ECOLOGICAL STUDIES IN *PSORALEA CORYLIFOLIA* LINN. I—PODS, SEEDS AND SEED GERMINATION

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Abstract

Seed/pod attributes, storage and the factors affecting seed germination both in laboratory and the natural conditions have been described in a medicinally important herb, *Psoralea corylifolia.*

Introduction

The present paper deals with pods, seeds and seed germination in *Psoralea corylifolia*, a medicinal herb of established theraptic value (Jois, Manjunath & Venkata-Rao, 1933; Seshadri & Venkata-Rao, 1937; Chakravarti, Bose & Siddiqui, 1948; Chopra, Chopra, Handa & Kapur, 1958) on which literature on ecology is wanting.

P. corylifolia, a member of grassland ecosystem also occurs as a weed of waste lands and post harvest agricultural lands. In nature, the seeds germinate in August-September, flowering commences in October-November, peak flowering and fruiting is seen in December. The species is distributed in Arabia, Pakistan, Bangladesh, India, Ceylon, Burma, China, Somalia and Socotra. It is widely distributed in plains of India from Uttar Pradesh to Tamil Nadu both in high as well as extremely low rainfall areas.

Material and methods

Initially, the seeds of *P. corylifolia* were collected randomly and separately from uniform populations of Karad, Patan and Surat, air-dried for 15-20 days in laboratory conditions and stored in dry glass stoppered bottles. Seed attributes of each locality were studied separately. The seed index values given are based on random observations of 100 seeds per locality. Air-dry weight and oven-dry weight per 100 seeds is an average of 10 to 15 lots, each of 100 seeds. Volume per 100 pods/seeds is an average of 10 replicates and was measured by water displacement method.

Air-dried pods and seeds have been used for all germination tests unless otherwise mentioned and the percentage germination is expressed on the basis of number of seedlings emerged out of total number of seeds tried for germination. Experiments were done in petriplates (7, 9, 10 cm in diameter) on a single or in between two sterilized moist blotting papers.

For chemical scarification concentrated H_2SO_4 and 10 N NaOH were used. After scarification, seeds were washed under running tap water. Mechanical scarification was done by breaking seed-coat with needle or by rubbing seeds in between sand papers. The air dry seeds stored in dry stoppered glass bottles under laboratory conditions were

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regularly subjected for monthly germination tests and percentage germination in 20 days per month was recorded throughout the investigation period which lasted for 2 1/2 years. Wet storage was done by keeping seeds with moist cotton in conical flask.

Refrigerator, freeze, deepfreeze, incubators, air conditioned chamber and oven were used to obtain requisite temperature conditions, whenever temperature treatments were given. In all these instruments the temperature fluctuation was $\pm 2°c$ than adjusted one except in air conditioned chamber where fluctuation was $\pm 3°c$.

During light treatments the light source was a 40 watt tungston Philip or Bajaj incandescent bulb emitting an energy of 4280 ergs/sec fitted at a distance of 30 cms from the petriplates. Dark conditions were obtained by wrapping petriplates with double layer of black papers. Red, far-red and safe light (green light) conditions were obtained by the procedure given by Witham, Blaydes and Devlin (1971) and seed germination was counted under safe light.

For pot culture, earthen pots (20 cms inner diameter and 25 cms height) were used as containers. Watering was done with sprinkler and the same amount of water was supplied to all the sets of the same experiment. Whenever water-logged condition was needed, the holes of the pot were sealed and care was taken that the soil remains in supersaturated state throughout the experimental period. Field capacity was maintained by keeping pots in trays containing water. Soils of different composition were obtained by mixing garden soil (GS), farm yard manure (FYM) and sand (S) in various proportions.

For each treatment, three replicates of 50 seeds each were used and mean values of germination and/or imbibition with standard deviation (S. D.) have been presented in tables.

Results

(i) *Pods and seeds*

The numerical attributes of pods and seeds in natural populations as well in plants under cultivation are represented in Table 1 and Fig. 1, a-m.

The natural populations did not exhibit much variation in seed/pod qualities though percentage germinable seeds was much less in white flowered form than in blue flowered one. Marked improvement in seed/pod qualities was seen in plants under cultivation.

(ii) *Dormancy and seed germination*

(1) *Germination in relation to ripening stages of pods (Table 2, Fig. 2, a-d)*

The germination percentage showed increasing trend during initial stages of ripening until pods blackened; thereafter there was a reduction. The air dried pods failed to germinate. During successive periods of ripening, various pod attributes like pod weight, pod index and moisture content also showed decreasing trend. The ripening pods underwent sharp decrease in moisture content and dry weight between stages II and III. Apparently, the dormancy block was introduced between stages III and IV when there was further loss of moisture.

