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Impact of different seed rates with planting methods on growth of ashwagandha (*Withania somnifera*)

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Abstract
The present experiment was laid out at Research Farm of Dr. KSG Akal College of Agriculture, Eternal University, Baru Sahib (H.P.) during summer season of 2021. The trial consisted of two factors (seed rates and planting methods) which prepared eight treatments combinations and positioned out in FRBD with three replications to attain the unvarying and unbiased result. The combinations of eight treatments comprising two different seed rates (S) (S_1-4 kg ha^{-1}, S_2-5.5 kg ha^{-1}) and four methods of planting (M) (M_1-broadcasting, M_2-Line sowing, M_3-Transplanting randomly, M_4-Transplanting in lines). The results reported that plant population in growth parameters were statistically affected by various seed rates and recorded maximum value with 5.5 kg^{-1}. It was ascertained that notably higher plant population, height of plant, length of root, root biomass, girth of root were reported under treatment M_3 (Transplanting randomly). Concerning interaction impact, the higher plant population height of plant, length of root, girth of root, was reported under the treatment M_3S_2 i.e. Transplanting randomly + 5.5 kg per hectare.

Keywords: Ashwagandha, growth parameters, planting methods, seed rates, transplanting

Introduction
The Indian Himalayan region (IHR) is a mega hot spot for plant bio diversity, consisting large number of medicinal plants which works as a tool for crop diversification in Himachal Pradesh Agriculture model. With the increased demand for natural health care substances for trade purposes the bio-diversity of Himachal Pradesh is under huge pressure. Ashwagandha (*Withania somnifera*) is known as important medicinal plant due to the presence of alkaloids and withanine substances in it. The cultivation technology of this herbal plant needs a special attention of scientists to increase its productivity in hill land agriculture of Sirmour district (H.P)

The experimental studies have also revealed that presence of active withanolides and alkaloid content in ashwagandha plant have the medicinal properties to be used in ayurveda and yunani drugs for enhancing the functions of brains and improves the memory system. The alkaloid present in roots of the plant possesses the antibiotic, anti-tumour and anti-cancerous properties. The paste of green leaves and roots of the plant are used to get relieve from joint pain and inflammations. The leaves as such as also used to provide comforts during eye diseases. It also promotes reproductive functions and its balances in human beings.

The annual estimated production of Ashwagandha in India is about 1500 tonnes against the requirement of 7000 tonnes in a calendar year. This gap in production has raised a critical issue for Agronomist working on this herbal crop to evolve the matching technologies to bridge up this yield gap (Anonymous, 2009). The recent research studies also clarified that different environment conditions, poor planting methods and shy germination of this crop are the major constrains for its lower yields in the country (Raghuveer, 2019) [6].

Sirmour district falls in mid Himalayan region of Himachal Pradesh which have peculiar environmental conditions like erractive rainfall and chilling temperature during winter months. The topography of the region is uneven and sloppy accompanied with erosion hazards. The poor inherent behaviour of its seed for germination is another limiting factor to obtain optimum plant population.

To overcome all these constrains from Mid-Himalayan Region of Himachal Pradesh, there is need to work out the seed rate per unit area and adoption of proper plant geometries with rights to direct seedling v/s nursery transplanting randomly or in line sowing pattern to promote its aerial and root growth. In general the grower use the seed rate @less than 4 kg/ha but experimental results are in favour of using more seed rate.

To mitigate the shy germination effect of its seeds there is need to sow its seeds in the nursery bed under protected conditions to have a 30-35 days old seedling for its transplanting in the main field either randomly or in line sowing depending upon the soil conditions. This technology may not only promote the number of leaves, height and branching of the plant but also likely to improve the length and quality of roots in which most the pharmaceutical ingredient like withanolides and alkaloids are present.

Material and Method

The experimental was conducted at Research Farm of Dr. K.S Gill Akal College of Agriculture, Eternal University, Baru Sahib during summer 2021, site was situated at an elevation of 6233 m above mean sea level at 30.7°N latitude and 77.3°. The area received an annual rainfall of about 985.8 mm which mostly occurred during June to September. Ashwagandha seed were sown on 25th July, 2021 simultaneously in field and nursery bed by keeping agronomic methodology in view, the direct seeding of ashwagandha was done by adopting two different methods of sowing (broadcasting and line sowing) with 2 different level of seed rates (4 kgha^{-1} and 5.5 kg ha^{-1}) by keeping the row distance at 25 cm apart. The data were recorded at 60, 120 and 180 DAS (Days After Sowing) from five randomly selected plants which were tagged from each plot and average of every parameter was recorded at different stages i.e., height of plant, length of root, root girth, plant population.

Result and Discussion

It is clear that the plant population was significantly influenced with the application of different seed rates for this herbal crop. Plant population recorded under S_2 (5.5 kg ha^{-1}) was 20.42, 18.92 and 18.17 /m^2 at 60, 120 and 180 DAS and M_3 (Transplanting randomly) at 60, 120 DAS and at harvest 22.83, 20.83 and 20.17 m^2 and was found significantly superior over other methods of planting Similar results were reported by Satyanarayana *et al*., (2009) [4] that at herbal garden, the effect of spacing and variable seed rates on dry root growth of ashwagandha reported highest no. of plants (plant population) per unit area with seed rate 20 kg/ha. The combined result of different seed rates and methods of planting on population of plant was found highest plant count (24.00 m^2) remained under S_2M_3 while the lowest plant population (12.00 m^2) was found in S_1M_2 at 60, 120 and 180 DAS (harvest) respectively.

