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Rakesh Kumar Ratre
College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Pundas
College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Rajesh Singh
College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Correspondence
Rakesh Kumar Ratre
College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Chlorophyll study (SPAD) value, soil moisture content, fresh and dry root weight and herbage yield of Ashwagandha (*Withania somnifera* (L.) Dunal) as influenced by sowing methods and organic sources of nutrient

Rakesh Kumar Ratre, Pundas and Rajesh Singh

Abstract
An experiment was conducted to find out the effect of different sowing methods and organic sources of nutrient on yield and quality of ashwagandha (*Withania somnifera* (L.) Dunal). The experiment was carried out during *rabi* seasion 2016-17 at college of agriculture, IGKV Raipur. Raipur is situated in 21^0 16' N latitude and 81^0 26' E longitudes. There were eighteen combinations of three sowing methods in main plot *i.e.* flat bed, ridge bed and raised bed and six sub plots *i.e.* control, FYM @ 10t ha^{-1}, FYM @15t ha^{-1}, vermicompost @ 5t ha^{-1}, vermicompost @ 7.5t ha^{-1} and NPK@ 40:60:20 kg ha^{-1}. Treatments were replicated thrice in split plot design. Raised sowing methods recorded highest chlorophyll study (SPAD) value, soil moisture content, fresh and dry root weight and herbage yield. An organic sources of nutrient FYM @ 15t ha^{-1} recorded significant effect on chlorophyll study (SPAD) value, soil moisture content, fresh and dry root weight and herbage yield.

Keywords: vermicompost, raised, nutrient, replication, main plot

Introduction
Medicinal plant cultivation is becoming a tool for diversification of Indian agriculture as many farmers have been looking for some better alternative to diversify from traditional agriculture due to gradual reduction in profit, decline in productivity and increased incidence of diseases and pests. Cultivation of medicinal plants, especially high value medicinal plants is creating new dimension in the field of agriculture. *Ashwagandha, the 3rd important prioritized medicinal plant listed by National Medicinal Plant Board (NMPB) is also known as Indian Ginseng.* . Ashwagandha is a small woody shrub or herb that grows or reaches about 30-150 cm in height belongs to the family Solanaceae. The stem and branches are covered with minute stellate hairs. Leaves are simple upto 10 cm long, ovate, pedicillate and alternate. Plant bears small (1cm long), greenish or yellow flowers borne together in short axillary clusters. The fruits or berries are smooth, spherical, yellow, red coloured with 6 mm diameter enclosed in an inflated and membranous calyx.

Material and Methods
The study was under taken with a view to find out the effect of different sowing methods and organic sources of nutrient and their interaction on growth and yield of ashwagandha. The experiment was carried out during *rabi* seasion 2016-17 at college of agriculture, IGKV Raipur. There were eighteen combinations of three sowing methods in main plot flat bed, ridge bed and raised bed and six sub plots control, FYM @ 10 t ha^{-1}, FYM @15 t ha^{-1}, vermicompost @ 5 t ha^{-1}, vermicompost @ 7.5 t ha^{-1} and NPK 40:60:20 kg ha^{-1}. Treatments were replicated thrice in split plot design. All the data on plant height, number of leaves, number of primary and secondary branches and number of berries were recorded and statistically analyzed. Half dose of N and full dose of FYM, vermicompost, P, K were applied uniformly at sowing as a basal dose and remaining half of N was given as top dressed in two equal split. The allocation of these treatments was done randomly and all the cultural practices were followed as per recommended.

Results and Discussion

Chlorophyll study (SPAD value)

The chlorophyll study was taken with the help of chlorophyll meter as a SPAD value. Significant differences were noticed in SPAD values due to all methods of sowing at different stages of observation. Highest value (74.29) was noticed from 90 to 120 DAS in raised bed sowing method and minimum value (68.72) was recorded with flat bed sowing method. The raised bed sowing provided comparatively higher nutrient and water use efficiency and thereby triggered the vegetative growth Singh and Singh (2010). The different organic sources of nutrient were also showed significant for SPAD value in ashwagandha at each 30 days interval till harvest. It increased considerably with an increase in age after sowing up to 90 DAS but it decreased thereafter. Maximum SPAD value was noticed at 120 DAS (79.41) with application of FYM @ 15 t ha^{-1} which was at par with FYM @ 10 t ha^{-1} (78.23). Nitrogen and phosphorus supplied through FYM and vermicompost which increase vegetative growth and chlorophyll formation. The interaction effect between sowing methods and organic sources of nutrient were also found significant.

Table 1: Chlorophyll (SPAD value) of ashwagandha as influenced by sowing methods and organic sources of nutrient

Treatment	Chlorophyll (SPAD) value				
	30 DAS	60 DAS	90 DAS	120 DAS	At harvest
Main plot : Sowing methods (MS)					
M_1: Flat bed method	38.84	54.99	63.60	68.72	45.65
M_2: Ridge and furrow method	41.67	58.18	68.58	72.38	48.70
M_3: Raised bed method	44.19	61.38	70.39	74.29	52.20
SEm±	0.32	0.29	0.45	0.34	0.06
CD (P= 0.05%)	1.29	1.15	1.76	1.37	0.23
Sub plot: Organic sources of nutrient (S)					
S_1: Control	33.47	48.08	55.36	44.31	35.44
S_2: FYM @ 10 t ha^{-1}	46.68	62.72	71.59	78.23	53.65
S_3: FYM @ 15 t ha^{-1}	48.92	65.35	75.05	79.41	58.47
S_4: Vermicompost @ 5 t ha^{-1}	38.98	55.29	65.59	75.42	46.32
S_5: Vermicompost @ 7.5 t ha^{-1}	41.05	58.89	67.15	77.84	50.94
S_6: NPK @ 40:60:20 kg ha^{-1}	40.31	58.58	64.40	75.56	48.26
SEm±	0.65	0.48	0.80	0.67	0.46
CD (P= 0.05%)	1.88	1.41	2.33	1.95	1.33
Interaction (MS × S)	S	S	S	S	S