Table 1—*Psoralea corylifolia* : **Pod and seed attributes in natural populations and under cultivation**

Locality	PATAN		KARAD		SURAT	BOMBAY Potculture Cultivated
Pod/seed attribute	White	Blue	White	Blue	Blue	Blue
1. Length of the pod mm		4.187	3.874	3.775	3.888	4.204
2. Breadth of the pod mm		2.794	2.782	2.634	2.7	2.879
3. Pod index		11.697	10.776	9.944	10.497	12.103
4. Length of the seed mm		3.798	3.542	3.452	3.629	3.794
5. Breadth of the seed mm		2.451	2.449	2.319	2.362	2.478
6. Seed index		9.309	8.673	8.004	8.572	9.402
7. Air dry weight/100 pods gm	1.3407	1.3205	1.3513	1.2257	1.2300	1.7122
8. Oven dry weight/100 pods gm	1.2075	1.1725	1.2235	1.1495	1.1035	1.5200
9. % of moisture/100 gms of pods	9.9	12.6	9.5	6.2	10.3	11.2
10. Air dry weight/100 seeds gm	0.9961	0.9927	1.0255	0.9144	0.9133	1.2394
11. Oven dry weight/100 seeds gm	0.8970	0.8810	00.9285	0.8575	0.8193	1.1002
12. % of moisture/100 gms of seeds	9.9	11.3	9.5	6.2	10.3	11.3
13. Contribution of pericarp (%)	25.703	24.824	24.110	25.398	25.735	27.614
14. Volume/100 pods ml	1.075	1.075	1.050	0.950	0.925	1.385
15. Volume/100 seeds ml	0.7888	0.7777	0.7888	0.7111	0.7000	0.9625
16. % of bad seeds	39.9	13.1	14.1	7.5	2.00	4.30
17. % germination	55.5	91.0	79.5	96.00	99.5	100
18. Seed out put	+	2323	1469	2324	582	8665
19. Reproductive capacity	—	2114	1168	2231	579	8665

(2) *Pod storage and seed germination*

Monthly record of percentage seed germination of air dried stored pods for two years period tabulated in Table 3 Shows that the storage period did not improve the germination performance. However, T. T. C. test for seeds stored even for two years showed them to be 96 per cent viable,

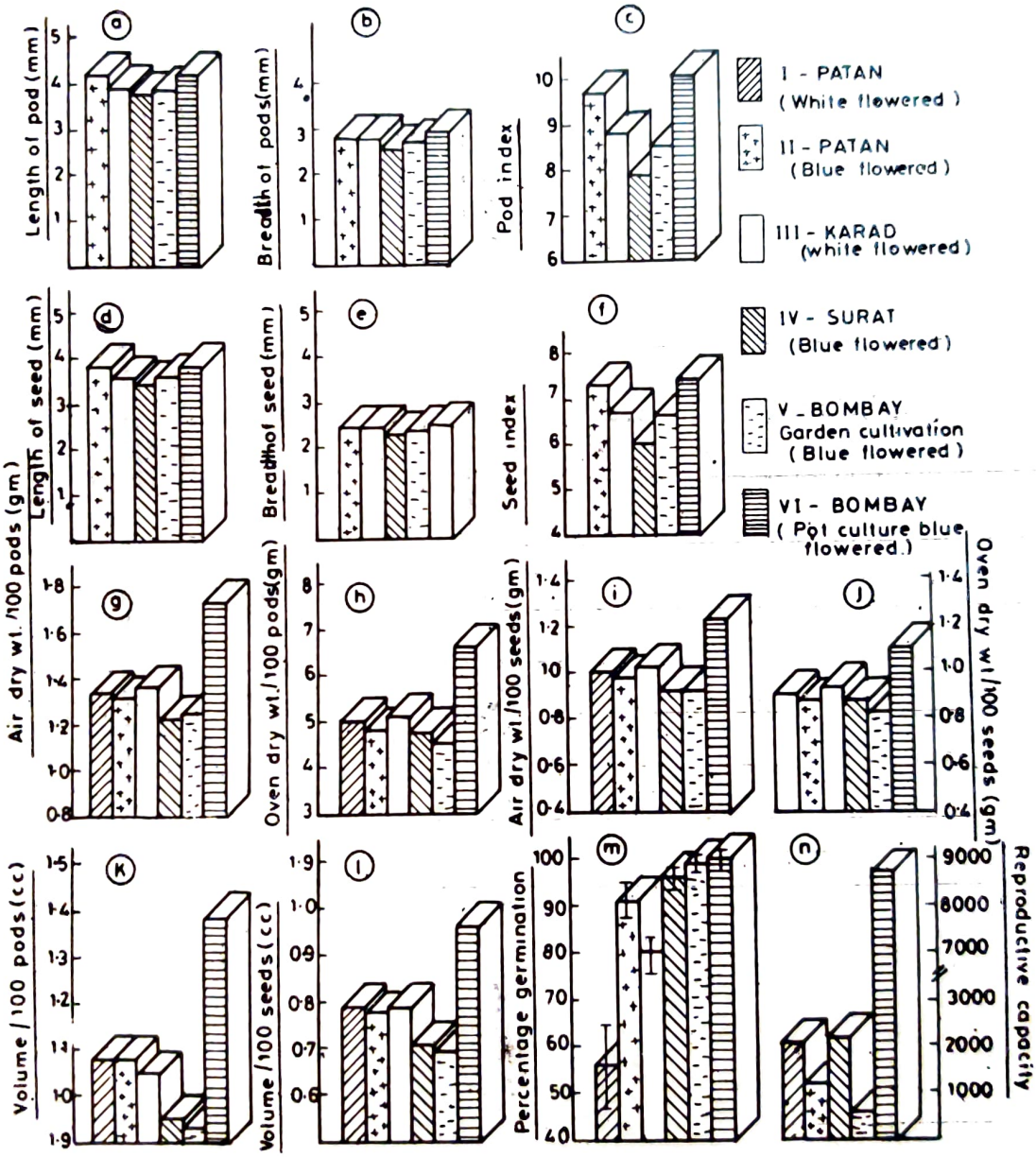

Fig. 1. Seeds and seed attributes of P. corylifolia in natural populations and under cultivation

