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Short Communication

Effect of Scarification of Seed on Germination Parameters in Butterfly Pea (*Clitoria ternatea*)

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Butterfly pea/Aprajita (*Clitoria ternatea* L.) belongs to the family Fabaceae. It is perennial crop with hardy nature which can survive on less fertile sandy soils with limited moisture conditions prevalent in semi-arid regions. It is an important range legume for nutritional improvement of rangelands under semi-arid regions and also be used for cut-and-carry system; conserved as hay and dry leaf meal as protein bank. The dry matter production potential ranges from 2-3 t/ha/year with about 18-20% protein content and 80% digestibility.

Establishment of *Clitoria* is difficult because its fresh seed do not germinate immediately due to dormancy of seeds. Dormancy in the *Clitoria* is due to hard seed coat [1]. Emergence of the sown crop is delayed due to hard seed. Long gap between sowing and emergence of this crop gives the chance of emergence and establishment of other unwanted vegetation specially weeds, which suppress establishment of *Clitoria*. Little information is available on the effect of scarification treatments on mean germination time and other dormancy breaking treatments in range legumes.Therefore, present investigation was undertaken to evaluate the effect of seed scarification on mean germination time, germination index and other germination parameters in *Clitoria*.

For observing the effect of scarification treatments (control v/s scarification/s), two seed lots of *Clitoria* of different age; freshly harvested during November, 2014 and one year old seed (harvest of November, 2013) stored under ambient condition in cloth bag, were used in the present study. The germination test was conducted during January, 2015 in laboratory of Western Regional Research Station of Indian Grassland and Fodder Research Institute, Avikanagar. Non scarified seeds were used as control. Two types of seed scarifications *viz.*, with sand paper and nicking (making a small cut on seed side) were applied for removal of dormancy. Germination test of scarified and non scarified seed lots were conducted at 25°C and 30°C in the dark, between the papers (BP) as per ISTA rules [2]. Four replications of 100-seeds each were put for germination test. First observation was recorded after 24 hr and subsequent observations were recorded at 12 hr interval up to 120 hr and afterwards at 1 day interval up to 20 days at which germination was assumed to be complete. In this study germination is defined as the radical become visible, about 5 mm or more in length.

Germinated seeds were removed from the paper after counting. Mean germination time (MGT) represents the mean time a seed lot requires to initiate and end germination [3]. The lower MGT implies faster germination and higher vigour. The germination index (GI) is a measure of both percentage and speed of germination and assigns maximum arithmetic weights to seeds that germinate first and lowest to those germinate last [4]. A higher GI value denotes a higher percentage

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and rate of germination. The coefficient of velocity of germination (CVG) gives an indication of the rapidity of germination and increases when the number of germinated seeds increases and the time required for germination decreases [5]. CVG gives an indication of the rapidity of germination. It is reciprocal of the MGT. Germination rate index (GRI) basically gives an indication of the percentage of seeds germinating per day of the test run period [6]. Peak value (PV) is the maximum quotient derived by dividing daily the accumulated number of germinant by the corresponding number of days [7]. First day of germination (FDG), the day on which the first germination event occurs and Last day of germination (LDG), the day on which the last germination event occurs. Time spread of germination (TSG) is the time elapsed between the FDG and LDG. The data was analysed using Factorial CRD design following Gomez and Gomez [8].

Analysis of variance indicated that effect of scarification, seed age and scarification x age were significant while effect of temperature and other effects were non-significant (Table 1 & 2).

Table 1. Effect of scarification and seed age on germination % in *Clitoria*

Seed Age (SA)	Germination (%) in Different Scarification (S)			
	Control	Sand paper scari-fication	Nicking	Mean
Fresh seed	6.8 (15.0)*	94.6 (76.6)	95.8 (78.2)	65.7 (56.6)
1 Yr old seed	25.3 (50.2)	93.9 (76.1)	94.5 (76.5)	71.2 (60.9)
Mean	16.0 (22.6)	94.3 (76.4)	95.1 (77.3)	68.5 (58.8)

SEm(±) : S-0.5 (0.6); SA-0.4 (0.5); S x SA-0.7 (0.8)
CD (p=0.05): S-1.4* (1.6); SA-1.2* (1.3); S x SA-2.0* (2.3)

*Values in parentheses are arcsine transformed values.