Soil moisture content (%)

The soil moisture content was significantly influenced by various sowing methods. Highest soil moisture content (19.54 %) was observed under raised bed sowing method at 30 DAS. This might due to less evaporation and higher water holding capacity than other sowing methods. The soil moisture content was decreased with increased plant age due to more water absorption and high evapotranspiration. A perusal of data indicates that the soil moisture content influenced significantly with the organic sources of nutrient. Highest soil moisture (23.82%) content was observed with application of FYM @ 15 t ha^{-1} due to organic matter increase soil porosity and water holding capacity of soil. The interaction effect between sowing methods and organic sources of nutrient for soil moisture content were also found significant.

Table 2: Soil moisture content as influenced by sowing methods and organic sources of nutrient

Treatment	Soil moisture content (%)				
	30 DAS	60 DAS	90 DAS	120 DAS	At harvest
Main plot : Sowing methods (MS)					
M_1: Flat bed method	16.94	14.43	12.75	10.90	9.75
M_2: Ridge and furrow method	18.98	16.67	13.31	12.65	11.30
M_3: Raised bed method	19.54	17.00	14.32	13.25	11.50
SEm±	0.26	0.06	0.08	0.05	0.02
CD (P= 0.05%)	1.02	0.25	0.32	0.20	0.08
Sub plot: Organic sources of nutrient (S)					
S_1: Control	13.56	8.48	8.25	7.02	6.22
S_2: FYM @ 10 t ha^{-1}	20.50	17.93	13.73	12.77	12.61
S_3: FYM @ 15 t ha^{-1}	23.82	19.15	15.49	14.79	13.34
S_4: Vermicompost @ 5 t ha^{-1}	16.57	14.81	12.82	12.01	11.35
S_5: vermicompost @ 7.5 t ha^{-1}	19.29	18.21	14.50	13.19	12.61
S_6: NPK @ 40:60:20 kg ha^{-1}	17.18	17.62	14.45	13.83	10.69
SEm±	0.37	0.11	0.19	0.09	0.03
CD (P= 0.05%)	1.09	0.32	0.56	0.28	0.08
Interaction	S	S	S	S	S

Fresh root weight plant^{-1} (g)

The highest (25.08 g) fresh root weight plant^{-1} was recorded with raised bed sowing method. The maximum (29.32 g) fresh root weight plant^{-1} was superior with the application of FYM @ 15 t ha^{-1}. The interaction effect between sowing methods and organic sources of nutrient were found significant for fresh root weight plant^{-1}. Chandra *et al.* (2007) noted that the double row raised bed method was significantly higher the leaf area, root weight per clump, fresh root yield of safed musli (*Chlorophytum borivilianum)* as compared to the

triple row raised bed method and ridge and furrow. Maximum root yield in safed musli under raised bed planting techniques were reported by Pandey *et al* (2007).

Dry root weight plant^{-1} (g)

Dry root weight plant^{-1} was significantly influenced by different sowing methods. The highest (8.14 g) dry root weight plant^{-1} was recorded with raised bed sowing method which was significantly over other method of sowing of ashwagandha. The maximum (9.41g) dry root weight plant^{-1} was found superior with the application of FYM @ 15 t ha^{-1} over other organic sources of nutrient.

Herbage yield (q h^{-1})

The maximum herbage yield was obtained with raised bed sowing method. With respect to organic sources of nutrient the higher herbage yield was recorded with the application of FYM @ 15 t ha^{-1}.

Table 3: Fresh root weight, dry root weight and herbage yield of ashwagandha as influenced by sowing methods and organic sources of nutrient

Treatment	Fresh root weight plant^{-1}(g)	Dry root weight plant^{-1}(g)	Herbage yield q ha^{-1}
Main plot : Sowing methods (MS)			
M_1: Flat bed method	18.70	5.84	31.62
M_2: Ridge and furrow method	20.97	6.58	39.40
M_3: Raised bed method	25.08	8.14	41.08
SEm±	0.35	0.18	0.11
CD (P= 0.05%)	1.39	0.74	0.41
Sub plot: Organic sources of nutrient (S)			
S_1: Control	11.31	4.68	21.25
S_2: FYM @ 10 t ha^{-1}	25.37	8.10	41.10
S_3: FYM @ 15 t ha^{-1}	29.32	9.41	47.57
S_4: Vermicompost @ 5 t ha^{-1}	19.47	4.73	40.25
S_5: Vermicompost @ 7.5 t ha^{-1}	24.08	7.97	44.16
S_6: NPK @ 40:60:20 kg ha^{-1}	19.95	6.20	41.58
SEm±	0.72	0.33	0.16
CD (P= 0.05%)	2.07	0.95	0.47
Interaction (MS × S)	S	S	S

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