

## Effect of Pre-sowing Seed Treatments on Dormancy of Sunn hemp (*Crotalaria juncea*)

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**ABSTRACT:** An experiment was conducted to find out the influence of presowing treatments on viability, germination and initial seedling vigour of freshly harvested sunn hemp (*Crotalaria juncea* L.) seeds. The seeds were subjected to pre-sowing treatments *viz.*; hot water soaking at 50°C, 60°C and 70°C for 8 hours, sand scarification for 5, 10 and 15 min, Acid scarification (H<sub>2</sub>SO<sub>4</sub> @100 ml/kg) for 5, 10, 15 and 20 min, soaking in 1% and 2% of CaOCl<sub>2</sub> and H<sub>2</sub>O<sub>2</sub> for 8 hrs and dry seed served as the control. Treated seeds were tested for seed quality under *in vitro* conditions. The results revealed that the seeds treated with hot water (70°C) for 8 hours had broken the seed coat dormancy without affecting the viability of seeds thus reduced the hard seed from 33 per cent to 2 per cent and also improved the germination (89%), shoot length (19.2 cm) and vigour index (3185).

**Keywords:** Dormancy, Germination, Pre-sowing seed treatments, Vigour index

Sunn hemp (*Crotalaria juncea* L.) is a potential green manure crop because the species has many important agronomic attributes [1]. These attributes include adaptation to tropical conditions [2], rapid growth [3], high biomass yield [4], adequate performance in calcareous soils with high pH, efficient nitrogen fixation [5], resistance to root-knot (*Meloidogyne* spp.) nematodes [6], and effectiveness in suppression of weeds. It is a potential tropical cover crop, reduces erosion, and improves soil fertility and tilth [7]. It can provide considerable amount of nitrogen for other crops [8] and in an average it fixes 75-80 kg nitrogen/ha./year resulting in reduced nitrogenous fertilizer uses. In nature hard seededness is one of the significant ecological benefits as it helps to overcome unfavorable conditions. Sometimes it is often disadvantageous, as it affects germination and prevents uniform plant establishment in the field [9]. Seed dormancy hampers viability testing and seed regeneration for germplasm managers. Wild *Crotalaria* species exhibited dormancy/hard

seededness ranging from 99-100% [10]. Physical dormancy is not a major problem in old seeds of domesticated sunn hemp. There is no work so far carried out to find out the dormancy mechanism of freshly harvested sunn hemp seeds. Against the stalemate a study was initiated to find out the influence of pre-sowing treatments on dormancy, germination and seedling vigour of fresh sunn hemp seeds.

### MATERIALS AND METHODS

An experiment was conducted at the Department of Seed Science and Technology, Agricultural Collage and Research Institute, Madurai, Tamil Nadu during 2013-14 to find out the influence of pre-sowing treatments on viability, germination and seedling vigour of fresh sunn hemp seeds. The matured pods of sunn hemp were collected from the mother crop nutrient management trial field at Seed Technological Research Farm during the month of October, 2013 and threshed and seeds were dried to 10% moisture content. The seeds

Received : March 2017

Revised : June 2017

Accepted : July 2017

were subjected to hot water soaking at 50°C, 60°C and 70°C for 8 hours (the said temperature was maintained at the initial stage of the soaking), sand scarification for 5, 10 and 15 min, acid scarification ( $H_2SO_4$  @100 ml/kg) for 5, 10, 15 and 20 min, soaking in 1% and 2% of  $CaOCl_2$  and  $H_2O_2$  for 8 hours and dry seed served as the control. The seeds were soaked in water (1:2) for 12 hours to evaluate the hard seed percentage along with control and tested the viability of control and treated seeds by using the standard tetrazolium test [11]. Thus, there were 15 seed treatments;  $T_1$  - Control,  $T_2$  Hot water soaking at 50°C for 8 hrs,  $T_3$  - Hot water soaking at 60°C for 8 hrs,  $T_4$  - Hot water soaking at 70°C for 8 hrs,  $T_5$  - Sand scarification for 5 min.,  $T_6$  - Sand scarification for 10 min.,  $T_7$  - Sand scarification for 15 min.,  $T_8$  - Acid scarification ( $H_2SO_4$ @ 100 ml/kg) for 5 min.,  $T_9$  - Acid scarification ( $H_2SO_4$  @100 ml/kg) for 10 min.,  $T_{10}$  - Acid scarification ( $H_2SO_4$  @100 ml/kg) for 15min.,  $T_{11}$  - Acid scarification ( $H_2SO_4$  @100 ml/kg) for 20min.,  $T_{12}$  - Soaking in 1%  $CaOCl_2$  for 8 hrs,  $T_{13}$  - Soaking in 2%  $CaOCl_2$  for 8 hrs,  $T_{14}$  - Soaking in 1%  $H_2O_2$  for 8 hrs, and  $T_{15}$  - Soaking in 2%  $H_2O_2$  for 8 hrs, in total. The pre conditioned and control seeds were then placed for germination in roll towel paper method. The experiment was conducted in a completely randomized block design with eight replications. Seed germination was expressed as the percentage of seeds producing normal seedlings. Ten days after sowing ten seedlings from each replication were randomly selected and the root and shoot lengths were measured and the mean was recorded [12]. Ten seedlings were randomly selected and dried in a hot air oven at 85°C for 24 hours, and the dry weight was measured and expressed as mg/10 seedling. The vigour index was calculated following the formula [13]. The data was analyzed for variance and tested (t-test) for significant difference, and arc sine transformation made wherever needed [14].

