International Journal of Agricultural Sciences
Volume 17 | Issue 2 | June, 2021 |359-364 ■ ISSN : 0973-130X
DOI:10.15740/HAS/IJAS/17.2/359-364
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RESEARCH PAPER

Standardization of field conditions and time of sowing on nursery growth of *Asparagus racemosus* Willd under mid hills conditions of Himachal Pradesh

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Abstract : For successful introduction and cultivation of the plant in a new region, the knowledge about the parameters related to the planting material and its growth in that region is very important *viz*., time of sowing, conditions of growth etc. Keeping in mind the basic requirements and the need to introduce the *Asparagus racemosus* Willd. from the tropical region to mid hill conditions, the experiment was conducted in the experimental farm of department of Forest Products, College of Forestry, Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan which falls under mid hill zone of Himachal Pradesh. Seeds were sown under open and protected conditions from March month upto July in growing media (Soil + Cocopeat + Vermicompost (1:1:1)) and observation were recorded after 60 days of seed sowing. It was revealed that maximum germination percentage (31.33), maximum seedling shoot (23.13 cm) and root length (11.10 cm) was recorded during May month under protected conditions. There was 840.84%, 539.73% and 205.79% increase over control in emergence percentage, shoot length and root length, respectively.

Key Words : *Asparagus*, Field conditions, Germination, Protected conditions, Root length, Shoot length

View Point Article : Thakur, Usha, Sood, Meenu and Rani, Jadhav (2021). Standardization of field conditions and time of sowing on nursery growth of *Asparagus racemosus* Willd under mid hills conditions of Himachal Pradesh. *Internat. J. agric. Sci.*, **17** (2) : 359-364, **DOI:10.15740/HAS/IJAS/17.2/359-364.**

Article History : **Received :** 25.02.2021; **Revised :** 27.02.2021; **Accepted :** 16.03.2021

INTRODUCTION

The genus *Asparagus* includes about 150 species distributed throughout the world, of which nearly 17 are found in India (Anonymous, 1948). Flora of Himachal Pradesh, described 7 species of genus *Asparagus* which are distributed in different parts of Himachal Pradesh (Chowdhery and Wadhwa, 1984). Out of 17 species found in India, *A. racemosus*, *A. gonaclades* and *A. adscendens* are most commonly used in indigenous medicine (Rao, 1952 and Goyal *et al.,* 2003). *A. racemosus* is also the one most regularly used as Rasayana in traditional medicinal system 'Ayurveda' (Ashok and Ali, 2003 and Garg and Gupta, 2010). *A. racemosus* produces about 1.6-fold higher root yield than *A. adscendens (*Ram *et al.*, 2001).

Several medicinal properties are attributed to the root (Anonymous, 1948). Its medicinal usage has been

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reported in Indian and British Pharmacopeias and in traditional system of medicine such as Ayurveda, Unani and Siddha (Bopana and Saxena, 2007). It is considered both a general tonic and a female reproductive tonic. It is however, used for sexual debility and infertility in both sexes (Saxena *et al.,* 2010).

Medicinal plants have so far largely been collected from wild resources. Moreover, the plant material collected from these sources is replete with the problems of adulteration and misidentification. Therefore, cultivation of genuine, authentic variety of plants may be the only way to have raw material of required quality. The non-availability of proper techniques and authentic planting material are the main constraints in cultivation of these plants.

Due to multiple uses of *A. racemosus*, its tuberous roots are in much demand. Being a tropical-subtropical species, it is currently being cultivated in regions of Haryana, UP, MP, Rajasthan, Maharashtra etc. However, experience has showed that its plants also do well under sub temperate climatic regions prevalent in mid-hill Himalayas. It is imperative to study its yield performance in newer regions with a view to bring more areas under its cultivation.Mid hills of Himachal Pradesh are one such potential region where its cultivation can be taken upto meet the constant rising demand. Proper agro-techniques would encourage cultivation of *Asparagus racemosus* and solve the problem of erratic and inadequate supply.

Keeping in view the importance of cultivation of *Asparagus racemosus* and meager information on its cultivation in Himachal Pradesh, the present study was conducted.

