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Screening of superior germplasm of *Mucuna pruriens* (L.) based upon germination parameters

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Abstract

Germination is one of the most important criteria of seed quality, because it affects crop establishment and therefore the yield and quality of the future harvest. Good germination is measured by the lesser time taken for initiation of germination, germination period and completion of germination by accession. Lesser the time taken by accession to germinate better will be the accession. In this context, a systematic research trial was conducted at AICRP (M&APs) farm, BAU in 2017 to evaluate various germination parameters of 24 germplasm of *Mucuna pruriens* thus to select superior germplasm of it. Minimum time for initiation of germination was observed for MP14 accession (4.00 days). Minimum time for the germination period was observed for MP3, MP4, MP9, MP11 and MP19 (3.25 days). Minimum time taken for the completion of germination was recorded for MP5 (6.75 days). Maximum germination rate was recorded for MP9 and MP19 (0.151). When rate of germination reached its peak, maximum germination energy was recorded for MP8 (58.41). MP8 and MP19 showed highest germination percentage as 100.00. However grand mean of germination percentage of all the 24 accessions was recorded as 86.62%, which showed the higher viability of *Mucuna* seeds in general. Maximum survival percentage was recorded for MP8 (95%) with grand mean of all the 24 accessions as 80.87%.

Keywords: germplasm, *Mucuna pruriens* (L.), germination parameters

Introduction

Germination of a seed is the emergence and development of a seedling to a stage where the aspect of its essential structures (root system, shoot axis, cotyledons, terminal buds) indicates whether or not it is able to develop further into a satisfactory plant under favorable soil conditions (ISTA, 2006). It involves the reactivation of the metabolic pathways that lead to growth and the emergence of the radicle and plumule. Since germination is a complex biological process and at a point of time several factors have to enact simultaneously the resultant effect is reflected, in the form of emergence of seedling, after a certain period of time (Black and Halmer, 2006) [4]. Effective stand after germination (associated parameters like germination energy, germination period, germination percentage, etc.) is important characteristic that gives an idea about the final population. Thus, it would be desirable to have information regarding these parameters for producing good quality seedlings.

A systematic study on seed germination parameter is essential for any seed propagated crop to ensure crop stand and yield. Since *Mucuna pruriens* is seed propagated, it is essential to assess the seed quality for ensuring the crop stand which depend on quality seed. Percentage of germination is the most important characteristics of the seed to be used for cultivation. It is simply the proportion of seeds that germinate from all seeds subject to the right conditions for growth and affected by seed viability, dormancy and environmental effects (Kumar *et al.*, 2011) [12]. Germination energy is the measure of the speed of germination and hence responsible for the vigour of the seed and of the seedling which it produces. Only those seeds which germinate rapidly and vigorously under the favorable situation are likely to be capable of producing vigorous seedlings in field conditions. Rate of germination is the length of time taken by seeds to germinate, useful for calculating the seed requirements for a given area or desired number of plants. Seed vigour is a measure of the quality of seed, and involves the viability of the seed, the germination percentage, germination rate and the strength of the seedlings produced (Czabator, 1962) [6].

Mucuna pruriens, commonly known as Velvet bean, belongs to the Fabaceae family, sub family Papilionaceae, found widespread in tropical and sub-tropical regions of the world. It is a vigorous annual climbing legume, semi woody, annual with slender terate branches that when young are usually clothed with short whitish hair but becomes glabrescent or only slightly hairy when mature widely.

It is widely cultivated as a green vegetable crop (Duke, 1981)^[7], as a cover crop (Buckles, 1995)^[5], as weed control agent (Thurston, 1997)^[20], used for nematode suppression (Rodriguez *et al.*, 1988)^[17], helps in nitrogen fixation (Sanginga *et al.*, 1996)^[18], used as feed (Ravindran and Ravindran, 1988)^[16], used as food (Janardhanan and Lakshmanan, 1985)^[10], and for various medicinal uses (Bhasin *et al.*, 1996; Amin, 1996)^[3, 11].