Final germination was significantly higher in the sand paper scarification (94.3%) and nicking (95.1%) over control (16%). In the present study there was no significant difference for germination

Table 2. Effect of scarification and temperature on final germination % in *Clitoria*

Seed Age (SA)	Germination (%) in Different Scarification (S)			
	Control	Sand paper scari-fication	Nicking	Mean
25°C	15.1 (21.9)*	94.0 (76.2)	95.3 (77.4)	68.1 (58.5)
30°C	16.9 (23.2)	94.5 (76.5)	95.0 (77.2)	68.8 (59.0)
Mean	16.0 (22.6)	94.3 (76.4)	95.1 (77.3)	68.5 (58.8)

SEm(±) : S-0.5 (0.6); T-0.4 (0.5); S x T-0.7 (0.8);
CD (p=0.05): S-1.4* (1.6); T-NS ; S x T- NS

*Values in parentheses are arcsine transformed values.

at 25 and 30°C temperature (Table 2). Therefore, MGT and other parameters of germination were observed only at 25°C (Table 3).

Makasana *et al.* [9] also recorded no significant differences for germination in 11 *Clitoria* accessions at 25°C or 30°C. In the present study, higher germination was observed, at early stage of germination, in nicking over sand paper scarification in both the seed lots. Therefore, data of both scarification treatments are presented (Table 3). Scarification of the fresh seed with sand paper and nicking, for removing hardseededness, were very effective and by which 94.3 and 95.5% germination was achieved respectively in 8 and 3.5 days compared to 6.3% in non scarified seed even at 18 days. In earlier studies effect of nicking and sand paper scarification were observed in the fresh seed of *Clitoria ternatea* which significantly increased normal seedling percentage up to 90% and 70.5% as compared to 6.5% in non scarified seed at 25°C after 10 days [10]. Makasana *et al.* [9] observed that germination percentage in *Clitoria* was significantly increased over control with concentrated sulfuric acid treatment for 10-15 min at 25°C or 30°C. Villalobos and Machado [11] observed that scarification with sand paper yielded the highest values of per cent emergence (94% & 88%) in blue and white *Clitoria* genotypes in 4 &

Table 3. Effect of scarification on various germination parameters in *Clitoria*

Time periods of observations and Germination parameters	Non scarified seed		Scarified seed			
			Fresh seed		One year old seed	
	Fresh seed	One year old seed	Sand paper scarification	Nicking	Sand paper scarification	Nicking
24 hours	0.0	0.0	0.0	1.8	4.0	5.5
36 hours	0.0	1.3	21.8	67.5	56.5	69.3
48 hours	0.3	2.8	65.8	86.3	70.0	87.0
60 hours	0.3	5.0	80.5	93.8	76.5	92.8
72 hours	0.5	7.8	88.3	95.3	79.3	93.8
84 hours	0.8	10.0	90.5	95.5	83.5	95.0
96 hours	1.3	12.3	91.0	-	86.0	-
108 hours	1.8	14.0	91.5	-	88.3	-
120 hours	2.5	15.8	92.8	-	90.3	-
6 day	3.3	17.5	93.3	-	92.3	-
7 day	3.8	19.0	93.8	-	93.8	-
8 day	4.3	19.8	94.3	-	-	-
9 day	4.8	20.8	-	-	-	-
10 day	5.0	21.5	-	-	-	-
11 day	5.3	22.3	-	-	-	-
12 day	5.5	22.8	-	-	-	-
13 day	5.5	23.3	-	-	-	-
14 day	5.8	23.8	-	-	-	-
15 day	5.8	24.0	-	-	-	-
16 day	6.0	-	-	-	-	-
17 day	6.0	-	-	-	-	-
18 day	6.3	-	-	-	-	-
19 day	-	-	-	-	-	-
20 day	-	-	-	-	-	-
Final germination %	6.3	24	94.3	95.5	93.8	95
MGT (hours)	180.0	127.3	53.4	40.7	40.0	32.5
Germination index	84.4	376.8	1769.6	1843.6	1767.0	1836.6
CVG	0.6	0.8	1.9	2.5	2.5	3.1
GRI (%/day)	1.1	6.3	46.3	58.5	52.6	59.9
FDG (days)	2.0	1.5	1.5	1.0	1.0	1.0
LDG (days)	18.0	15.0	8.0	3.5	7.0	3.5
TSG (days)	17.0	14.5	7.5	3.5	7.0	3.5
PV	0.5	3.2	32.9	45.0	37.7	46.2
No. of days for attaining PV	6 .0	5.0	2.0	1.5	1.5	1.5

