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Standardization of method of sowing and organic farming practices for Ashwagandha (*Withania somnifera* (L.) Dunal)

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Abstract
Ashwagandha (*W. somnifera,* Apocynaceae) are becoming popular as commonly used medicinal plants. The steroidal lactones (withanolides) obtained from its roots have been implicated in a wide range of therapeutic activities and maintaining general health. The experiment was laid out in split plot design with three replications, having two treatments in main plot (Flat sowing and ridge and furrow sowing)and eight treatments(Control, FYM @10 t ha^{-1} ,FYM @15 t ha^{-1} Vermicompost @5 t ha^{-1}Vermicompost @7.5 t ha^{-1} ,Castor cake@ 1.5 t ha^{-1},Castor cake@ 2.5 t ha^{-1} RDF through inorganic fertilizers @60:40:40 kgha-1NPK) in sub plot. The treatments consists sixteen combinations of different sowing methods and organic sources of nutrient. .Maximum mean plant height (65.46cm), plant biomass (59.16 q ha^{-1}) and dry root yield (10.06 qha^{-1}) were found with application of vermicompost@7.5 t ha^{-1} which was superior overapplication of FYM@15.0 t ha^{-1} and other treatments. The highestmean net return (Rs. 64684 ha-1) was found with application of FYM@15 t ha^{-1}. The interaction effect between method of sowing and organic manure was influenced on dry root yield.

Keywords: Standardization, method of sowing, organic farming, ashwagandha

Introduction
Ashwagandha, the 3rd important prioritized medicinal plant listed by National Medicinal Plant Board (NMPB) is also known as Indian Ginseng. Herbal medicine**s** strongly involves mass appeal being safer and inexpensive. Ashwagandha (*W. somnifera,* Apocynaceae) are becoming popular as commonly used medicinal plant**s.** The steroidal lactones (withanolides) obtained from its roots have been implicated in a wide range of therapeutic activities and maintaining general health. The lack of adoption, poor planting method and nutrient management of ashwagandha crop are the major factors for lower yield realization in the country. Planting method play an important role in contributing to the high yield because poor establishment of seedling will not get proper growth and development and can easily infested by diseases. On the other hand, very small population will reduce the yield. Therefore proper planting method is necessary for harvesting dry root yield, protect the plant under water logging situation during heavy rainfall.

Material and Methods
The present investigation entitled "Standardization of method of sowing and organic farming practices for ashwagandha (*Withania somnifera* (L.) Dunal)" was carried out at university farm, Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur Chhattisgarh during *rabi* seasion of 2015-16, 2016-17 and 2017-18. The soil of the experimental field was clayey in texture. The Ashwagandha variety GAA-1 was sown. The experiment was laid out in split plot design with three replications, having two treatments in main plot (Flat sowing and ridge and furrow sowing) and eight treatments (Control, FYM @10 t ha^{-1} ,FYM @15 t ha^{-1} Vermicompost @5 t ha^{-1} Vermicompost @7.5 t ha^{-1} ,Castor cake@ 1.5 t ha^{-1},Castor cake@ 2.5 t ha^{-1} RDF through inorganic fertilizers @60:40:40 kgha-1 NPK) in sub plot. The treatments consists sixteen combinations of different sowing methods and organic sources of nutrient. The observation of various parameters viz. Plant height at harvest (cm), plant biomass yield at harvest (q/ha), dry root yield (q/ha) were recorded and net return (Rs./ha)) was also calculated.

