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SEED-GERMINATION STUDIES OF *PSORALEA ESCULENTA* PURSH (INDIAN TURNIP) AND *PSORALEA ARGOPHYLLA* PURSH (SILVER SCURFPEA)

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Seed germination of *Psoralea esculenta* Pursh and *Psoralea argophylla* Pursh was investigated using treatments involving scarification and gibberellic acid. The percentage of germination in the treatment using scarification was much higher than when using gibberellic acid.

† † †

INTRODUCTION

The food potential for *Psoralea esculenta* Pursh (Indian Turnip) as a cultivated plant has long been recognized. As early as 1843, Harris (1951) commented about the possible cultivation of Indian Turnip. Maisch (1889) and Prescott (1849) also commented on attempts to cultivate the plant in France as a substitute for the potato. Lamarea Picot attempted to cultivate the Indian Turnip in the early 1800's, and went to great expense in order to obtain the seed, which he then took to France where he tried to grow the plant. The plants were apparently grown and marketed for a period of time before the venture was abandoned. Harvard (1895) wrote "I have hardly any doubt that under patient cultivation for a few seasons it could be improved, perhaps to an extent that would make such cultivation profitable, and supply our market with another toothsome, wholesome, and nutritious vegetable." So far as is known, few other attempts have been made to cultivate *P. esculenta*.

At one time, Indian Turnip was one of the most widely distributed native food plants in the Great Plains and was one of the native plants most sought after by the Indians of the area. "The general impression given by eyewitnesses and ethnographers is that the prairie turnip roots were dug whenever they were encountered, and that other activities were often suspended until an adequate supply was accumulated for the present and future." (Reid, 1977). Captain Lewis of the Lewis and Clark Expedition observed the use of Indian Turnip as food as early as 1805 (Thwaites, 1904). Captain Lewis wrote "This root forms a considerable article of food with the Indians of the Missouri, who for this purpose prepare them in several ways. They are esteemed good at all seasons of the year. . . [and] are sought and gathered by the provident part of the natives for their winter store." (Thwaites, 1904).

Harvard (1895) said that "raw it has a very palatable farinaceous flavor entirely devoid of bitterness." Other authors who have noted the Indians' use of the Indian Turnip as food are: Brackenridge (1814), Pursh (1814), Bradbury (1817), James (1823), Maximilian (1843), Catlin (1844), Hind (1859), Stevens (1860), Hayden (1862), Palmer (1871), Upham (1884), Grinnell (1892, 1923), Fletcher and LaFlesche (1911), Gilmore (1919), Denig (1930), Tabeau (1923), McDermott (1941), Harris (1951), Ewers (1958), Angier (1974), Kirk (1975), Van Bruggen (1976), Wedel (1978), and Kindscher (1987).

The Plains Indians probably did not attempt to cultivate Indian Turnip. Kindscher (1987) reported that the seedlings take 2–4 years to produce mature taproots. Reid (1977) indicated that the Indian Turnip may have been reseeded by the Plains Indians. They may have replanted it during the harvest because the ripe seeds could have been placed in the hole where the tuber had been.

Psoralea argophylla Pursh has not been used extensively by Indians and prairie pioneers according to Fielder (1975). She reports it as having been used in the preparation of a snakebite remedy. The plant does have tubers, but they are smaller than those observed in Indian Turnip.

Psoralea esculenta has been analyzed by Kaldy et al. (1980) for its nutritive value, along with two other edible species of prairie plants which were of value to the Plains Indians and early white settlers. Of the three plants analyzed [*Helianthus tuberosus* L. var. *subcanescens* Gray, *Perideridia gairdneri* (Hook. & Arn.) Mathias, and *P. esculenta*], Indian Turnip was found to be highest in calcium (0.51% dry wt.), magnesium (0.14% dry wt.), and iron (0.004% dry wt.).

The three plants were analyzed for their amino acid content by Kaldy et al. (1980). Indian Turnip was regarded as containing the highest amount of lysine—an essential amino acid (6.5% total protein)—which made it valuable as a dietary supplement. It was also found to have the highest amount of the following proteins (given by percentage of total protein): histidine (3.0%), arginine (18.9%), aspartic acid (21.5%), serine (4.4%), leucine (5.8%), tyrosine (4.5%), and phenylalanine (2.9%). Kaldy et al. (1980) concluded that the Indian Turnip was a valuable source of food energy (starch = 69.8% dry wt).

Seed-coat impermeability has been mentioned in conjunction with the plant family Fabaceae (Leguminosae) [Crocker and Barton (1957), Mayer and Poljakoff-Mayber (1963), and Bewley and Black (1985)]. If this feature, characteristic of many legume seeds, had not been recognized by the early researchers, it could, in part, explain some of the lack of success in cultivating Indian Turnip. Reichart (1983) noted that *P. esculenta* seeds would sprout when scarified with a file.