Table 2—Seed germination in *P. corylifolia* in relation to ripening stages of pods

Stages of maturity	I	II	III	IV
Description of stage	Mature Pods started blackening	Pods Blackened and turgid	Pods just dried on plant	Air dried pods
1. Fresh weight/100 pods gm	2.784	2.120	1.404	1.394
2. Oven dry weight/100 pods gm	1.194	1.196	1.256	1.269
3. % Moisture/100 gms of fresh weight of pods	57.1	43.6	10.5	9.0
4. Length of pod mm	5.48	4.644	4.452	3.876
5. Breadth of pod mm	3.61	3.152	3.024	2.652
7. % germination in 15 days	68.00++ 14	81.33± 6.4	70.00± 6.9	00.00

Table 3—*Psoralea corylifolia* : Monthly record of germination of air dried pods stored in dry glass bottles under laboratory conditions

	% Germination in 25 days/month											
Month	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1979	—	—	—	3.0	—	—	—	9.0	4.0	—	1.0	1.0
1980	1.0	3.0	—	—	1.0	2.0	2.0	2.0	—	1.0	—	—
1981	1.0	—	—	—	—	—	—	—	—	—	—	—

(3) *Mechanical scarification and germination (Table 4).*

Table 4—*P. corylifolia* : Effect of mechanical scarification on germination

Material	Treatment	% germination in 3 days
Pods	Non scarified	00.0
Seeds	Non sacrified	2.0
Pods	Scarified by needle	74.0±2.8
Seeds	Scarified by sand paper	97.5±3.5
Seeds	Scarified by needle	99.6±0.6

Mechanical scarification could remove dormancy to a considerable extent. Seed scarification was found to be better than pod scarification. Both sand paper as well as needle scarification of seeds gave equally good results.

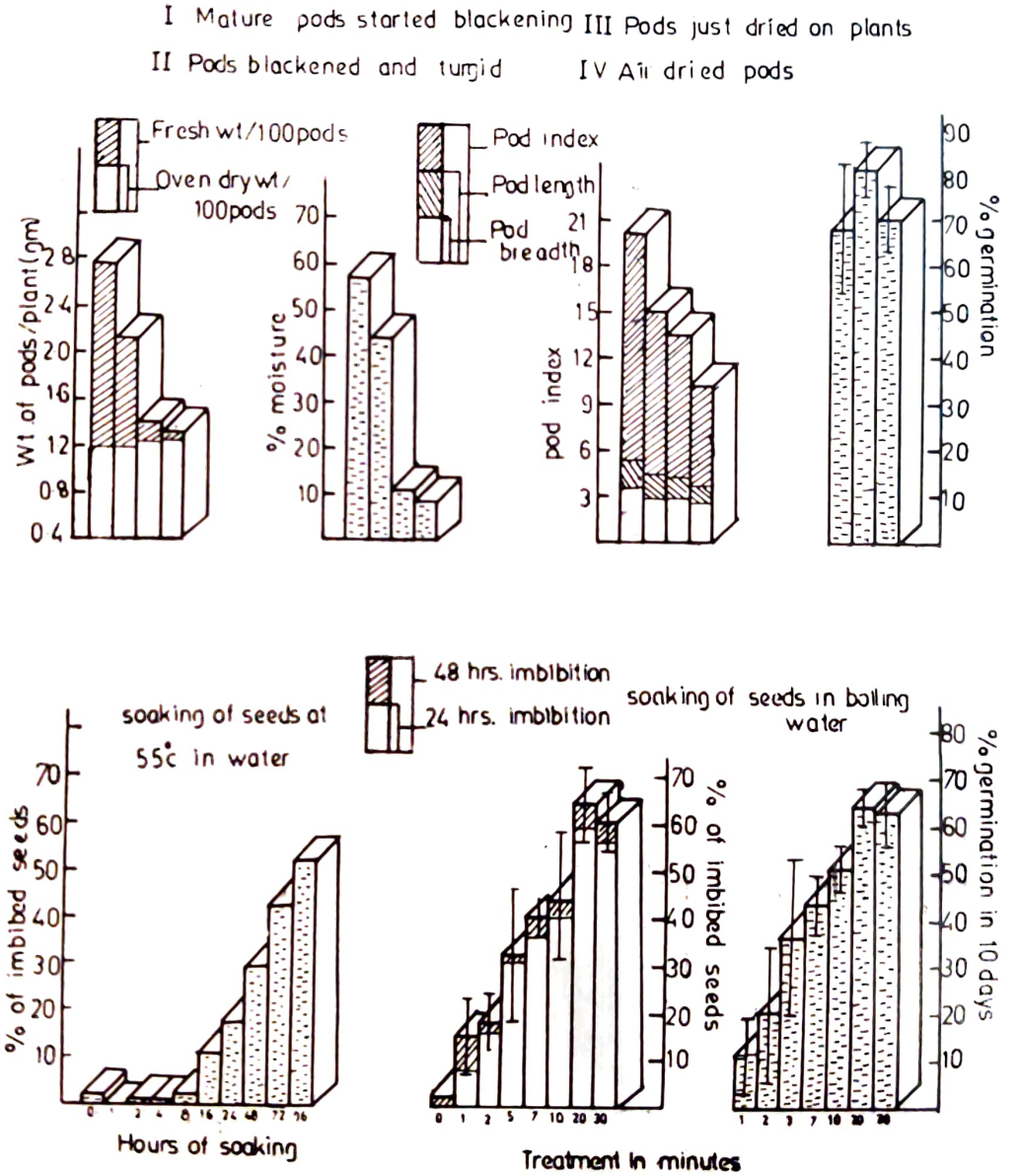

Fig.2: Effects of stages of pod ripening (a–d) and of temperature treatments (e–f) on seed germination of *P. corylifolia*