## RESULTS AND DISCUSSION

Pre sowing seed treatments in sunn hemp revealed significant improvement in germination and seedling vigour. Hot water soaking of seeds at 70°C recorded minimum hard seeds (2%), and was significantly superior to all other treatments which

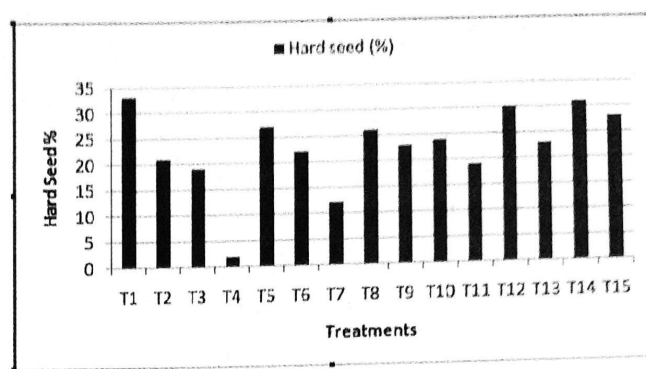


Fig. 1. Effect of pre-sowing seed treatments on hard seed of sunn hemp

were followed by sand scarification for 15 minutes (12%). Control had higher (33%) hard seeds (Fig. 1). Seeds treated with 1 and 2 per cent concentration of calcium oxychloride and hydrogen peroxide did not have any positive influence in breaking hard seededness. The percentage of hard seeds declined sharply from 33 per cent in control to 2 per cent when the seeds were soaked in hot water at 70°C. Tetrazolium test also revealed that the viability of the species is more than 98 per cent irrespective of the seed treatments. This proved that they were dormant. There was no viability loss due to pre-sowing treatments with hot water, acid and sand scarification was noticed (Table 1).

Data on the germination test revealed that seeds soaked in hot water at 70°C recorded germination of 89 % and found to be significantly superior over other treatments. This was followed by sand scarification for 10 minutes (82%). The lowest germination was recorded in control (47%). Regarding root length, seed soaking in  $H_2O_2$  for 8 hours recorded longest root length (17.7cm) followed by hot water treatment at 70°C (16.8 cm). Seeds soaked in hot water 70°C recorded the longest shoot length (19.2 cm) followed by hot water soaking at 60°C (17.5cm) and control recorded the shortest root length of 12.3 cm. The pre sowing seed treatments significantly influenced the dry matter production of the seedlings. Acid scarification ( $H_2SO_4$  @100 ml/kg) for 20 minutes registered the highest dry matter production (DMP) of 83 mg/10 seedlings and the lowest DMP was recorded in control (22 mg/10 seedlings). The seedling vigour index was also found to be maximum when the seeds were soaked in hot water

**Table 1. Influence of pre-sowing treatments on hard seed and viability in sunn hemp**

Treatments	Hard seed (%)	Viability (%)
T <sub>1</sub> - Control	33 (35.06)*	98 (82.01)
T <sub>2</sub> - Hot water soaking at 50°C for 8 hrs	21 (27.28)	98.6 (83.13)
T <sub>3</sub> - Hot water soaking at 60°C for 8 hrs	19 (25.84)	98.5 (83.13)
T <sub>4</sub> - Hot water soaking at 70°C for 8 hrs	2 (8.13)	99.5 (93.87)
T <sub>5</sub> - Sand scarification for 5 min.	27 (31.31)	98.7 (83.39)
T <sub>6</sub> - Sand scarification for 10 min.	22 (27.98)	98.3 (87.06)
T <sub>7</sub> - Sand scarification for 15 min.	12 (20.27)	98.5 (83.06)
T <sub>8</sub> - Acid scarification( H <sub>2</sub> SO <sub>4</sub> @ 100 ml/kg) for 5 min.	26 (30.66)	98.5 (82.97)
T <sub>9</sub> - Acid scarification (H <sub>2</sub> SO <sub>4</sub> @100 ml/kg) for 10 min.	23 (28.66)	97.2 (85.42)
T <sub>10</sub> - Acid scarification (H <sub>2</sub> SO <sub>4</sub> @100 ml/kg) for 15 min.	24 (29.33)	98.2 (82.47)
T <sub>11</sub> - Acid scarification (H <sub>2</sub> SO <sub>4</sub> @100 ml/kg) for 20 min.	19 (19.18)	98.3 (86.83)
T <sub>12</sub> - Soaking in 1% CaOCl <sub>2</sub> for 8 hrs	30 (33.21)	98.8 (83.76)
T <sub>13</sub> - Soaking in 2% CaOCl <sub>2</sub> for 8 hrs	23 (28.66)	97.8 (81.60)
T <sub>14</sub> - Soaking in 1% H <sub>2</sub> O <sub>2</sub> for 8 hrs	31 (33.83)	98.3 (82.81)
T <sub>15</sub> - Soaking in 2% H <sub>2</sub> O <sub>2</sub> for 8 hrs	28 (31.95)	98.8 (83.56)
Mean	22.6	98.4
SEd	0.40	5.80
CD (p = 0.05)	0.82	NS

