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Seed and Seed Germination in *Solanum nigrum* Linn.

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Abstract: The present paper deals with seed attributes, seed storage, dormancy, effect of temperature, pH and sowing depth on seed germination in *Solanum nigrum* have been described. Mature freshly collected air-dried seeds shows 52 % germination. Mechanical scarification with needle, sand paper and mortar-pestle methods shows 72, 78 and 33 % germination, respectively. The maximum percentage of seed germination shows at room temperature. Neutral pH shows high percentage of germination.

Key words: *Solanum nigrum* % Makoi % Seed germination % Chemical scarification % Mechanical scarification.

INTRODUCTION

Solanum nigrum (English name-Black Nightshade; Indian name-Makoi) is small annual herb with erect much branched stem. Leaves ovate-lanceolate, subacuminate, more or less pubscent. Fruits globose, usually purpulish-black, but some times reddish yellow containing yellowish discoid seeds. Fruits occurs in subumbellate drooping clusters of 3 to 10, each about a quarter of an inch in diameter. The plant is found throughout India and Ceylon. It is a cosmopolitan weed of all district from sea level to 7000 feet elevation. It is common in forest area, cultivated land, roadside and on open waste lands. The fruit is used as a cosmetic; rubbing the seeds on the cheeks to remove freckles. The fruit has been used for diabetes. Decoction of stalk, leaves, roots are good for wounds and cancerous sores [1-2].

Seed dormancy is a particular form of cessation of growth and is a crypto biotic state regards seed dormancy as an adaptive mechanism of growth cessation, which often confers a selective advantage in distribution and abundance [3].

Ecological studies of economical important species provided prerequisite information to bring them under cultivation. With this aim in mind studies were undertaken for seed attributes, seed germination and breaking dormancy.

MATERIALS AND METHODS

Mature fruits containing seeds were collected from Keshavshristi (Thane district). Seeds were separated from fruits and cleaned, air dried and stored in glass-stopped bottle under normal laboratory condition and used for various seed germination experiments.

The seed index was calculated on the basis of observation of hundred seeds each. The percentage sterility was determined by floration methods. The moisture percentage was calculated on the basis of oven dried weight at 110°C. Various scarification techniques such as mechanical and chemical scarification were used to evaluate the effect on seed germination.

Similarly, various temperature treatments were given at low temperature in refrigerator and higher temperature in incubator Germination tests were made in petriplates in between two sterile moist blotting sheets. Emergence of radical was taken as a criterion of seed germination. Mature air-dried seeds were periodically tested for germination. Sowing depth experiments was done in 30 x 30 cm size pots containing uniform volume of soil. Each set was represented by three pots. Various pH effects on seed germination was studied by irrigating germination seeds with solution adjusted at different pH levels.

OBSERVATION

Seed Attributes: Seeds of *S. nigrum* are small, slightly discoid, pale yellow to brown in colour and 1.24-1.34 mm and 1.0-1.1 mm in breadth. The average weight of 100 seeds was 28.0-30.0 mg. The percentage sterility of the seeds varies from 18-22 %, seed viability 95 %, moisture content in air dried seeds varies in the range of 8.0-10.0% and percentage germination was 52%.

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Table 1: Effect of mechanical scarification on seed germination of *Solanum nigrum*

Method		Germination (%)
Unscarified seeds		52±1.5
Sacrification with	Needle-pin	72±1.3
	Sand paper	78±0.9
	Mortar-pestle	33±1.0

Table 2: Effect of chemical scarification with dilute and conc. H_2SO_4 on seed germination of *Solanum nigrum.*

	Method	Germination (%)
Unscarified Seeds		53±1.8
Scarified with	0.15 min	23±1.2
a. Dilute H_2SO_4	0.30 min	34±1.8
	1.0 min	48±2.8
	2.0 min	32±1.6
b.Conc. H_2SO_4	0.15	34±1.2
	0.30	38±0.8
	1.0 min	20±2.6
	2.0 min	10±2.6

Seed Germination:

Mechanical Scarification: Three different methods for mechanical scarification such as needle-pin, sand paper and mortar-pestle were used. In needle pin method, the hilum region of seed was punctured with the help of pointed metal needle-pin and the seeds were placed for germination in petriplate. In second method, the matured seeds were rubbed in groups in between the sand papers to break the hard testa and seeds were kept for germination. In mortar-pestle method, the testa of seeds was gently broken and then kept for germination. 72% germination was observed when the seeds were scarified with needle-pin while with sand paper, 78% seed germination was observed followed by 33% germination with mortar-pestle scarification (Table 1). It was observed that sand paper scarification method was the best for breaking dormancy.