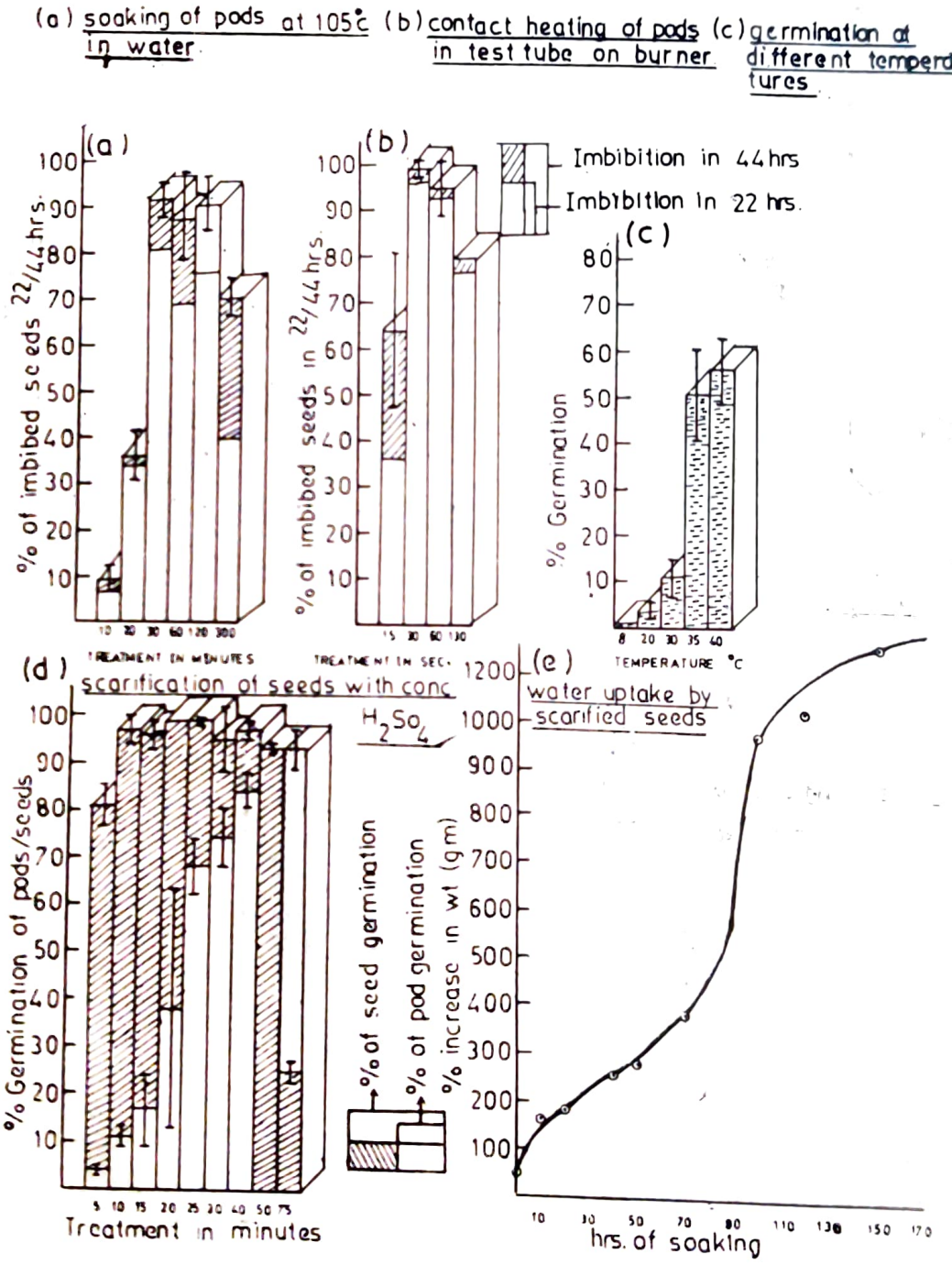

Fig. 3: Seed imbibition and germination in relation to temperature treatments (a, b, c) and acid scarification (d, e) in *P. corylifolia*.