Materials and Methods

The germination study of all the twenty four accessions of *Mucuna pruriens* was undertaken at field level in polythene tubes (13 cm × 7 cm) by establishing nursery in 2017. Experiment was conducted in Completely Randomized Design with 24 treatments replicated thrice by following the procedure outlined by Panse and Sukhatme (1985)^[13]. Finely powdered, sieved farm yard manure, sand and soil in the ratio of 1:2:1 was taken and filled into polytubes. The mixture was treated with carbendazim (0.2%) before seed sowing. Data on germination trend was recorded from initiation to completion of germination and based upon this different germination parameters were calculated.

Parameters studied were 100 seed weight (g), days taken for initiation of seed germination, days taken for completion of seed germination, germination period (days), rate of germination, germination energy (%), germination percentage (%) and survival percentage. 100 seed weight was calculated by counting 100 seeds and weighed on electronic balance and expressed in g. The number of days taken for appearance of plumule of the seed that germinated first was taken as criteria for initiation of germination. Days taken for completion of germination was worked out by counting the number of days taken from seed sowing to the last date when there was no further germination. The rate of germination was determined by taking the reciprocal of the number of days to complete germination (Bewley and Black, 1982). Germination period was calculated as the number of days taken by seeds from

initiation of germination to its completion. Germination energy was calculated as the percentage by number of seeds in a sample that have germinated up to the time when the number of seeds germinating per day reaches its peak (Khanna, 1993)^[11]. Survival percentage was calculated as the percentage of the number of seeds in a sample that develop into seedlings at transplantation age. Germination percentage has been used traditionally to measure germination and the effectiveness of germination procedures and expressed in percentage. It was calculated by

$$\text{Germination percentage} = \frac{\text{Total number of seeds germinated}}{\text{Total number of seeds used for sowing}} \times 100$$

Collected data on seed germination parameters was subjected to analysis of variance (ANOVA) and significant difference at 5% and 1% level was used to compare the means of different test parameters for all the accessions.

Results and Discussion

Data obtained on various morphological and germination parameters of the seeds of Velvet Bean are presented below. The colour of 12 accessions of *Mucuna pruriens* were white, followed by deep brown with white patches for 8 accessions and deep brown for 4 accessions. Harvais and Hadley (1967)^[8] demonstrated that light coloured seeds can swell and germinate, while brownish or brown seeds remained without any symptoms of swelling. Maximum value of 100 seed weight was recorded for MP20 (152.18g) followed by MP6 (145.29g) and minimum for MP2 (85.15g) with the grand mean of all the accessions as 116.48g. Rao and Suryawanshi (1988)^[14] reveal that the pod length and 100 seed weight are the ideal agro botanical characters in selecting ideal genotype for crop improvement and breeding programme in urdbean. Maximum value of length/breadth ratio was recorded for MP19 (1.47) and minimum for MP2 and MP16 (1.20) with the grand mean of all the accessions as 1.28.

Table 1: Colour, 100 seed weight and length/breadth ratio of seeds of different *Mucuna pruriens* accessions

Sl. No.	Accession no.	Colour of the seeds	100 seed weight (g)	Length/ breadth ratio
1.	MP 1	White	115.53	1.24
2.	MP 2	White	85.15	1.20
3.	MP 3	Deep brown	89.12	1.21
4.	MP 4	Deep brown with white patches	117.52	1.25
5.	MP 5	White	128.21	1.41
6.	MP 6	Deep brown with white patches	145.29	1.31
7.	MP 7	White	120.12	1.37
8.	MP 8	Deep brown with white patches	131.02	1.26
9.	MP 9	White	92.52	1.23
10.	MP 10	Deep brown	93.98	1.26
11.	MP 11	Deep brown with white patches	129.18	1.35
12.	MP 12	White	116.62	1.27
13.	MP 13	White	127.68	1.23
14.	MP 14	Deep brown with white patches	145.70	1.33
15.	MP 15	Deep brown	93.31	1.22
16.	MP 16	White	86.02	1.20
17.	MP 17	Deep brown with white patches	127.93	1.22
18.	MP 18	White	116.18	1.47
19.	MP 19	White	125.07	1.39
20.	MP 20	Deep brown with white patches	152.18	1.33
21.	MP 21	White	89.15	1.22
22.	MP 22	Deep brown	107.45	1.28
23.	MP 23	Deep brown with white patches	139.16	1.27
24.	MP 24	White	121.44	1.26
Grand mean			116.48	1.28

Highly significant differences in length of seeds were observed between different accessions of *Mucuna pruriens* and mean length of seeds of all the accession was calculated as 15.57 mm. Maximum value of length of seeds was recorded for MP11 (17.74 mm) and minimum for MP2 (13.12 mm). Highly significant differences in breadth of seeds were

observed between different accessions of *Mucuna pruriens* and mean breadth of seeds of all the accession was calculated as 12.11 mm. Maximum value of breadth of seeds was recorded for MP11 (13.14 mm) and minimum for MP2 (10.94 mm).