The purpose of this study was to study the effects of scarification, light, and gibberellin (GA) on seed germination of *P. esculenta*. *Psoralea argophylla* seeds were also tested to determine the experimental procedure to be used on *P. esculenta* seeds.

MATERIALS AND METHODS

Collections of *Psoralea argophylla* (Silver Scurfpea) and *P. esculenta* fruits were made at the Juhl Prairie in Buffalo County, Nebraska. The collections were made in June and July, 1987, after the fruits had formed. The collections were placed in a paper bag and allowed to dry prior to removing the seeds from the pods. As the seeds were extracted from the seed pods, they were placed in envelopes marked with the collection site and date of collection.

The seeds were scarified with sandpaper until the lighter-colored cotyledon could be seen through the seed coat. In the first test, scarified seeds were tested for light sensitivity. In subsequent tests, *P. argophylla* seeds were dark-grown and *P. esculenta* seeds were light-grown.

After scarification, the seeds were sterilized in 1% chlorine solution (1 part Chlorox to 4 parts distilled H_2O) for 15 minutes, and rinsed with distilled water. In the greenhouse experiment, the seeds and pots were sterilized in 1% chlorine solution. The soil was sterilized for 15 minutes in an autoclave.

The seeds were germinated under controlled conditions on germination plates in a growth chamber and in pots under uncontrolled greenhouse conditions. The controlled environment included constant photoperiod (12 hours light/12 hours dark), temperature (24C) and daily moistening (if needed). In the greenhouse, the scarified seeds (control: nonscarified seeds) were placed in pots and watered regularly. The seeds were checked daily for signs of germination and other factors such as mold growth.

Because gibberellic acid (GA) is a growth regulator which is known to break dormancy in the seeds of some plants, tests were run in which the seeds of *P. argophylla* and *P. esculenta* were tested with GA. The seeds tested with GA were not scarified. The seeds were sterilized using the method already described. Half of the seeds were soaked with a solution containing 0.01% GA for 14 days and the control seeds were moistened with distilled water.

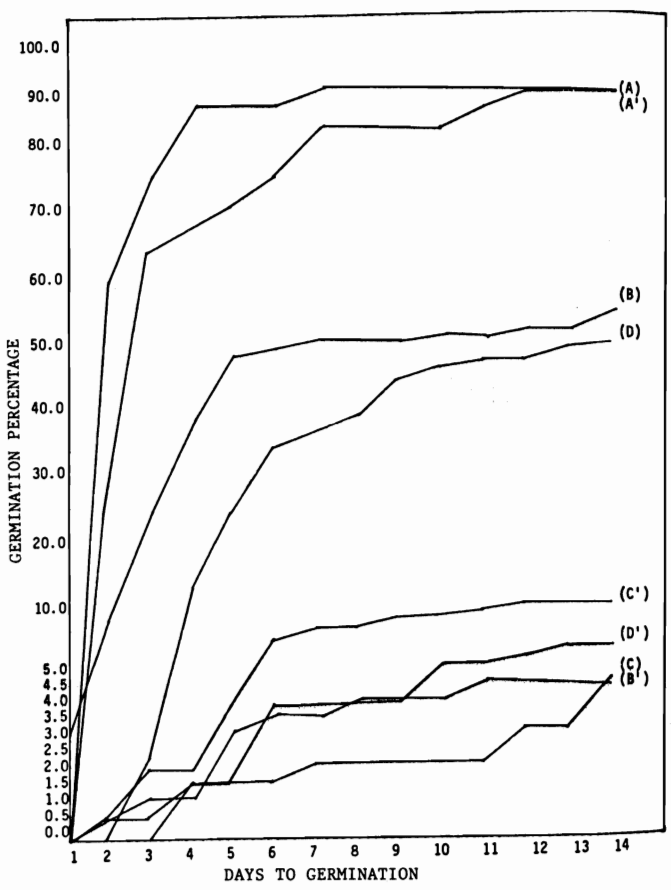

FIGURE 1: Seed germination in *Psoralea argophylla* Pursh (Silver Scurfpea).

A — light (growth chamber)
A' — dark control (growth chamber)
B — scarified (growth chamber)
B' — unscarified control (growth chamber)
C — GA (growth chamber)
C' — GA (growth chamber)
D — scarified (greenhouse)
D' — unscarified control (greenhouse)

RESULTS AND DISCUSSION

A preliminary run was done with *Psoralea argophylla* using 25 scarified seeds in each test, and with *P. esculenta* using 20 scarified seeds in each test. The objective of this run was to determine which conditions, light or dark, would be best for

seed germination. The results indicated that Silver Scurfpea seeds (Fig. 1) germinated more rapidly under dark conditions and Indian Turnip seeds (Fig. 2) germinated more rapidly under light conditions.