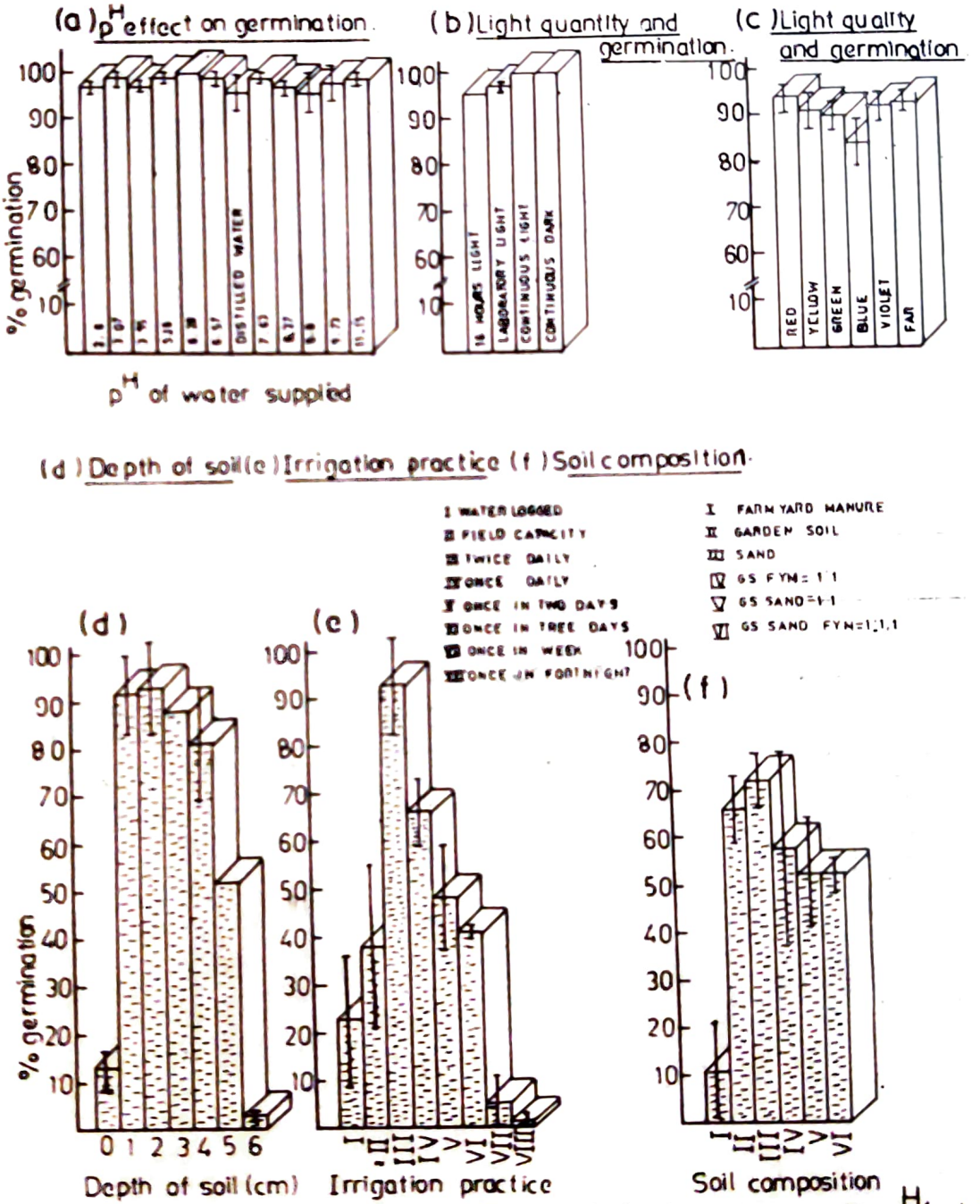

Fig. 4: Seed germination in P. corylifolia in relation to pH (a) light (b, c) and edaphic factors (d, e, f).

(4) *Permeability of seed-coat in relation to temperature (Table 5)*

Soaking seeds in water maintained at various temperatures ranging fron 8-40°C did not enhance imbitition. Seeds started imbibing water at 35°C and the process showed enhanced rate at 40°C (Table 5a).

Table 5a—*P. corylifolia* : **Permeability of seed coat in relation to temperature treatments**

Hours of imbibition	Temperature °C/Percentage imbibition				
	8	20	30	35	40
24 I	00.0	0.00	00.0	1.3± 1.2	6.0± 5.3
48	00.0	00.0	00.0	2.0± 70	16.6± 1.2

Table 5b—Soaking the seeds for varying time interval in water at 55 °C followed by imbibition upto 96 hours in cold water

Treatment in hours	1	2	4	8	16	24	48	72	96	Control
% Imbibition	0.5	1.0	1.0	2.5	11.00	17.5	29.5	42.5	51.5	2.00

Experiments 5b and 5d where seeds/pods were soaked in water maintained at 55°C and 105°C for varying time intervals followed by imbibition up to 96 hrs in cold water showed that the rate of imbibition was directly correlated with the period of hot water treatment to certain extent. While seeds subjected to hot water (55°C) for 96 hours showed 51% imbibition, the pods subjected to 105°C for two hours showed 90.6% imbibition after 44 hours. Further increase in duration of treatment, however, decreased the rate of imbibition. Subjection to boiling water treatment for varying time intervals followed by imbibition in cold water for 24 hrs and 48 hrs (Table 5c) showed that the rate of imbibition increased directly with the treatment time up to 20 minutes followed by decrease at higher time intervals. The percentage germination was also directly correlated with the rate of imbibition. When pods were heated in a test tube directly over the burner

Table 5c—Effect of boiling water treatment on permeability and germination

Treatment in minutes	Control	1	2	5	7	10	20	30
% Imbibition in 24 hours	2.0	8.0 ±4	16.0 8	30.6 ±15.2	36.0 ±4	40.0 ±12	58.6 ±4.6	56.0 ±8
% Imbibition in 48 hrs.	2.0	14.6 ±8.3	17.3 ±6.1	32.0 ±14.4	40.0 ±4	44.0 ±12	64.0 ±8	60.0 ±6
% germination in 10 days	—	10.6 ±8.3	20.0 ±14.4	37.3 ±16.7	42.6 ±6.8	50.6 ±4.6	64.0 ±4	62.6 ±6.8

Table 5d—Soaking of pods for varying time intervals in water at 105°C followed by imbibition up to 44 hours in cold water

Hours of imbibition	Treatment in minutes % imbibition						
	Control	10	20	30	60	120	300
22 hours	00.00 —	6.6 ±4.6	34.0 ±3.5	81.3 ±2.3	69.3 ±2.3	77.3 ±7.3	40.0 ±4
44 hours	00.00	9.3 ±3.1	36.0 ±5.3	92.0 ±4	88.0 ±10.6	90.6 ±6.1	71.0 ±4

(Table 5e) the imbibition rate increased only up to 30 seconds treatment followed by decline. Seeds heated for 150 seconds failed to imbibe water.

