be due to the heavy rainfall during this year. More number of shoot and root branches during 2008-09 may be due to resprouting of branches after the slight damage in plant by heavy rain, which results in to stunted growth and poor yield in the crop.

Table 2 shows that over all average dried root and seed yield was recorded 4.14 q/ha and 0.51 q/ha, respectively. Maximum average yield (4.93 q/ha) of root was recorded during 2007-08 whereas, it was minimum (3.14) during 2008-09. Seed yield was found maximum (0.57) during 2007-08 and minimum (0.41) in 2008-09. Table 2 indicated minimum root and seed yield during 2008-09, which may be due to heavy rainfall in that year, because heavy rainfall affects seed germination and plant population of Ashwagandha. Higher root and seed yield was reported by Ram *et al.* (2010) and Kubsad *et al.* (2009) and Kumar *et al.* (2009) in comparison to present study, which may be because of experiment under controlled conditions and special treatments, whereas, in present study, cultivation was done under normal field conditions by the farmers without any special input (manures, fertilizers, irrigation etc.) and treatment.

From the overall average of six year yield and economic data it can be explicated that net return form the one hectare crop cultivation ranged from Rs. 26284 to Rs. 38150 with the average of Rs. 31359. Increasing trend of gross return and net return was observed from year 2006-07 to 2011-12 except for the year 2008-09, which may be due to the increasing market price of Ashwagandha root. Besides the low root yield (3.81q/ha), higher gross return (Rs. 47781/ ha), net return (Rs. 37001/ha) and benefit – cost ratio (4.43) was calculated for the year 2010-11, which was also due to the good market price of Ashwagandha root. Due to the variation in the market rate the trend of benefit cost ratio differed from the trend of gross and net return. The average benefit cost ratio of six year cultivation was 4.02, which shows that Ashwagandha cultivation is economically profitable in the area and farmers of this area can get more than Rs. 4.0 from Rs. 1.0 investment on Ashwagandha cultivation. During the course of the study it was observed that social acceptance of the crop was increased with a significant rate. After the demonstration in 2006-07, only few farmers have accepted to grow crop in the next season, whereas, this acceptance got increased by passing the time.

Therefore, on the basis of above results and facts it can be concluded that Ashwagandha crop is most suitable for rainfed conditions of district Sonbhadra. It can be grown as a cash crop to get better profit from poor fields with low cost, lesser efforts and less skill. So, the species has more potential for commercial cultivation in the district through which farmers of the area can be socially and economically benefited.

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Table 1 : Growth performance* of Ashwagandha crop grown under rainfed conditions of district Sonbhadra

Years	Plant height	Collar diameter (cm)	No. of primary shoot branches	Root length (cm)	Root diameter (cm)*	No. of primary root branches	Root – shoot ratio
2006-07	42.80	1.52	2.96	25.45	0.82	0.42	0.59
2007-08	45.30	1.61	2.73	27.10	0.85	0.38	0.60
2008-09	29.65	1.10	4.10	15.36	0.59	1.33	0.52
2009-10	34.10	1.33	3.05	20.85	0.71	0.67	0.61
2010-11	32.50	1.38	3.15	19.40	0.67	0.54	0.60
2011-12	37.25	1.42	3.25	23.15	0.74	0.50	0.62
Average	36.90	1.39	3.21	21.89	0.73	0.64	0.59

* Average of 10 demonstrations

Table 2 : Yield and economic performance* of Ashwagandha crop grown under rainfed conditions of district Sonbhadra

Year	Average yield (q/ha)		Cost of cultivation (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B : C ratio
	Dried root	Seed				
2006-07	4.86	0.48	8650	34950	26300	4.04
2007-08	4.93	0.57	9441	37514	28073	3.97
2008-09	3.14	0.41	11060	37344	26284	3.31
2009-10	3.98	0.51	10720	43068	32348	4.08
2010-11	3.81	0.54	10780	47781	37001	4.43
2011-12	4.15	0.52	11560	49710	38150	4.30
Average	4.14	0.51	10369	41728	31359	4.02

*Average of 10 demonstrations

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