STUDIES IN THE EXTENT AND ROLE OF DORMANCY IN THE SEEDS OF *INDIGOFERA ASTRAGALINA* DC. PRODR.

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(Received for publication on August 22, 1969)

Introduction

Seed dormancy is a particular form of cessation of growth and is a cryptobiotic state. Amen (1966) regards seed dormancy as an adaptive mechanism of growth cessation which often confers upon some species a selective advantage in distribution and abundance.

In the arid regions, particularly where the soils are deficient in nitrogenous and other plant nutrients, the role of legumes has special significance. In spite of heavy seed production (2,500–3,500 seeds per plant) *I. astragalina* has a restricted distribution and a poor density. The cause may be expected in the germination behaviour of the seeds, consequently the present study was designed.

Materials and Methods

Indigofera astragalina DC. Prodr. is an erect herb about 80–120 cm high and densely covered with soft greyish or slightly brownish hairs. The plant bears 4-angled, densely pubescent, downwardly pointing and 3 to 6 seeded pods. Seeds are rectangular and grey-coloured. Average weight and volume per 100 seeds have been recorded to be 0·5181 gm and 0·35 ml respectively.

The seeds of *I. astragalina* collected from maize fields near Umra—Udaipur (24° 35′ N. latitude and 85° 49′ E. longitude) on 13–11–1967 and dry stored in stoppered glass bottles in dark were used for germination studies.

Germination experiments were made in petri dishes (10 cm in diameter) on a single layer of ordinary blotting-paper. Light source consisted of a 25-watt tungston Phillip incandescent bulb fitted at a distance of about 30 cm from the petri dish and emitting an energy of 2,675 ergs/sec. Separation of spectral regions was achieved by filtration of white light (source given above) through cellophene papers.

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Results of germination experiments expressed in percentage (± standard deviation) are means of 4 replicates (25 seeds each). Observations were recorded at an interval of 24 hours.

OBSERVATIONS

Effect of dry storage on imbibition and germination.—Freshly harvested seeds did not indicate germination in any condition, *viz.*, continuous light, continuous dark or diffuse light. Imbibition to the extent of 4% and 2% was observed under continuous light or diffuse light conditions respectively. In continuous dark imbibition initiated only after a dry storage period of 12 weeks. Initiation of germination in continuous light was observed after a dry storage period of 4 weeks and in continuous dark or diffuse light after that of 18 weeks. The maximum percentage germination was observed in continuous light with the seeds dry-stored for 53 weeks. The results are presented in Table I.