Table 5e—Effect of contact heating of pods in test tube on permeability

Hours of Imbibition	Treatment in seconds/Percentage imbibition					
	Control	15	30	60	130	150
22 hours	00.0	36-0 ±4.0	96.0 ±4.0	93.3 ±6.1	77.3 ±2.3	Seeds lose their power of imbibition
44 hours	00.0	64.0 ±17.4	98.6 ±2.3	94.6 ±4.6	80.0 ±00.00	

(5) *Germination at different temperatures (Table 6)*

Table 6—*P. corylifolia*—Germination of freshly harvested and air dried pods at different temperatures

	Temperature °C % germination after 25 days					
	8°C	20°C	30°C	35°C	40°C	60°C
Fresh pods			87.0 ±1.4			
Air dried lods	1.0 ±0.0	3.6 ±2.1	10.3 ±4	58.5 ±10	56.0 ±7.0	60.0

The percentage germination increased to certain extent along with increase in temperature. At lowest and highest temperatures of 8°C and 60°C respectively, the pods failed to germinate. While freshly harvested pods showed maximum germination at 30°C air dried pods showed best performance at 35°C.

(6) *Storage temperatures and seed germination (Table 7)*

Table 7—*P. corylifolia* : **Seed gramination in relation to dry/wet strorage of freshly harvested pods at different temperatures Storage period 25 hours)**

Storage	Temperature/ °C % germination in 10 days			
	20°C	30°C	35°C	60°C
Wet storage	29.3 ±2.3	30.6 ±14.0	77.3 ±14.8	00.0
Dry storage	30.0 ±8.7	73.3 ±24.4	00.0	00.0

The results indicate that the dormancy block is fully introduced within 25 hours if the pods are stored at 35°C under dry conditions.

(7) *Chemical scarification and germination (Table 8)*

Table 8—*P. corylifolia* : **Chemical scarification and germination**

	Chemical	Treatment in minutes/% germination									
		Control	5	10	15	20	25	30	40	50	75
Pods	Conc. H_2SO_4	00.0	3.5 ±0.3	10.5 ±2.1	16.5 ±7.7	38.0 ±25.5	68.0 ±5.6	74.0 ±5.6	84.0 ±3.4	93.3 ±1.1	92.6 ±4.1
Seeds	Conc. H_2SO_4	00.0	81.0 ±4.2	96.5 ±3.5	96.0 ±2.8	99.0 ±0.0	99.0 ±1.4	95.0 ±7.1	93.3 ±2.3	92.0 ±4.0	24.6 ±2.3
Seeds	1ON NaOH	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0	00.0

The results show that 15-20 minutes seed scarification with concentrated sulphuric acid gave maximum germination while pods required as high as 50 minutes treatment. Sodium hydroxide had no effect in breaking dormancy.

(8) *Water uptake by scarified seeds (Table 9)*.

The water uptake increased gradually during first forty eight hours followed by rapid increase during next forty eight hours. During further period there was again reduction in imbibition.

Table 9—*P. corylifolia* : **Water uptake of seeds scarified by H_2SO_4 for 15 minutes**

Hours of soaking	Initial weight gm	Final weight gm	Increase in weight gm	% increased in weight
1.	0.4748±0.0123	0.7160±0.0261	0.24111±0.0177	50.779
2.	0.4737±0.0086	0.9452±0.0215	0.4715±0.0128	99.536
3.	0.4647±0.0065	1.0496±0.0397	0.5849±0.0363	125.866
4.	0.4592±0.0128	1.1037±0.0459	0.6445±0.0331	140.352
5.	0.4789±0.0153	1.1620±0.0422	0.6831±0.0282	142.639
6.	0.4897±0.0072	1.2019±0.0218	0.7122±0.0242	145.435
7.	0.4784±0.0097	1.2145±0.0514	0.7361±0.051	153.867
8.	0.4636±0.006	1.1623±0.0164	0.6988±0.0105	150.733
9.	0.4801±0.019	1.2221±0.0466	0.7420±0.0276	154.551
10.	0.4897±0.0072	1.2606±0.0211	0.7711±0.0136	157.463
11.	0.4784±0.0097	1.2421±0.0249	0.7637±0.0153	159.636
12.	0.4706±0.0155	1.2335±0.0346	0.7629±0.019	162.112
16.	0.4706±0.0155	1.3054±0.0352	0.8348±0.0341	177.3906
20.	0.4706±0.0155	1.4082±0.0287	0.8376±0.0131	177.985
24.	0.4784±0.0090	1.5553±0.1182	1.0769±0.1634	225.104
36.	0.4706±0.015	1.7080±0.0011	1.2374±0.0167	262.940
48.	0.4897±0.0072	1.2606±0.2114	1.3489±0.369	275.454
72.	0.4746±0.012	3.6791±0.5553	3.2040±0.5456	675.0948
96.	0.4647±0.0065	4.9913±0.4220	4.5266±0.4182	974.090
120.	0.4592±0.0128	5.1026±0.2292	4.6434±0.2165	1011.1933
144.	0.4737±0.0086	5.9900±0.6537	5.5162±0.3011	1164.4922

(9) *pH effect on imbibition and germination of scarified seeds* (*Table 10*)

Imbibition in 24 hrs was maximum under nutral pH and declined gradually both acidic as well as basic sides. There was on the other hand no significant effect of pH on germination. However under extreme basic ranges the radicle turned red and the seedlings died off.