Two hundred seeds of *P. argophylla* and 200 seeds of *P. esculenta* were scarified. Two hundred seeds of each species were not scarified (control seeds). These were placed in the growth chamber on germination plates. The results showed that germination of the scarified seeds in both *P. argophylla* (Fig. 1) and *P. esculenta* (Fig. 2) began very rapidly (within 24 hours). The germination rate in the nonscarified control seeds of both species was much slower and the total number of germinated nonscarified seeds was much lower than with the scarified seeds.

In the gibberellin (GA) test, 200 unscarified seeds of both *P. argophylla* and *P. esculenta* were placed in 0.01% GA. Two hundred seeds of each species were placed in distilled water (control). The seeds were placed on germination plates in the growth chamber. The seeds of Silver Scurfpea (Fig. 1) germinated better than the seeds treated with 0.01% GA. Very little difference was noticed in the germination rate of Indian Turnip seeds (Fig. 2) using GA or distilled water. In both species the germination rate was very slow.

For the greenhouse test, 132 seeds of *P. argophylla* were scarified and 132 were not scarified (controls). One hundred thirty-one seeds of *P. esculenta* were scarified and 131 were not scarified. As had occurred in the growth chamber test using scarified vs. nonscarified seeds, the scarified seeds in the greenhouse test germinated first in both *P. argophylla* (Fig. 1) and *P. esculenta* (Fig. 2). The control seeds germinated more slowly with a lesser number having germinated by the end of the 14 day test period.

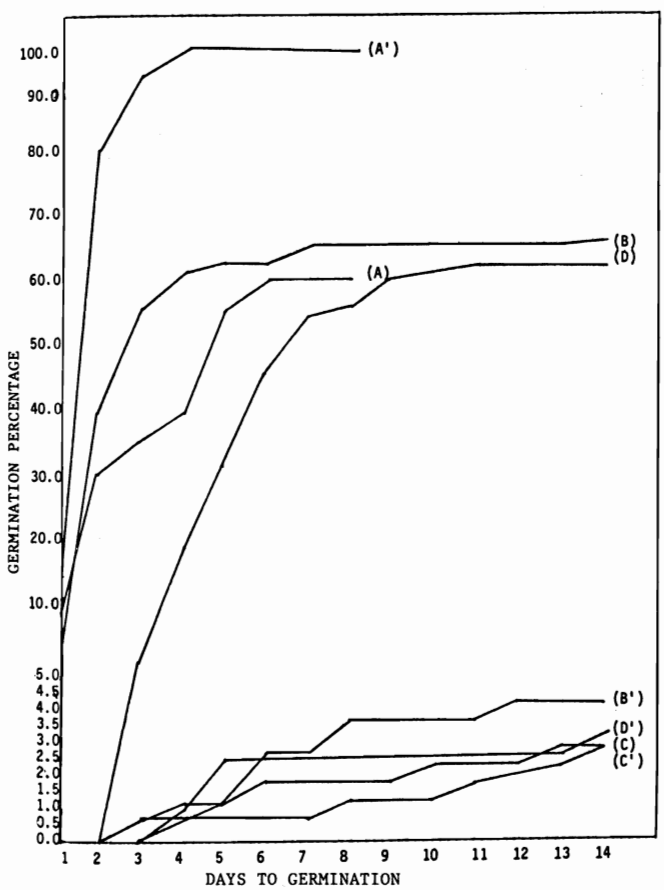

FIGURE 2: Seed germination in *Psoralea esculenta* Pursh (Indian Turnip).

A — light (growth chamber)
A' — dark control (growth chamber)
B — scarified (growth chamber)
B' — unscarified control (growth chamber)
C — GA (growth chamber)
C' — GA (growth chamber)
D — scarified (greenhouse)
D' — unscarified control (greenhouse)

CONCLUSIONS AND SUMMARY

Results show that scarification of the seed coat is an important factor in the germination of *P. argophylla* and *P. esculenta* seeds. In nature scarification would be accomplished by weathering processes and abrasion of the seed coat against soil particles.

Gibberellic acid (GA) did not seem to have an effect on germination. Presumably this is due to the inability of externally-applied GA to penetrate the seed coat. The controls in the GA tests germinated better than in the GA-treated seeds. An explanation for this may be that the control seeds which germinated may have had minute cracks or fissures in the seed coat which would allow liquid penetration. These minute fractures may not have been detected when they were chosen as control seeds.

Indian Turnip has potential as a food plant. Seed germination seems to be easily induced by fracturing the seed coat. Further studies are needed before absolute conclusions can be made. Also further studies are needed in order to successfully grow this organism to maturity under greenhouse or crop conditions.

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