Material and Methods

The study was conducted at the experimental farm of department of Forest Products, College of Forestry, Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan (H.P.) as the area falls under mid hill zone. The experiment was conducted under two field conditions *i.e.* protected and open conditions with different time of sowing *i.e.* from April to July for four consecutive years *i.e.* from 2012 to 2015. Growing media used was Soi + Cocopeat + Vermicompost (1:1:1) and observations were recorded on emergence percentage, root length (cm) and shoot length (cm) after 60 days of seed sowing. The experiment was conducted under Randomized Block Design (RBD Factorial) with three replications.

Results and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Emergence percentage :

A perusal of data presented in Table 1 revealed that the effect of different field conditions and time of sowing on emergence percentage was observed significant in 2012, 2013, 2014 and 2015. In 1st year, among different time of sowing maximum emergence percentage (27.33) was observed in T_3 which was significantly higher than the others. Among the two field conditions maximum emergence percentage was observed in F_1 (21.60) compared to F_2 (14.13) in 1st year and same trend was followed in rest of the years.

In pooled analysis maximum emergence percentage (26.92) was observed in T_3 which was significantly higher than the rest of the values and minimum (6.92) was observed in T_1.

Shoot length (cm) :

Data presented in Table 2 revealed that in 1st year, among different time of sowing maximum shoot length (20.95 cm) was observed in T_3 which was statistically at par with T_4 (20.10 cm). Same trend was followed in 3rd year. In 2nd year maximum shoot length was observed in T_3 (20.22) which was significantly higher than the rest of the values. Same trend was observed in 4th year. Among two field conditions, in 1st year maximum shoot length (17.52 cm) was observed in F_1 compared to F_2 (12.99 cm). Same trend was followed in 2nd, 3rd and 4th year.

In pooled analysis, among different time of sowing maximum shoot length (20.28 cm) was observed in T_3 which was significantly higher than the rest of the values. Among two field conditions, maximum shoot length (17.25 cm) was observed in F_1 compared to F_2 (12.54 cm). Interaction was observed non-significant.

Root length (cm) :

A perusal of data presented in Table 3 revealed that among different time of sowing in 1st year, maximum root length (10.43 cm) was observed in T_3 which was statistically at par with T_4 (10.20 cm). Same trend was observed in 3rd year. In 2nd year however, maximum root length was also observed in T_3 (10.50 cm) but it was significantly higher than the rest of the values. In 4th

year maximum root length was observed in T_4 (10.50 cm) which was significantly higher than the rest of the values. Among two field conditions maximum root length (8.74 cm) was observed in F_1 compared to F_2 (7.26 cm) in 1st year. Same trend was followed in 2nd, 3rd and 4th year.

Interaction effect of different time of sowing and field conditions was observed non-significant in 1st and 2nd year. In 3rd year maximum root length was observed in T_3F_1 (11.10 cm) which was statistically at par with T_4F_1 (10.70 cm). While in 4th year maximum root length was observed in T_4F_1 (11.67cm) which was significantly higher than the rest of the values.

In pooled analysis among different time of sowing, maximum root length (10.20 cm) was observed in T_3 which was significantly higher than the rest of the values. Among two field conditions maximum root length (8.79 cm) was observed in F_1 compared to F_2 (7.07 cm). Interaction effect was found non-significant.

Conditions needed for seed germination of a particular species are the results of interaction between its genetic makeup and environmental complex. The environmental conditions include availability of water, optimum temperature, season and light intensity.

Table 1: Effect of different field conditions and time of sowing on emergence percentage of *A. racemosus*