Table 2: Length, breadth, days taken for initiation of germination, germination period and days taken for completion of germination of seeds of different *Mucuna pruriens* accessions

Sl. No.	Accession no.	Length of seeds (mm)	Breadth of seeds (mm)	Initiation of germination (days)	Germination period (days)	Completion of germination (days)
1.	MP 1	15.32	12.32	4.25	4.50	7.75
2.	MP 2	13.12	10.94	4.75	3.50	7.25
3.	MP 3	13.74	11.33	5.25	3.25	7.50
4.	MP 4	15.39	12.30	5.00	3.25	7.25
5.	MP 5	17.53	12.42	4.25	3.50	6.75
6.	MP 6	16.78	12.80	4.50	3.50	7.00
7.	MP 7	16.96	12.34	4.25	3.75	7.00
8.	MP 8	15.95	12.70	5.00	3.50	7.50
9.	MP 9	13.70	11.15	4.75	3.25	7.00
10.	MP 10	14.31	11.34	5.00	4.50	8.50
11.	MP 11	17.74	13.14	4.75	3.25	7.00
12.	MP 12	15.37	12.08	5.00	4.75	8.75
13.	MP 13	15.23	12.35	5.00	3.50	7.50
14.	MP 14	17.10	12.88	4.00	4.00	7.00
15.	MP 15	13.99	11.43	5.00	3.50	7.50
16.	MP 16	13.24	11.07	5.00	4.25	8.25
17.	MP 17	15.51	12.67	4.75	3.75	7.50
18.	MP 18	17.39	11.83	4.25	4.00	7.25
19.	MP 19	17.35	12.47	4.50	3.25	6.75
20.	MP 20	17.42	13.07	4.25	4.25	7.50
21.	MP 21	13.45	11.03	5.00	4.00	8.00
22.	MP 22	14.90	11.67	5.25	4.25	8.50
23.	MP 23	16.56	13.02	5.00	4.50	8.50
24.	MP 24	15.63	12.42	4.75	4.50	8.25
Grand mean		15.57	12.11	4.73	3.84	7.57
S.E. (m)		0.28	0.4	0.19	0.36	0.48
C.D. 5%		0.55	0.28	0.39	0.73	NS
C.D. 1%		0.64	0.33	0.44	NS	NS
C.V. (%)		3.56	2.33	8.17	19.12	12.80

Highly significant differences in days taken for initiation of seed germination were observed between different accessions of *Mucuna pruriens* and mean number of days taken for initiation of seed germination was calculated as 4.73. Maximum value of days taken for initiation of seed germination was recorded for MP3 and MP22 (5.25) and minimum for MP14 (4.00). Significant differences in germination period were observed between different accessions of *Mucuna pruriens* and mean germination period was calculated as 3.84 days. Kumar *et al.* (2011) [12] also found days to initiation of seed germination of Kalmegh as 3rd days from seed sowing at 30°C. It has been observed that the germplasm showed early initiation of germination has light coloured seeds. Maximum value of germination period was recorded for MP12 (4.75 days) and minimum for MP3, MP4, MP9, MP11 and MP19 (3.25 day). Non-significant differences in days taken for completion of seed germination were observed between different accessions of *Mucuna pruriens* and mean number of days taken for completion of seed germination was calculated as 7.57. Maximum value of

days taken for completion of seed germination was recorded for MP12 (8.75) and minimum for MP5 (6.75). Raven *et al.* (2005) [15] highlighted the presence of certain plant hormones like abscisic acid, which inhibits germination and causing physiological dormancy in seeds.