Chemical Scarification: The mature air-dried seeds were treated with dilute and concentrated sulphuric acid separately for 15 sec., 30 sec., 1.0 min. and 2.0 min., respectively. Scarification with diluted sulphuric acid gave 48% of germination at 1.0 min and then it decreased with increasing in time. Similarly, germination was the highest, 38% at 30 sec., with concentrated sulphuric acid and decreased later on (Table 2). It was observed that chemical scarification with both dilute and concentrated sulphuric acid showed adverse effect as compared to that of control (unscarified seeds).

pH: Low imbibition was observed in unscarified seeds as compared to sand paper scarified seeds at all pH treatments. But, in both seeds, there was no significant variation in imbibition percentage in acidic pH as well as alkaline pH range. The rate of germination of scarified and unscarified seeds also showed variation. The maximum percentage germination occurred in pertiplate irrigated with only distilled water (neutral pH). The percentage rate germination was low at acidic as well as alkaline pH in both the sets of scarified and unscarified seeds (Table 3). It was observed neutral pH plays in an important role in increasing germination of *S. nigrum*.

Imbibition: Both scarified and unscarified seeds showed an increase in rate of imbibition with increase in time interval. After soaking the scarified seeds for 5.5 hours, the maximum imbibition was observed and it remained constant afterwards. Similarly, the rate of imbibition of unscarified seeds was low and maximum imbibition was observed at 6.0 hours and then remained constant (Table 4).

Sowing Depth: The maximum percentage of seed germination was observed in all the three sets in sand paper scarified seeds as compared to unscarified seeds. In scarified seeds, the maximum percentage of seed germination was observed in the seeds, sown one cm

Table 3: Effect of pH on imbibition and seed germination of *Solanum nigrum*

		pH values							
Parameter	Seeds	4.1	5.1	6.1	6.5	D/W	8.1	9.2	10.3
% of imbibition (6 hrs)	Scarified	8.39	8.31	8.59	8.43	8.51	8.13	8.21	8.17
	Unscarified	6.83	6.31	6.91	6.83	6.91	6.78	6.78	6.61
% of germination	Scarified	71±1.2	73±0.8	75±1.4	78±1.2	82±1.6	76±3.2	73±0.6	63±1.2
	Unscarified	31±0.6	38±0.8	40±1.2	38±1.2	48±1.6	36±0.8	28±1.8	22±2.0

Table 4: Rate of imbibition on scarified and unscarified seeds of *S. nigrum*

	Percentage imbibition in gm	
Time (hrs)	Unscarified seeds	Scarified seeds
0.5	5.31	5.81
1.0	5.38	5.93
1.5	5.48	6.46
2.0	5.50	6.49
2.5	5.53	6.54
3.0	5.58	6.58
3.5	5.60	6.63
4.0	5.81	6.71
4.5	5.93	7.13
5.0	6.31	7.41
5.5	6.68	7.42
6.0	6.73	7.42
6.5	6.74	7.42
7.0	6.74	7.42

Table 5: Effect of sowing depth on seed germination of *Solanum nigrum*

	% Germination	
Sowing Depth	Scarified	Unscarified
Superficial	68±7	38±3
1 cm	78±8	52±4
2 cm	54±4	44±2

deep in the soil followed by seeds, sown superficially and 2.0 cm deep in the soil. Similar trends were observed in case of unscarified seeds with low values. Thus, a suitable depth of sowing of the seeds is 1.0 cm below the soil surface (Table 5).

Temperature Effect on Germination: Unscarified seeds showed lesser percentage of germination as compared to sand paper scarified seeds at all temperature treatments. The maximum percentage of germination was observed at 27°C followed by 32°C in scarified seeds in which the lowest percentage seed germination was observed at low temperature (3% after 5 days of incubation at 5°C) as well as at high temperature (2% after 5 days of incubation at 60°C). Variation was observed in the germination rate of scarified and unscarified seeds and the maximum percentage germination was noted on 4th day. The rate of percentage germination was low for first two days and on last day (Table 6). Therefore, the temperature (27°C) increased the germination of *S. nigrum* scarified seeds.

Storage: The highest percentage of seed germination was observed in the month of June followed by July, August, October and December in case of sand paper scarified seeds and June in case of unscarified seeds, while there was not much variation in other months. (Table 11 and Fig. 16) The scarified seeds showed

Table 6: Effect of temperature on seed germination of *Solanum nigrum*.