Result

The impact of different sowing methods on growth attributing characters, yield and quality of ashwagandha has been studied extensively, as it varies substantially with genotypes, organic manuring, location and seasons. On the basis of three year of experimentation, it was found that maximum mean plant height (60.87cm), plant biomass (54.14q ha-1), dry root yield (8.84q ha-1) and net return (Rs.52025/ha) were found with ridge and furrow sowing method which was superior over flat method of sowing (Table 1 & 2**).** Among the various organic manures and its levels was influenced on plant height, plant biomass yield, dry root yield and net return of ashwagandha crop. Maximum mean plant height (65.46cm), plant biomass (59.16 q ha^{-1}) and dry root yield (10.06 qha^{-1}) were found with application of vermicompost@7.5 t ha^{-1} which was superior over application of FYM@15.0 t ha^{-1} and other treatments. The highest mean net return (Rs. 64684 ha-1) was found with application of FYM@15 t ha^{-1}. The interaction effect between method of sowing and organic manure was influenced on dry root yield (Table 3). The optimum level is ridge and furrow sowing method with application of vermicompost @7.5 t ha^{-1} for obtaining higher dry root yield of ashwagandha crop(11.80q ha^{-1}) (Table 3). The use of the organic manures will reduce dependency on costly chemical fertilizers and pesticides, besides being ecological sound and eco-friendly in nature. The term "Farmyard manure" refers to the decomposed mixture of dung and urine of farm animals along with the litter (bedding material) and leftover material from roughages or fodder fed to the cattle. The FYM can be used for all the crops as it contains all the major nutrients required for healthy growth. Koppad and Gouda (2006) [4] found that ridge + furrow were the suitable for stevia and ashwagandha and broad bed + furrow were the most suitable for tulsi and kalmegh cultivation. Chandra *et al.* (2007) [2] 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. Saha *et al.* (2005) reported that the organic fertilizer in the form of vermicompost and vermiwash was effective and comparable to the inorganic fertilizers in increasing gel moisture, gel ash and aloin content in Aloevera. Abbas and Fadul (2013) [1] reported that significantly highest grain yield (4.3 t ha^{-1}) was obtained from the combination of 20 t ha^{-1} FYM with ridge planting method and the lowest grain yield (3.8 t ha^{-1}) from the combination of 20 t ha^{-1} FYM with flat planting method. Eltegani and Rahman (2013) [3] reported that significantly highest leaf area index of alfalfa was recorded under combination of flat bed and 5 t ha^{-1} chicken manure as compare to other combination.

Table 1: Effect of method of sowing and organic farming practices on growth, plant biomass yield at harvest (q/ha) of ashwagandha crop

Treatment	Plant height at harvest (cm)				Plant biomass yield at harvest (q/ha)			
	2015-16	2016-17	2017-18	Mean	2015-16	2016-17	2017-18	Mean
Main plot treatment: sowing method								
M_1- Flat sowing	42.33	62.47	70.78	58.53	44.19	52.90	58.23	51.77
M_2- Ridge and furrow sowing	45.16	63.73	73.71	60.87	47.32	54.97	60.15	54.14
SEm±	0.74	1.06	2.01	-	0.67	1.49	2.27	-
CD (5%)	2.15	NS	NS	-	1.97	NS	NS	-
Sub plot treatments: Organic manures								
OM_1- Control	33.5	58.52	61.59	51.20	35.25	47.69	51.25	44.73
OM_2- FYM 10 t ha^{-1}	37.66	60.80	71.38	56.61	39.71	51.54	55.95	49.06
OM_3- FYM 15 t ha^{-1}	48.66	65.08	76.1	63.28	50.71	56.01	63.32	56.68
OM_4- Vermicompost 5 t ha^{-1}	44.66	63.45	70.90	59.67	46.71	54.13	59.78	53.54
OM_5- Vermicompost 7.5 t ha^{-1}	50.33	67.40	78.65	65.46	52.34	59.72	65.44	59.16
OM_6- Castor cake 1.5 t ha^{-1}	41.0	62.17	72.07	58.41	43.04	53.12	58.82	51.66
OM7- Caster cake @2.5 t ha^{-1}	45.66	62.72	73.63	60.67	47.71	53.77	58.71	53.39
OM8-RDF through inorganic fertilizers (60:40:40 kg/ha NPK)	46.83	64.68	73.64	61.71	48.87	55.56	60.21	54.88
SEm±	2.87	2.11	3.77	2.91	2.94	2.10	2.38	2.47
CD (5%)	9.94	6.52	11.62	9.36	10.21	6.49	7.34	8.01