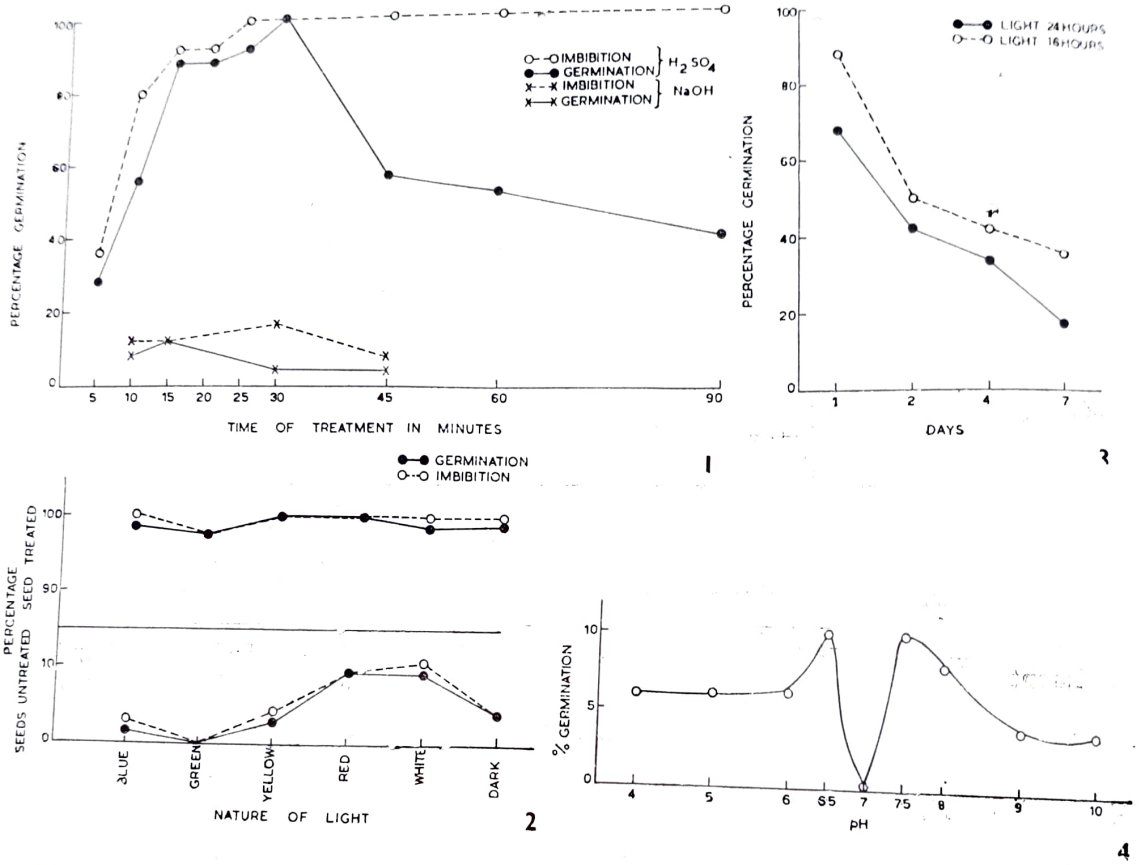
TABLE I

Percentage imbibition and germination of I. astragalina *seeds after different dry storage period*

Date of start of experiment	Storage period in weeks	Light conditions					
		Continuous light		Continuous dark		Diffuse light	
		Imbibition	Germination	Imbibition	Germination	Imbibition	Germination
13-11-1967	Nil	4±0*	0	0	0	2±1·4	0
12-12-1967	4	4±0	2±1·4	0	0	4±0	0
9—1-1968	8	4±0	2±1·4	0	0	4±0	0
6 -2-1968	12	4±0	4±0	2±1·4	0	4±0	0
19—3-1968	18	8±0	4±0	6±2	4±0	4 0	4±0
23—4-1968	24	6±2	4±0	6±2	4±0	4±0	4±0
21—5-1968	28	8±0	4±0	6±2	4±0	4±0	4±0
18—6-1968	32	8±0	4±0	6±2	4±0	4±0	4±0
16—7-1968	36	8±0	8±0	4±0	4±0	4±0	4±0
13—8-1968	40	10±2	10±2	4±0	4±0	6±2	4±0
13-11-1968	53	10±2	10±2	8±0	6±2	8±0	6±2

* Standard deviation. Temperature during experiment 30° C ± 2

Effect of dormancy breaking pretreatments.—Very poor percentage of imbibition speaks of dormancy due to impervious nature of seed coat. As such acid and alkali pretreatments were tried to improve the permeability. Seeds were pretreated with sulphuric acid (96% W/W) and sodium hydroxide (1ON) for different durations at a temperature of 30±2° C. The data as presented in Fig. 1 indicate that 100% germination is obtained with sulphuric acid pretreatment for 30 minutes. The further increase in duration of this treatment causes embryo injury and consequent low germination values.



FIGS. 1–4. Fig. 1. Effect of chemical scarification on imbibition and germination of *I. astragalina* seeds. Fig. 2. Effect of different light spectra on the imbibition and germination of normal and sulphuric acid treated seeds of *I. astragalina*. Fig. 3. Effect of low temperature (0° C) treatment on germination of chemically scarified seeds of *I. astragalina*. Fig. 4. Germination of *I. astragalina* seeds in relation to pH.

Pretreatment with sodium hydroxide though improved the imbibition as well as germination did not prove much effective.

Effect of photoperiod on imbibition and germination.—Seeds pretreated with sulphuric acid for 30 minutes were kept for germination under different duration of light, *viz.*, 0, 8, 12, 16 and 24 hours to find out its effect on imbibition and germination. The results are presented in Table II. Though the maximum imbibition as well as germination are obtained in continuous light, the difference with those of other photoperiodic duration is not statistically significant. However, in terms of germination energy index (Grose, 1963), a photoperiod of 16 hours is most favourable.

TABLE II

Effect of duration of light on Seeds of I. astragalina *pretreated with Sulphuric acid for 20 minutes*

Duration of light in hours per day	Percentage imbibition	Percentage germination	Germination energy index
0	97·3±1·89*	97·3±1·89	0·972
8	96 ±3·26	96 ±3·26	0·957
12	92 ±3·23	92 ±3·26	0·967
16	98·6±1·89	98·6±1·89	0·981
24	100	98·6±1·89	0·966

* Standard deviation. Temperature during experiment 30° C ± 2.

