Germinability and Seedling Vigor of *Haloxylon salicornicum* as Affected by Storage and Seed Size

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Highlight: *When newly collected in early spring, seeds of* Haloxylon salicornicum *(Moq.) Bge., an important range shrub in Iraq, attained 100% germination within 24 hours. As the summer months followed, a considerable loss of viability was observed in seeds stored at room temperature. By December, only about 50% of the seeds germinated. The seeds maintained their full germination capacity, with little difference between large and small size seeds when stored at 5°C. Under room temperature, the small size seeds lost their viability faster than the larger ones. Seeds stored at 5°C produced more vigorous seedlings than those stored at room temperature. Large seeds produced more vigorous seedlings than small seeds, regardless of method of storage. Seeds that germinated rapidly produced more vigorous seedlings than those that germinated slowly.*

To remedy the deteriorating desert range vegetation in Iraq, reseeding the favourable habitats with suitable species must be considered. *Haloxylon salicornicum* (Moq.) Bge., of the family *chenopodiaceae*, is a perennial shrub widely distributed in Iraqi deserts and considered as one of the most promising species for reseeding and sand dune fixation (Guest, 1966; Al-Ani et al., 1971a, 1971b, 1973). The shrub is about 60 cm in height, with jointed stem and branches and with leaves reduced to short-triangular scales at the tips of joints. It is a succulent, palatable, semihalophytic, and well adapted to endure the severe environmental stress in these desert areas. This paper presents results of a study dealing with its seed viability and seedling vigor as affected by seed-age, storage conditions, and seed size.

Materials and Methods

Seeds of *Haloxylon salicornicum* were collected from the southern desert of Iraq in early spring, 1973, and the husked seeds were placed in glass jars and kept at room temperature. On May 1, 1973, a sample of seeds was placed in a refrigerator at 5°C; and a similar sample was placed in a laboratory drawer at temperatures ranging from 25°C to 45°C. Germination tests were made in glass petri dishes, 9 cm in diameter, containing two layers of filter paper moistened with 5 ml of distilled water. In all the tests, 50 seeds were placed in each dish with two replications per treatment. Germination tests were performed two times each month, and the average was used to represent the monthly germination percentage. A seed was considered germinated when the radicle protruded to a length of at least 2 mm. An incubator (Precision model 806) with continuous light, and a constant temperature of 22°C was used for all germination trials.

The smaller seeds were separated from the larger ones visually. The seeds were cone-shaped and the average diameter of the large seeds at the base was about 1.5 mm, while that of the small seeds was about 1.0 mm. Seedling vigor was expressed by the total length of seedlings measured on the seventh day after the trial began.

Results and Discussion

Seed Viability as Affected by Age of Seeds

Once ripe in early spring, the seeds of *Haloxylon salicornicum* germinated very rapidly and 100% germination occurred within 24 hours. This high germination capacity was maintained throughout the spring months (Fig. 3) until April, then a gradual decline became evident. A considerable loss of viability was observed during the summer months. Such viability loss increased progressively to about 50% in December. These and similar findings by Hammouda and Bakr (1969) and Sankary and Barbour (1972) may be due to the oxidation of the limited supply of food materials stored in the embryo. It is of interest to note, in this connection, the results of tests on germination of different aged seeds of six grass varieties, where it was found that the best age of seed for planting differed greatly among the varieties (Shaidaee et al., 1969).

The observed rapid and early germination behavior seems to be an adaptation of the species for survival in the desert. Added to this are the facts that the seeds have no endosperm and the already green embryonic cotyledons presumably assume their photosynthetic function immediately after being released from the seed cover.

Seed Viability as Affected by Storage Conditions and Seed Size

Seeds stored in a refrigerator were 100% germinable throughout the summer months and into the following winter (Figs. 2 and 3), whereas germination rate and percent decreased with seed age in those stored at room temperature. As mentioned earlier, high summer temperatures are probably the main factor causing the loss of viability. Barbour (1968) reported similar findings with the North

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Fig. 1. *(upper) A well-developed bush, and (lower) a stand of* Haloxylon salicornicum.

American desert shrub *Larrea*. Cold storage treatment preserved germination capacity, with little difference between large and small seeds (Fig. 3). When stored at room temperature, the small seeds lost their viability faster than the larger ones; and this difference increased with storage time. It has been reported also that heavy seeds of several grasses had higher percentage of germination than light seeds (Green and Hansen, 1969). It is believed that small seeds are depleted of their stored material by oxidation faster than large seeds.