		% Germination / day				
Temp. (°C)	Seeds	1	2	3	4	5
5	Scarified	-	-	3±0.8	9±0.8	3±0.3
	Unscarified	-	-	1±0.9	3±0.2	2±0.2
10	Scarified	-	-	8±0.6	7±0.2	4±0.4
	Unscarified	-	-	2±0.4	2±0.6	1±0.6
27	Scarified	-	4±0.8	28±0.6	38±1.3	14±1.8
	Unscarified	-	1±0.3	8±1.2	6±0.3	4±0.8
32	Scarified	-	-	14±1.2	22±0.8	18±0.2
	Unscarified	-	-	8±0.3	4±0.3	3±0.4
40	Scarified	-	-	6±0.6	18±0.7	3±0.3
	Unscarified	-	-	5±0.2	3±0.3	1±0.7
50	Scarified	-	-	8±0.2	3±0.4	7±0.3
	Unscarified	-	-	3±0.1	4±0.8	2±0.2
60	Scarified	-	-	3±0.2	8±0.7	2±0.2
	Unscarified	-	-	1±0.3	3±0.3	2±0.4

Table 7: Effect of storage on seed germination of *Solanum nigrum*

	Germination (%)	
Months	Scarified seeds	Unscarified seeds
Oct.	68±1.2	43±0.8
Nov.	63±1.3	42±0.3
Dec	68±1.2	46±0.4
Jan.	62±0.8	43±0.3
Feb.	58±0.7	38±0.7
Mar.	53±0.3	37±1.3
Apr.	68±0.8	43±0.8
May	63±1.1	46±0.9
June	73±0.8	54±1.5
July	71±1.2	52±1.1
Aug.	69±0.3	50±0.7
Sept.	49±0.2	38±0.9

higher germination percentage as compared to that of unscarified seeds at every month. It was also observed that months in monsoon were the best time for germination of *S. nigrum* seeds.

DISCUSSION

Seed attributes are very much influenced not only by climatic and edaphic factors, but also with the density of plant and genetic variation within different populations of a species [4-5]. The mechanism of seed dormancy in *Solanum nigrum* is associated with its impermeable seed coat. As in other cases of such kind of dormancy, it is easily removed either by mechanical or chemical scarification of the seeds. The macroscleried layer of mature seed coat is mainly responsible for imparting impermeability to the seeds [6].

Sharma and Lavania [8] demonstrated that the percentage germination increased in Vicia hirsuta and *V. sativa* with sand paper scarification with 100 and 86.6% respectively [7]. Similarly, in present investigation, mechanical scarification by careful piercing, chipping or rubbing the seed coat with sand paper broke the dormancy of the seed. In *S. nigrum*, mechanical scarification showed best results for germination with sand paper followed by needle and least obtained in motor pestle.

In present investigation, the chemical scarification was carried out in concentrated as well as diluted sulphuric acid. In *Solanum nigrum*, treatment with concentrated sulphuric acid as well as diluted sulphuric acid reduced the germination percentage as compared to control, which could be due to adverse effect caused by the acid to the embryo.

Several workers have studied the importance of temperature in seed germination [8]. *Solanum nigrum* showed the maximum germination percentage at at 27°C on 3rd and 4th day of its germination cycle and below or above this temperature showed considerable reduction in germination percentage. In number of species having impermeable, seed coat, a variety of high temperature treatment have been employed successfully to overcome the dormancy [9-11]. The seed germination of sand paper scarified as well as unscarified *Solanum nigrum* seeds were maximum at pH 7.0 and further any change in pH on either side showed a reduction in germination. Similar observations were made in various studies [11-14].

The ideal soil depth at which maximum germination varies with the species as in *Erigeron linifolius* and *Euphorbia nivula* [12, 15]. Superficially sown seeds showed maximum germination *Ambrosa trifida* and *Cleome viscose*-2 cm depth was ideal [13-15]. *Solanum nigrum* also showed 1 cm depth was ideal for seed germination similar observation were made in *Scolochaba festucacea* [17].

The air-dried seeds of *Solanum nigrum* could be stored successfully under dry storage condition for one academic year without loss in viability. Several workers have reported that many types of seed dormancies are overcome by dry storage for varying period of time [18-19]. Laboratory germination tests of unscarified stored seed of *Solanum nigrum* at monthly interval showed that the percentage was increase in number, while scarified seeds there is slightly increase in percentage germination. In scarified and unscarified seeds maximum percentage of germination was observed in month of June-August, October and December. Laboratory germination test of scarified stored seeds of *Solanum nigrum* at monthly intervals showed that the germination improved during rainy season.

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