Table 10—*P. corylifolia* : **p H effect on imbibition and germintion of scarified seeds**

	pH of the supplied water										
	2.6	3.07	3.95	5.16	6.28	6.57	Dist. water	7.63	8.27	8.8	9.73	11.15
% Imbibition in 24 hours	62.6	65.3	68.6	69.3	77.3	66.0	71.3	69.3	60.6	59.3	53.3	66.6
% Germination in 10 days	97.3 ±1.1	99.3 ±1.1	97.3 ±1.1	98.6 ±1.1	100 —	99.3 ±1.1	96.3 ±4.1	98.6 ±1.1	96.6 ±1.6	96.0 ±3.5	98.0 ±3.5	98.6 ±1.1

(10) *Light in relation to seed germination* (*Table 11*).

Table 11—*P. corylifolia* : **Light in relation to germination—Quantitative**

Seeds used	Temperature	Light condition/% germination			
		8 hours light	Laboratory light	continuous light	Continuous dark
Scarified seed	Room temp. 30°C±3°C	96.0±00.0	97.0±1.4	100	100
	Culture room 20°C±3°C	99.5±0.3	98.5±0.3	99.00±1.4	100
Non-scarified seeds	30°C±3°C	00.0	00.0	00.0	00.0
	20 C±3 C	00.0	00.0	00.0	00.0

Qualitative

Quality of light	Red	Yellow	Green	Blue	Violet	FAR
% Germination of scarified seeds	93.3 ±3.0	90.6 ±4.1	90.0 ±2.0	84.0 ±5.3	92.0 ±3.5	92.6 ±2.3

The nonscarified seeds failed to germinate in all the light conditions, suggesting that the light quantum has no role in breaking dormancy.

There was no significant difference in percentage germination of scarified seeds kept under various light conditions showing that seeds are not photosensitive. They germinated in all the light spectra but percentage germination was comparatively less in blue light.

(11) *Seed germination in Blue and White flowered populations (Table 12)*

Table 12—*P. corylifolia* : **Seed germination in Blue and White flowered populations**

	Source of seed collection	Flower colour	Date of collection	% germination of scarified seeds in 4 days
1	Patan	White	10.12.1980	55.5±9.1
2	Karad	White	12.12.1980	79.5±2.1
3	Patan	Blue	10.12.1980	91.5±3.5
4	Surat	Blue	20.3.1979	96.5±0.7
5	Ruia College Garden	Blue	27.2.1982	99.33±0.9
6	Pot culture	Blue	14.9.1980	100.00±6

The seeds of white flowered population showed significantly lesser percentage germination as compared to blue flowered population. Even in blue flowered populations, differences in germination percentage were encountered in seeds collected from different natural habitats. However, these were not much significant. Plants grown under well nourished conditions of cultivation yielded better quality seeds showing almost cent percent germination.

(12) *Soil factors and germination (Table 13)*

(a) *Depth of soil (Table 13* a)—Non-scarified seeds and pods failed to germinate. Scarified seeds showed maximum percentage germination when sown at 2 cm depth. Increaase or decrease in depth resulted in decrease in germination percentage.

Table 13—*P. corylifolia* : **Soil factors and germination 13(a): Depth of soil**

Seeds/pods	Depth of soil cm/% germination in 44 days						
	Superficial	1	2	3	4	5	6
Scarified seeds	13.0 ±4.2	92.0 ±8.4	93.0 ±9.9	88.0 ±0.0	81.0 ±12.7	52.0 ±0.0	3.0 ±1.4
Non-scarified seeds	—	—	2.0 ±2.0	—	—	—	—
Non-scarified pods	—	—	00.0	—	—	—	—

(b) *Irrigation practice* (*Table 13*, b)—Under water logged condition the germination was very less. Amongst the different sets, the one receiving water twice daily showed best performance.

Table 13 (b)—Irrigation practice

Irrigation Practice/% of seed germination in 10 days							
Water logged	Water holding capacity of soil	Watering twice daily	Watering once daily in morning	Alternate day watering	Watering once in three days	Watering once a week	Watering fortnightly
23.0 ±12.7	38.0 ±16.9	93.0 ±9.9	66.0 ±6.9	48.0 ±10.5	41.3 ±1.1	5.3 ±6.1	1.3 ±2.3

(c) *Soil composition* (*Table 13*, c)—Germination was maximum in sand and minimum in FYM. Garden soil also sustained fairly good percentage of germination.