Effect of light spectrum on imbibition and germination.—Seeds used in this experiment were those aged for 37 weeks. Data set in Fig. 2 indicate that maximum imbibition is obtained in white light while the maximum germination is in white and red light. Yellow, blue and green spectra have inhibitory effects.

The same experiment was repeated with the seeds made permeable by sulphuric acid treatment. The data (Fig. 2) reveal that in such seeds red and yellow light cause maximum germination while behaviour of blue is similar to that of white light.

Effect of temperature.—Seeds aged for 37 weeks were subjected to different temperatures, *viz.*, 20, 25, 30, 35 and 40° C as well as different photoperiods (0, 8, 16 and 24 hours). The results obtained are presented in Table III. Maximum imbibition (42 ± 6) is obtained at 40° C and with continuous light while maximum germination (10 ± 2) is obtained at 30° C and in continuous light. Beyond a temperature of 30° C germination decreases due to embryo injury.

Seeds made permeable with sulphuric acid were subjected to low temperature (0° C) for 1, 2, 4 and 7 days. After the required treatment the seeds were kept for germination in continuous light as well as alternating light and dark period of 16 and 8 hours respectively. The observations compiled in Fig. 3 suggest that with an increase in duration of low temperature treatment the percentage germination decreases and it becomes only 18% after 7 days' treatment. However, after this treatment if seeds are provided alternating light and dark period the inhibition is comparatively less.

TABLE III

Effect of temperature and duration of illumination on imbibition and germination of the seeds of I. astragalina

Temperature ..	20°				25°				30°			
Duration of light in hours	0	8	16	24	0	8	16	24	0	8	16	24
% imbibition ..	4±0*	2±2	0	0	2±0	2±2	2±2	4±0	4±0	6±2	10±2	8±0
% germination	4±0	2±2	0	0	2±2	2±2	2±2	4±0	4±0	4±0	10±2	8±0

Temperature ..	35°				40°			
Duration of light in hours	0	8	16	24	0	8	16	24
% imbibition ..	8±0	8±0	10±2	12±0	16±0	18±2	30±6	42±6
% germination	4±0	4±0	8±2	8±0	0	0	0	0

* Standard deviation.

Effect of pH of the germination medium.—Data presented in Fig. 4 reveal that the seeds of *I. astragalina* have the capacity to germinate in a pH range of 4 to 10, however, the peak value of 10% is obtained at pH value 6·5 or 7·5. Neutral medium completely inhibits germination.

DISCUSSION

Very poor imbibition and high correlative percentage germination (75 to 100) suggests the presence of dormancy block in *Indigofera astragalina* due to seed coat. Sulphuric acid pretreatment for 30 minutes has been found to be most effective in removing this block.

Freshly harvested seeds are light sensitive but they lose this characteristic after 18 weeks of dry storage.

Sulphuric acid pretreatment has been found to cause photoperiodic and spectral insensitivity in *I. astragalina* seeds (Table II, Fig. 2).

Permeable seeds when subjected to a temperature of 0° C show inhibition of germination. This suggests that it induces secondary dormancy. However, this adverse effect is neutralized to some extent if seeds are subjected to alternate 16 hours light and 8 hours dark period during germination (Fig. 3).

Interaction of temperature and photoperiod suggests that an increase in temperature particularly from sub-optimal to optimal has a tendency to compensate for light.

As an adaptation to the extreme environment as existing in the arid and semi-arid zones of Rajasthan, seeds of *I. astragalina* have developed seed coat dormancy—impermeable seed coat. In terms of Went (1957) this hard seed coat acts as a kind of rain-gauze which determines when germination should occur.

Germination of *I. astragalina* has been observed to be better in slightly acidic or alkaline medium and it decreases with increase of acidity or alkalinity (Fig. 4). Complete inhibition of germination of these seeds in a neutral medium is surprising, however, similar observations have also been made by Schalin (1967) in *Alnus* species.

SUMMARY

The present paper deals with the germination behaviour of the seeds of *Indigofera astragalina* DC. Prodr. in which seed coat impermeability has been observed. Sulphuric acid pretreatment for 30 minutes has been found to be most effective in removing dormancy. Freshly harvested seeds are light-sensitive but this characteristic is lost on account of dry storage. Sulphuric acid treatment has been found to cause photoperiodic and spectral insensitivity. Role of dormancy in these seeds have been discussed.

We thank Professor H. D. Kumar for facilities and Shri R. L. Sharma for statistical help. One of us (S. K. A.) is thankful to Council of Scientific and Industrial Research for financial assistance in the form of a Fellowship.

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