Seedling Vigor as Affected by Seed Age

Early seedling vigor is an important factor for successful establishment of young plants. Generally, the total length of the seedlings was directly related to the seedling vigor, as judged by physical appearance of healthy seedlings with ascending hypocotyls. Hence, seedling vigor was expressed quantitatively by the seedling length. Measurements showed that seedling vigor was reduced as storage time increased (Table 1). It seems, therefore, that as the stored food in the seeds was gradually lost by oxidation, the ability of such embryos to produce vigorous seedlings was also gradually diminished. Thus, as germination dropped to 50% in December, the average total length dropped to 13 mm.

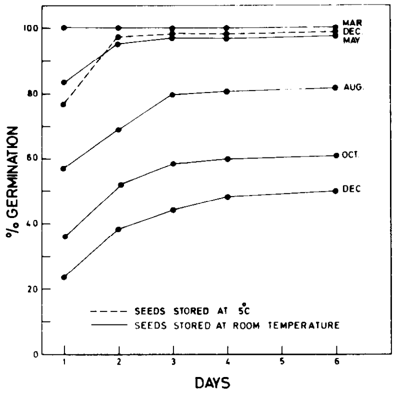

Fig. 2. *The rate of germination as affected by age of seed and storage conditions.*

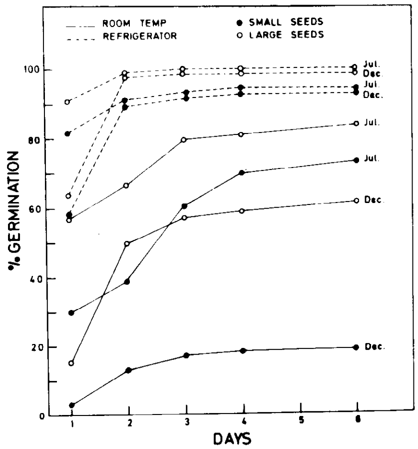

Fig. 3. *The rate of germination as affected by storage conditions and seed size.*

Effects of Storage Conditions and Seed Size on Seedling Vigor

Seeds stored at 5°C throughout the summer months produced more vigorous seedlings than those stored at room temperature. Large seeds produced more vigorous seedlings than small seeds stored under similar conditions (Fig. 4). The small seeds stored at room temperature evidently lost their food reserves faster than the larger seeds and consequently produced less vigorous seedlings. It is apparent that cold storage delays such oxidative losses. Several workers (Hittock and Patterson, 1962; Kaufmann, 1958; Kaufmann and McFadden, 1960, 1963; Kaufmann and Guitard, 1967) have found that barley seedlings from large seeds were

Table 1. Effect of seed age on seedling vigor.

Seed age (month)	Total seedling length (mm)
5	36
7	26
9	18
11	13

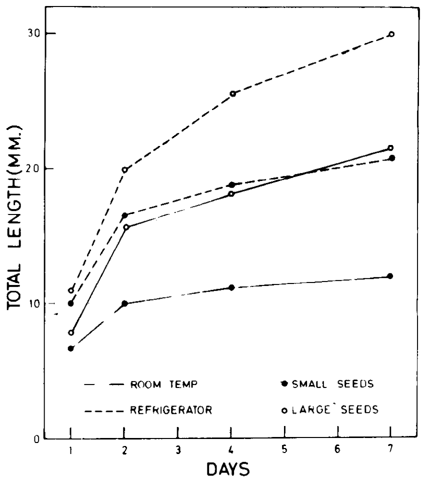

Fig. 4. *Effect of storage conditions and seed size on seedling vigor.*

superior to those grown from small seeds.

Effect of Rate of Germination on Seedling Vigor

Since early seedling vigor is dependent on seed size and availability of food reserves in the embryo and since the rate of germination is also influenced by the same factors, we felt that seedling vigor might be correlated with, and influenced by, the rate of germination. An experiment was, therefore, carried out in early September, 1973, in which a group of 250 seeds were placed in petri dishes, and seeds which germinated in the first, second, and third days were collected separately. A duplicate sample of 10 seedlings, with radicles extended to a length of 5 mm, were selected from each group and transferred to new germination petri dishes. Seedling lengths were measured on the sixth day after the corresponding transfer of each group. We found that seedling vigor decreased as the period required for germination increased (Table 2).

Table 2. Effect of rate of germination on seedling vigor.

Successive date of germination	Seedling length (mm)
1st day	31.1
2nd day	20.7
3rd day	15.5

Conclusions

It is, therefore, seen that seeds of *H. salicornicum*, collected from desert rangelands, should be stored under cold temperature (about 5°C) in order to preserve their viability, and should also be graded into small and larger size seeds. Highly viable and large seeds will not only give higher germination, but will also produce more vigorous seedlings that may be more capable of withstanding adverse desert environments.

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