	Emergence percentage														
Field conditions / Time of sowing	2012			2013			2014			2015			Pooled		
	Protected (F_1)	Open (F_2)	Mean	Protected (F_1)	Open (F_2)	Mean	Protected (F_1)	Open (F_2)	Mean	Protected (F_1)	Open (F_2)	Mean	Protected (F_1)	Open (F_2)	Mean
March (T_1)	10.00	3.33	6.67	11.33	4.00	7.67	10.00	3.33	6.67	10.67	2.67	6.67	10.50	3.33	6.92
	(18.43)	(10.40)	(14.42)	(19.66)	(11.28)	(15.47)	(18.38)	(10.40)	(14.39)	(19.05)	(9.27)	(14.16)	(18.18)	(10.34)	(14.61)
April (T_2)	16.00	12.00	14.00	20.67	10.67	15.67	20.00	12.67	16.33	20.00	11.33	15.67	19.17	11.67	15.42
	(25.38)	(20.23)	(21.90)	(27.00)	(19.05)	(23.02)	(26.55)	(20.84)	(23.69)	(26.55)	(19.66)	(23.10)	(25.92)	(19.94)	(22.93)
May (T_3)	32.00	22.67	27.33	30.67	22.67	26.67	31.33	23.33	27.33	31.33	21.33	26.33(3	31.33	22.50	26.92
	(34.34)	(28.41)	(31.42)	(33.61)	(28.41)	(31.01)	(34.01)	(28.85)	(31.43)	(34.01)	(27.47)	0.74)	(34.01)	(28.29)	(31.15)
June (T_4)	28.67	19.33	24.00	25.33	18.00	21.67	26.00	18.67	22.33	24.67	17.33	21.00	26.17	18.33	22.25
	(32.29)	(26.08)	(29.18)	(30.19)	(25.08)	(27.64)	(30.65)	(25.55)	(28.10)	(29.75)	(24.55)	(27.15)	(30.72)	(25.31)	(28.02)
July (T_5)	21.33	13.33	17.33	19.33	12.00	15.67	21.33	13.33	17.33	19.33	11.33	15.33	20.33	12.50	16.42
	(27.47)	(21.40)	(24.44)	(26.06)	(20.27)	(23.16)	(27.47)	(21.40)	(24.44)	(26.04)	(19.66)	(22.85)	(26.76)	(20.68)	(23.72)
Mean	21.60	14.13	17.87	21.47	13.47	17.47	21.73	14.27	18.00	21.20	12.80	17.00	21.50	13.67	
	(27.24)	(21.30)	(24.27)	(27.30)	(20.82)	(24.06)	(27.41)	(21.41)	(24.41)	(27.08)	(20.12)	(23.60)	(27.26)	(20.91)	
	SE	CD		SE	CD		SE	CD		SE	CD		SE	CD	
Field conditions		1.09			1.17			1.09			1.24			0.17	
Time of sowing		2.05			2.19			2.05			2.32			0.42	
Field conditions* Time of sowing		NS			NS			NS			NS			NS	
Year														NS	
Year*Field conditions														NS	
Year*Time of sowing														NS	
Time of sowing*Field conditions* Year														NS	

NS= Non-significant

Table 2: Effect of different field conditions and time of sowing on shoot length of *A. racemosus*

Field conditions / Time of sowing	Shoot length (cm) 2012			2013			2014			2015			Pooled		
	Protected (F_1)	Open (F_2)	Mean	Protected (F_1)	Open (F_2)	Mean	Protected (F_1)	Open (F_2)	Mean	Protected (F_1)	Open (F_2)	Mean	Protected (F_1)	Open (F_2)	Mean
March (T_1)	8.47	5.43	6.95	11.03	4.67	7.85	8.67	5.16	6.92	8.80	5.80	7.30	9.24	5.26	7.25
April (T_2)	14.99	11.81	13.40	16.34	12.93	14.64	15.57	11.14	13.36	13.87	10.53	12.20	15.19	11.60	13.40
May (T_3)	23.83	18.07	20.95	22.83	17.60	20.22	22.37	16.73	19.55	23.47	17.30	20.38	23.13	17.43	20.28
June (T_4)	22.73	17.47	20.10	19.03	14.57	16.80	21.47	16.50	18.99	20.00	14.70	17.35	20.81	15.81	18.31
July (T_5)	17.57	12.17	14.87	17.37	11.58	14.47	19.13	12.47	15.80	17.40	14.17	15.78	17.87	12.60	15.23
Mean	17.52	12.99	15.25	17.32	12.27	14.80	17.45	12.40	14.92	16.71	12.50	14.60	17.25	12.54	
	SE	CD		SE	CD		SE	CD		SE	CD		SE	CD	
Field conditions		0.97			0.58			0.76			0.92			0.12	
Time of sowing		1.82			1.09			1.43			1.72			0.30	
Field conditions*Time of sowing		NS			NS			NS			NS			NS	
Year														NS	
Year*Field conditions														NS	
Year*Time of sowing														NS	
Time of sowing*Field conditions*Year														NS	

NS=Non-significant

Collectively such environmental conditions not only determine the time of sowing and success of germination percentage, but also determine the growth cycle of species.