Table 13 (c)—Soil composition

Soil composition/% germination in 10 days					
Farm yard manure (FYM)	Garden soil (GS) (GS)	Sand (S)	GS + FYM 1 : 1	GS + S 1 : 1	GS + FYM + S 1 : 1 : 1
11.3 ±9.8	66.0 ±6.9	72.0 ±6.0	57.3 ±20.2	52.0 ±10.5	52.0 ±37.4

Discussion

The seed attributes of white flowered population of *P. corylifolia* were found to be of inferior type than those or blue flowered population affecting the reproductive capacity of the former to a considerable extent. Similar observations have been made by Singh (1972) who reports that seeds of white flowered form of *Solanum surattense* consistently germinate to lesser extent than those of violet flowered form.

Mature air-dry seeds of *P. corylifolia* showed seed-coat dormancy, a characteristic feature of majority of legumes (Barton, 1965; Rolston, 1978). In addition to impermeable testa, the seeds of this species are further provided with resinous pericarp impeding seed imbibition and protecting it from bacterial and fungal infection. Antibacterial properties of pericarp of this species have been experimentally demonstrated (Jois *et al.*, 1933; Seshadri & Venkata-Rao, 1937; Chakravarti, Bose & Siddiqui, 1948).

The dormancy block in *P. corylifolia* is introduced in final phases of ripening when seeds get air-dried accompanied by drastic reduction in their moisture content which varied from 6.5 to 11.5 percent. Similar observations have been made in *Cassia tora* (Singh, 1965), *Leucaena leucocephala* (Pathak *et al.*, 1974) and *Crotalaria* species (Pandey and Sinha, 1979). In several leguminous members studied by Chatterji and Kamal Monhot (1968) the moisture percentage in air-dried dormant seeds varied from 5.83 to 10.3 percent.

The dry storage brings about many changes in the seeds, frequently affecting the dormancy also (Barton, 1965; Kozlowski, 1972). In *P. corylifolia* however there was virtually no effect of storage in overcoming dormancy. Pods of *P. corylifolia* failed to germinate during 2-1/2 years period of dry storage eventhough TTC tests showed them to be viable. Probably in nature, the seeds resting in soil germinate in due course of time in a single lot once they get rid of the pericarp resin accompanied by decay of hard seed-coat.

Both mechanical as well as chemical scarification could overcome the dormancy as observed in numerous other species with water impermeable seeds (Chatterji, 1969; Rolston, 1978). Though 10-20 minutes scarification of seeds with concentrated sulphuric acid could bring about cent percent germination, pods required 50 minutes scarification. As in many other legumes (Chatterji, 1069; Vyas & Agarwal, 1970) alkali scarification had no effect on imbibition or on germination. However in *Rhynchosia minima* and *R. urenaria* beneficial effects of NaOH scarification have been reported (Chatterji, 1969).

Temperature treatments to dormant seeds of *P. corylifolia* mainly influenced the permeability property of the seed-coat. The rate of imbibition as well as germination increased with increase in temperature up to 40°C followed by decrease at higher temperatures. The seeds failed to germinate at and above 55°C. Parallel observations have been made by several other workers dealing with different leguminous species (Quinlivan, 1961, 1966; Vyas & Agarwal, 1970; Agarwal & Vyas, 1970; Pathak *et. al.*, 1974; Rao & Reddy, 1981.) High temperature treatments, contact heating and hot water treatments were beneficial in making seed-coat permeable to water and hence to a certain extent improved the seed germination. A variety of temperature treatments have been employed by other workers to make hard seed-coats permeable to water and to overcome the dormancy (Rolsten, 1978; Rao & Reddy, 1981).

Nonscarified seeds of *P. corylifolia* failed to germinate while the scarified ones germinated equally well in darkness, continuous light or partial light indicating that the seeds are photoinsensitive or non-photoblastic and light has no role in overcoming seed dormancy. Even spectral qualities of light did not much influence the germination process in scarified seeds as observed in *Indigofera linnaei* (Vyas & Agarwal, 1970). Majority of legume seeds tested so far have been found to be non-photoblastic (Chatterji, 1969; Agarwal & Vyas, 1970; Agarwal & Prakash, 1978; Pandey & Sinha, 1979) though in *Butea monosperma* (Agarwal & Prakash, 1978) germination has been reported to be better in dark than in light.

Scarified seeds of *P. corylifolia* could germinate equally well in a wide range of pH varying from 2.6 to 11.15 as against most of the leguminous members which favour narrow range (Agarwal and Vyas, 1970; Vyas & Agarwal, 1970,1972; Agrawal & Prakash,1978; Rao & Reddy, 1981) though in *Indigofera astragalina* (Agarwal & Vyas, 1970) seeds were found to germinate in pH range varying from 4 to 10.

Depth of sowing has been found to influence seed germination universally. The ideal depth at which maximum germination is obtained varies with species. Scarified seeds of *P. corylifolia* could germinate between 0-6 cm sowing depth. The germination percentage was best between 1-2 cm depth as reported in most other legumes.

Seed germination is also markedly influenced by the soil moisture level, the response depending upon the species. While some species prefer water-logged conditions for better germination (Mayer and Poljakoff-Mayber, 1978) others germinate well under water stress (Chatterji, 1969; Pickett, 1978). *Psoralea* seeds could germinate under wide range

of soil moisture conditions. However, the germination was best in soil watered twice daily. The process was markedly affected in water-logged conditions as well as under conditions of extreme moisture stress.

Singh (1972) studied the effect of soil composition on seed germination in *Solanum surattense* and found 50% germination in farm yard manure. In farm yard manure seeds of *P. corylifolia* showed just 11% germination and seedlings could not survive. Maximum germination was found in sand followed by garden soil.

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