In case of plant height values remained numerically higher 18.51, 36.78, and 45.03 cm with S_2 (5.5 kg ha^{-1}) and the tallest plants of 19.06, 38.22 and 47.27 cm were recorded under M_3 (Transplanting randomly) at 60, 120 DAS and harvest where as the smallest plants of 17.88, 35.03 and 43.15 cm high was noticed under M_2 (Line sowing).interaction result showed that the longest (47.31 cm) and shortest (17.86 cm) plant height were observed under S_2M_3 and S_1M_2 respectively under similar growth period of crop. Ram *et al*., (2010) [2] reported similar results in his experiment about plant height that among all the treatments early sowing in August with line sowing method produced maximum plant height, when compared to late sowing on September with broadcasting method, similar goes with the results of Vilhekar *et al*., (2014) [5], revealed that maximum height of plants were recorded when sowing was done on 28th MW with 12 kg ha^{-1} seed, when conducted trial with 3 replications and 12 treatment combinations which was laid out in FRBD having four different sowing dates (28th, 31st, 33rd and 35th MW) and 3 different seed rates (8,10 and 12 kg ha^{-1}).

Result of different level of seed rates and methods of planting on root length revealed that the longer root length values recorded under S_2 (5.5 kg ha^{-1}) were 7.25, 20.77 and 24.78 cm deep in to the soil at 60DAS, 120 DAS and 180 DAS remained statistically at par with root length values of 7.18, 20.76 and 24.72 cm obtained under S_1 (4 kg ha^{-1}) at similar growth stage of crop., different planting methods have shown significant differences in root length among one on other. The longest roots were observed under M_3 (Transplanting randomly) as 7.83, 22.23 and 26.29 cm deep in soil at 60, 120 DAS and harvest and adjudged significantly superior to all other planting methods (M_4, M_1 and M_2). Anand *et al*., (2016) [1] in his experiment reported similar results on root growth and revealed that line sowing on raised bed method was found superior in relation of its growth as compared to Broadcasting. The profuse branching occurred due to disturbances caused to the plant during transplanting.

However the higher value of root girth was recorded in S_2 (5.5 kg ha^{-1}) as 0.86 cm at harvest which remained at par with S_1 (4 kg ha^{-1}) with root girth value of 0.84 cm. Different methods of sowing have shown a significant bearing in root girth development of ashwagandha. M_3 (transplanting randomly) enabled the root to produce its maximum girth of 1.04 cm and remained significantly higher over all other planting treatments M_4 (transplanting in lines), M_1 (broadcasting) and M_2 (line sowing).Experiment conducted by Ratre and Dewangan (2017) [3] on growth of ashwagandha revealed that raised bed sowing methods recorded highest root diameter and dry root yield

Table 1: Impact of different seed rates and planting method on plant population and plant height of ashwagandha.

T. No.	Treatment	Plant population (plants/m^2)			Plant height (cm)		
		60 DAS	120 DAS	180 DAS	60 DAS	120 DAS	180 DAS
Seed rates							
S_1	4 kg ha^{-1}	18.08	16.09	15.17	18.34	36.72	44.97
S_2	5.5 kg ha^{-1}	20.42	18.92	18.17	18.51	36.78	45.03
Sem±		0.28	0.32	0.33	0.08	0.05	0.06
CD(0.05)		0.87	0.99	1.01	NS	NS	NS
Methods of planting							
M_1	Broadcasting	18.33	16.67	15.67	18.09	36.27	44.37
M_2	Line sowing	16.17	14.50	13.67	17.88	35.30	43.15
M_3	Transplanting randomly	22.83	20.83	20.17	19.06	38.22	47.27
M_4	Transplanting in lines	19.67	18.00	17.17	18.66	37.20	45.20
M_5	Methods of planting	0.40	0.46	0.46	0.11	0.07	0.08
Sem±		1.23	1.41	1.42	0.35	0.22	0.24
CD(0.05)		18.33	16.67	15.67	18.09	36.27	44.37

Table 2: Impact of different seed rates and planting method on root length and root girth of ashwagandha.

T. No.	Treatment	Root length (cm)			Root girth (cm)
		60 DAS	120 DAS	180 DAS	180 DAS
Seed rates					
S_1	4 kg ha^{-1}	7.18	20.76	24.72	0.84
S_2	5.5 kg ha^{-1}	7.25	20.77	24.78	0.86
Sem±		0.04	0.07	0.05	0.01
CD(0.05)		NS	NS	NS	NS
Methods of planting					
M_1	Broadcasting	7.08	20.23	24.33	0.79
M_2	Line sowing	6.38	19.36	23.17	0.69
M_3	Transplanting randomly	7.83	22.23	26.29	1.04
M_4	Transplanting in lines	7.59	21.23	25.22	0.90
M_5	Methods of planting	0.06	0.09	0.07	0.01
Sem±		0.17	0.13	0.23	0.03
CD(0.05)		7.08	20.23	24.33	0.79

Conclusion

The experimental study clearly showed that the growth can be enhanced with M_3 (transplanting randomly) due to establishment of vigorous plants of ashwagandha obtained from the 30-35 days old seedlings when compared to other planting geometries M_4 (transplanting in lines), M_1 (broadcasting method of sowing) and M_2 (sowing in lines). The higher seed rate (5.5 kg ha^{-1}) also favoured all these parameters due to more plant population obtained in comparison to the application of lower seed rate (4 kg ha^{-1}).

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