\*Figures in parentheses are arcsine transformation values

at 70°C (3185) followed by seed scarification with sand (2477) for 15 min. (Table 2). The results of this present investigation clearly indicate that fresh sunn hemp seeds' shell are softened with hot water (or) acid scarification (or) sand scarification to promote germination. It can be inferred that dormancy is imposed only by the testa and is not due to physiological factor. This mechanism of dormancy has been reported in many other crops [15-19]. Scarification of seed coats destroys the tough layers of cuticle, suberin, thickened palisade cells and osteosclereids and thereby enhancing permeability of the seed coat to water and other essential gasses.

The positive responses of seeds to the pre-sowing scarification treatments may be due to the factor that the hard testa is responsible for the low percentage germination of untreated seeds (control) by preventing imbibitions of water and air. Prevention of germination by hard testa of sunn hemp fresh seeds has different ecological

advantages. This feature favors the accumulation of persistent seed banks in the soil, temporal spreads germination, suffers the extremely environmental condition and increases the chance that some seeds will germinate, survive and establish in natural ecosystem. Seed dormancy is most common in wild flora mainly for ecological adaptation under unfavorable environmental conditions [20].

From this study it was observed that the fresh seed of sunn hemp soaked in hot water at 70°C for 8 hours secured the higher germination of 89% and shoot length (19.2 cm) and vigour index (3185) this was possible by softening seed coat thus facilitate the imbibition and necessary gases diffusion. The hard seeds of untreated control were 33% as against 2% in 70°C hot water treatment. Hence, it is concluded that the germination of sunn hemp could be accelerated by treating seeds with 70°C hot water for 8 hours by drastically reducing the number of hard seeds.

Table 2. Effect of pre-sowing seed treatments on germination and seedling growth attributes in sunn hemp

Treatments	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production (mg seedlings <sup>-10</sup> )	Vigour index I
T <sub>1</sub> - Control	47 (42.99)*	12.7	12.3	22	1169
T <sub>2</sub> - Hot water soaking at 50°C for 8 hrs	67 (55.01)	13.4	16.8	41	2028
T <sub>3</sub> - Hot water soaking at 60°C for 8 hrs	69 (56.27)	14.0	17.5	53	2159
T <sub>4</sub> - Hot water soaking at 70°C for 8 hrs	89 (70.82)	16.8	19.2	61	3185
T <sub>5</sub> - Sand scarification for 5 min.	68 (55.62)	14.0	15.5	35	2006
T <sub>6</sub> - Sand scarification for 10 min.	82 (64.83)	11.6	15.9	61	2250
T <sub>7</sub> - Sand scarification for 15 min.	79 (62.47)	15.3	16.2	72	2477
T <sub>8</sub> - Acid scarification (H <sub>2</sub> SO <sub>4</sub> @100 ml/kg) for 5 min.	67 (54.67)	16.6	17.3	72	2259
T <sub>9</sub> - Acid scarification (H <sub>2</sub> SO <sub>4</sub> @100 ml/kg) for 10 min.	74 (59.13)	13.5	14.0	72	2028
T <sub>10</sub> - Acid scarification (H <sub>2</sub> SO <sub>4</sub> @100 ml/kg) for 15min.	70 (56.56)	13.4	17.2	62	2131
T <sub>11</sub> - Acid scarification (H <sub>2</sub> SO <sub>4</sub> @100 ml/kg) for 20 min.	76 (61.03)	12.8	16.0	83	2208
T <sub>12</sub> - Soaking in 1% CaOCl <sub>2</sub> for 8 hrs	68 (55.30)	14.6	16.3	51	2091
T <sub>13</sub> - Soaking in 2% CaOCl <sub>2</sub> for 8 hrs	61 (51.18)	14.7	15.9	78	1855
T <sub>14</sub> - Soaking in 1% H <sub>2</sub> O <sub>2</sub> for 8 hrs	67 (54.81)	17.7	17.3	63	2399
T <sub>15</sub> - Soaking in 2% H <sub>2</sub> O <sub>2</sub> for 8 hrs	67 (54.90)	14.6	14.4	71	1929
Mean	57	14.4	16.16	57.33	2145
SEd	2.50	0.14	0.15	0.54	119.87
CD (p = 0.05)	4.97	0.28	0.29	1.08	237.69

\*Figures in parentheses are arcsine transformation values

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