Table 2: Effect of method of sowing and organic farming practices on dry root yield and net return (Rs./ha) of ashwagandha crop

Treatment	Dry root yield (q/ha)				Net return (Rs./ha)			
	2015-16	2016-17	2017-18	Mean	2015-16	2016-17	2017-18	Mean
Main plot treatment: sowing method								
M_1- Flat sowing	8.37	8.46	8.36	8.39	39117	55321	54292.5	49576
M_2- Ridge and furrow sowing	8.89	9.02	8.61	8.84	42404	58834	54838.3	52025
SEm±	0.13	0.51	0.25	-	-	-	-	-
CD (5%)	0.38	NS	NS	-	-	-	-	-
Sub plot treatments: Organic manures								
OM_1- Control	6.73	6.84	6.38	6.65	37840	50383	45883.3	44702
OM_2- FYM @10 t ha^{-1}	7.88	8.99	8.50	8.46	42077	66850	62066.6	56997
OM_3- FYM @15 t ha^{-1}	9.48	9.65	9.62	9.58	52353	70950	70750.0	64684
OM_4- Vermicompost @5 t ha^{-1}	8.71	8.45	8.38	8.51	28746	41516	40816.6	37026
OM_5- Vermicompost@ 7.5 t ha^{-1}	9.87	10.36	9.94	10.06	25473	48116	43950.0	39179
OM_6- Castor cake@ 1.5 t ha^{-1}	8.27	8.16	8.94	8.46	42687	56133	63916.6	54245
OM7- Caster cake @2.5 t/ha	8.96	8.32	7.82	8.37	43207	52666	47733.3	47868
OM8- RDF through inorganic fertilizers @60:40:40 kg/ha NPK	9.17	9.17	8.30	8.88	53700	70006	61406.6	61704
SEm±	0.35	0.48	0.42	-	-	-	-	-
CD (5%)	1.22	1.49	1.30	-	-	-	-	-

Table 3: Interaction effect of method of sowing and organic farming practices on dry root yield of ashwagandha

Treatment	OM1: Control				OM2: FYM @10 t ha^{-1}				OM3: FYM @15 t ha^{-1}				OM4: Vermi compost @5 t ha^{-1}				OM5: Vermi compost @7.5 t ha^{-1}				OM6: Castor cake@ 1.5 t ha^{-1}				OM7 : Caster cake @2.5 t/ha				OM8- RDF @60:40:40 kg ha^{-1} NPK				Mean
	2015-16	2016-17	2017-18	Mean	2015-16	2016-17	2017-18	Mean	2015-16	2016-17	2017-18	Mean	2015-16	2016-17	2017-18	Mean	2015-16	2016-17	2017-18	Mean	2015-16	2016-17	2017-18	Mean	2015-16	2016-17	2017-18	Mean	2015-16	2016-17	2017-18	Mean	
M1: Flat	6.69	6.53	6.44	6.55	7.46	7.85	7.77	7.69	9.21	9.85	9.41	9.49	8.92	8.36	8.19	8.49	9.58	8.91	9.93	9.47	7.90	8.34	8.66	8.30	8.21	8.33	8.04	8.19	8.46	9.52	8.46	8.81	**8.37**
M2:	6.77	7.14	6.33	6.75	8.30	10.11	9.24	9.21	9.74	9.43	9.84	9.67	8.51	8.54	8.57	8.54	10.16	11.80	9.97	10.64	8.64	7.98	9.23	8.61	9.71	8.29	7.61	8.53	9.88	8.80	8.15	8.94	**8.86**
Mean	6.65				8.45				9.58				8.51				**10.06**				8.46				8.36				8.87				-

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