Dash (-) indicates that no increment was recorded over the previous observation.

12 days, respectively. The emergence rate was 4.4 and 7.5 days for blue and white genotypes, respectively. Physical and chemical scarifications applied on the hard seed causes degradation of the seed coat thus allowing water permeability that resulted faster germination in *C. ternatea* and five wild *Vigna* species [12-13].

Observations given in the Table 3 showed that one single parameter itself is not sufficient to fully describe germination [14]. The final germination percentage (FGP) is end parameter which only reflects the capacity of a seed lot to reach germination. FGP does not reflect speed, synchrony or spread of germination which are the vital factors from agronomic stand points. The time spread of germination was more in non scarified seed lot (17 and 14.5 days) than in the scarified seed with the sand paper (7.5 & 7.0 days) and with nicking (3.5 days) in the fresh and one year old seed lot, respectively. The lower MGT indicates faster germination by scarified seed (53.4 & 40.7 hours and 40 & 32.5 hours) while it was 180-127.3 hours in the non-scarified seed in the fresh and one year old seed, respectively. MGT does not show any linkage between germination percentage and speed hence, fails to define the TSG and LDG. Higher GI was observed in scarified seed (1769.6 & 1843.6 and 1767 & 1836.6) which denotes higher percentage and rate of germination as compared in non-scarified seed (84.4 and 376.8) in the fresh and one year old seed, respectively.

The coefficient of velocity of germination is reciprocal of the MGT. CVG was 0.6 and 0.8 in the non-scarified seed and 1.9 & 2.5 and 2.5 & 3.1 in the scarified seed with sand paper and nicking in the fresh and one year old seed, respectively. Nagar and Meena [15] also observed 0.3 & 0.9 CVG in the non-scarified seed and 1.6 & 2.0 in the sand paper scarified seed in the fresh and one year old seed of Hairy Indigo, respectively [15]. Germination rate index (GRI) basically gives an indication of the percentage of seeds germinating per day of the test run period which was very high (46.3 & 58.5 and 52.6 & 59.9 %/day) in seed scarified with sand paper and nicking while it was very low (1.1 and 6.3 %/day) in the non scarified seed in the fresh and one year old seed, respectively. Earlier studies also observed very high GRI (39.0 and 47.8 %/day) in scarified seed while it was very low (0.2 and 0.7 %/day) in the non scarified seed in the fresh and one year old seed of Hairy Indigo, respectively [15]. It may over estimates the FGP in some situations. Peak value is a most vigorous component of a seed lot which was 32.9 & 45 and 37.7 & 46.2 in the seed scarified with sand paper and nicking as compared to 0.5 and 3.2 in the non scarified seed in the fresh and one year old seed of *Clitoria*. On the other hand number of days required in attaining PV was also low (2-1.5 days) as compared in non-scarified seed (6-5 days).

Scarification of seeds with sand paper and nicking were equally effective in overcoming dormancy in *Clitoria*. It also increased the FGP and lower TSG in fresh as well as one year old seed over the non-scarified seed. Thus, scarification was effective in reducing the MGT and increasing GI, CVG and GRI in *Clitoria* seeds.

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