Non-significant differences in rate of seed germination were observed between different accessions of *Mucuna pruriens* and mean rate of seed germination was calculated as 0.13. Maximum value of rate of germination was recorded for MP9 and MP19 (0.151) and minimum for MP12 (0.115). Highly significant differences in germination energy were observed between different accessions of *Mucuna pruriens* and mean germination energy was calculated as 42.14%. Maximum value of germination energy was recorded for MP8 (58.41%) and minimum for MP6 and MP24 (31.11%). Talei *et al.* (2012) [19] found that due to hard seed-coating layer in seeds provides a combination of physical and physiological dormancy that prevents water uptake by the embryo resulting in lower germination percentage.

Table 3: Rate of germination, germination energy, germination percentage and survival percentage of different *Mucuna pruriens* accessions

Sl. No.	Accession no.	Rate of germination	Germination energy (%)	Germination percentage	Survival percentage
1.	MP 1	0.130	31.82	80.23	75.45
2.	MP 2	0.140	35.00	82.50	82.50
3.	MP 3	0.137	40.83	84.72	82.22
4.	MP 4	0.140	46.59	95.45	90.90
5.	MP 5	0.146	56.39	95.00	79.17
6.	MP 6	0.143	31.11	71.94	63.89
7.	MP 7	0.147	42.50	100.00	90.00
8.	MP 8	0.136	58.41	97.50	95.00
9.	MP 9	0.151	47.50	90.00	90.00
10.	MP 10	0.118	45.00	95.00	92.50
11.	MP 11	0.143	43.75	78.13	71.88
12.	MP 12	0.115	32.50	80.00	80.00
13.	MP 13	0.134	31.82	68.41	65.91
14.	MP 14	0.146	35.00	75.00	65.00
15.	MP 15	0.136	41.36	77.95	75.45
16.	MP 16	0.122	52.50	87.50	87.50
17.	MP 17	0.140	50.23	95.45	83.18
18.	MP 18	0.143	54.54	97.73	88.63
19.	MP 19	0.151	51.14	100.00	87.50
20.	MP 20	0.136	31.25	78.75	65.00
21.	MP 21	0.125	46.59	95.23	92.95
22.	MP 22	0.118	32.50	72.50	67.50
23.	MP 23	0.118	41.96	84.52	76.78
24.	MP 24	0.122	31.11	95.33	91.94
Grand mean		0.13	42.14	86.62	80.87
S.E. (m)		0.01	3.77	4.08	5.89
C.D. 5%		NS	7.53	8.15	11.76
C.D. 1%		NS	8.68	9.39	13.56
C.V. (%)		14.82	17.89	9.52	14.34

Highly significant differences in germination percentage were observed between different accessions of *Mucuna pruriens* and mean germination percentage was calculated as 86.62%. Maximum value of germination percentage was recorded for MP7 and MP19 (100.00%) and minimum for MP13 (68.41%). Highly significant differences in survival percentage were observed between different accessions of *Mucuna pruriens* and mean survival percentage was calculated as 80.87%. Maximum value of survival percentage was recorded for MP8 (95.00%) and minimum for MP6 (63.89%). Talei *et al.*, (2012) ^[19] also observed significant correlation between germination traits of Kalmegh seeds. Four parameters namely seed weight, germination period, rate of germination and germination energy have direct positive effect on germination percentage of Kalmegh seeds under laboratory conditions.

Conclusion

A reliable assessment of germination quality is essential to ensure that the users of seed lots get the high level of quality they expect. In this regard, seeds of 24 accessions of *Mucuna pruriens* have been tested for various germination parameters, provided by Directorate of Medicinal and Aromatic Plant Research, Anand, Gujarat. On the basis of germination trend, different germination parameters like germination period, completion of germination, rate of germination, germination energy, survival percentage etc were recorded and analyzed. In this trial, minimum time for initiation of germination has been taken by MP14 accession. Minimum time for the germination period was taken by MP3, MP4, MP9, MP11 and MP19 (3.25 days). Minimum time taken for the completion of germination recorded for MP5 (6.75 days). Germination rate was best shown by MP9 and MP19 (0.151). When rate of germination reached its peak, the number of seeds germinated was recorded maximum in MP8 (58.41). MP8 and MP19

showed highest germination percentage as 100.00%, however germination percentage grand mean of 24 accessions was recorded as 86.62%. Highest survival percentage was recorded in MP8 (95%) with grand mean of all the 24 accessions was 80.87%.

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