During the present investigations among different time of seed sowing maximum emergence percentage (26.92) was observed during May month which was followed by sowing during June (22.25). Minimum germination percentage (6.92) was observed during March. Among different field conditions maximum germination percentage was recorded under protected condition (21.50) and minimum was recorded in open conditions (13.67). However among interaction effect between field conditions and time of sowing, maximum germination percentage (31.33) was observed when seeds were sown during May month under protected condition. Maximum seedling shoot (23.13 cm) and root length (11.10 cm) was recorded during May under protected conditions and proves to be best.

Present findings are in accordance with the Tiwari *et al.* (1998) and Ved *et al.* (2002) who reported May month for sowing of the seeds. Maibangsa *et al.* (2004) also reported mid-March to mid-May sowing was optimum for *A. racemosus*. Sharma *et al.* (1992) observed that germination begins only with the commencement of monsoon in Maharashtra. According to Gupta *et al.* (2002) the optimum period for germination of *A. racemosus* under Jammu type conditions, was June-July, indicating that high temperature and humidity were requisites for its germination. Further they reported that with the decrease in temperature and humidity from middle of August onwards, germination was arrested abruptly, probably because seeds underwent a secondary dormancy during this time period. This may be the probable reason for maximum emergence percentage in May month followed by June under protected conditions in the experimental area.

The higher values may be due to the fact that

Table 3: Effect of different field conditions and time of sowing on root length of *A. racemosus*

Field conditions / Time of sowing	Root length (cm) 2012 Protected (F_1)	2012 Open (F_2)	2012 Mean	2013 Protected (F_1)	2013 Open (F_2)	2013 Mean	2014 Protected (F_1)	2014 Open (F_2)	2014 Mean	2015 Protected (F_1)	2015 Open (F_2)	2015 Mean	Pooled Protected (F_1)	Pooled Open (F_2)	Pooled Mean
March (T_1)	4.43	3.93	4.18	4.77	2.47	3.62	5.80	4.23	5.02	6.87	3.90	5.38	5.47	3.63	4.55
April (T_2)	7.80	6.73	7.27	7.53	5.60	6.57	7.03	6.20	6.62	7.00	5.47	6.23	7.34	6.00	6.67
May (T_3)	11.47	9.40	10.43	11.33	9.67	10.50	11.10	8.70	9.90	10.50	9.43	9.97	11.10	9.30	10.20
June (T_4)	11.03	9.37	10.20	10.00	8.30	9.15	10.70	8.30	9.50	11.67	9.33	10.50	10.85	8.83	9.84
July (T_5)	8.97	6.87	7.92	9.67	8.10	8.88	9.13	6.93	8.03	9.00	8.50	8.75	9.19	7.60	8.40
Mean	8.74	7.26	8.00	8.66	6.83	7.74	8.75	6.87	7.81	9.01	7.33	8.17	8.79	7.07	
	SE	CD		SE	CD		SE	CD		SE	CD		SE	CD	
Field conditions		0.41			0.39			0.28			0.26			0.05	
Time of sowing		0.76			0.74			0.53			0.49			0.12	
Field conditions*Time of sowing		NS			NS			0.75			0.69			NS	
Year														NS	
Year*Field conditions														NS	
Year*Time of sowing														NS	
Time of sowing*Field conditions*Year														NS	

Non-significant

controlled conditions are provided in protected condition. Under these conditions the effect of moisture and optimum light intensity facilitates the seeds to germinate and grow early.

From the above experiment it was concluded that May month is the best time of sowing under mid hill conditions of the experimental area.

Acknowledgement :

Author highly acknowledge Department of Science and Technology for DST-INSPIRE Fellowship for financial assistance and Department of Forest Products, Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan (H.P.) for all the necessary facilities.

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