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Dormancy Studies in Black Gram *(Phaseolus mnngo L.)*

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Abstract. Mechanical scarification of seeds of *Phaseolus mungo* L. resulted in 100 per cent germination in comparison to 90 per cent dormant control. Seeds treated with concentrated sulphuric acid for 8 min led to 85 per cent germination. Heat treatment at 70 °C for 24 h exhibited 75 per cent germination, while boiled water treatment for 7 min caused 65 per cent germination.

Dormancy in legume seeds is of relatively common occurrence and is frequently associated with the covering structures (JACKSON and BLUNDELL 1963, 1966, IRVING 1968). Black gram (*Phaseolus mungo* L.), one of the major important pulses, has about 3—4 months seed dormancy. The present paper describes the results of various physical and chemical treatments on dormant black gram seeds and their comparative efficiency in overcoming dormancy in such seeds.

Material and Methods

A locally grown black gram (*Phaseolus mungo* L.) cv. T.9 harvested in the month of October 1973 was used for the study. The initial dormant seed content of the harvested lot was 90%. Seeds were separated carefully from the pods and cleaned by hand screening. After various treatments, 25 seeds were germinated on 7.5 cm × 7.5 cm moistened germinating pads in 10.5 cm round Petri dishes in a germinator (25 °C).

Germination counts were made after three days. For clarity, seeds were distinguished as germinated seeds, firm seeds and hard seeds. Firm seeds were those that imbibed water but did not germinate, while hard seeds implied those that neither imbibed water nor germinated. In all studies, protrusion of the radicle through the covering structures was used as the criterion for germination. In certain cases the seeds were germinated with their covering structures removed. All treatments were replicated thrice with 25 seeds per replication.

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Results and Discussion

Mechanical Scarification

In black gram, dormant seeds possess thick and hard seed coats that hinder imbibition of water even under favourable environmental conditions. It is assumed that the physical limitation to moisture diffusion by the covering structures is responsible for this dormancy (WEBB and DUMBROFF 1969, DUMBROFF and WEBB 1970). Covering structures may also exert their effects by limiting oxygen diffusion to the embryo (VISSER 1954, COMÉ 1967). In the present investigation, mechanical scarification anywhere on the seed coat other than the hilar region with a razor blade or a needle completely eliminated the hard dormant seeds in 2 replicates of 100 seeds each and induced germination in as much as 100% of the seeds. Generally, impermeability in legume seed has been ascribed to either the cuticle or to a macrosclereide layer (LUTE 1928, BURNS 1959). NELSON (1926) postulated that impermeability in sweet pea (*Lathyrus* spp.) was associated with a varnish-like deposit on the surface of the seed. HYDE (1954) suggested that the hilum of a legume seed contains a fissure known as the hilar valve. This valve closes when atmospheric humidity is higher than the moisture content inside the seed, but opens when the reverse condition prevails. In the present experiment, location of the puncture or abrasion was of no consequence, since a break anywhere on the seed coat was effective in permitting uptake of water.

Hot Water Treatment

Preliminary studies indicated that a short dip in boiling water made many dormant (hard) seeds permeable. In this study black gram seeds were immersed in boiled water and kept there for different durations up to 20 min (the temperature of the water decreased during this period). Twenty five seeds were used for each treatment. Fig. 1 indicates that treatments of up to 7 min dip effected a significant reduction in percentage of hard (dormant) seeds and increased the germinable seeds to 65 per cent. Beyond this period, germination declined but was still higher than the controls. No further reduction was however observed in the hard seeds percentage. Percentage of firm seeds went on increasing with the duration of the treatment. The hot water treatment was thus found effective in making the hard seeds permeable thereby increasing the germinable seed percentage. The treatment would, however, seem partially effective, that is, only on a portion of the seed lot denoted as firm seeds, inasmuch as their permeability increased progressively with the duration of the treatment, but not germinability. Tetrazolium staining indicated that these seeds were all viable. This would seem to indicate that longer duration of the treatment somehow interfered with germination in these seeds, or that dormancy in this portion of the seed lot was related to the embryo as well. Further investigations would bring out useful information. On the whole, it may be suggested that by treating with boiling water, the mechanical stress induced by differential thermal expansion ruptures the seed coat and separates the macrosclereide cells permitting water to penetrate into the cells (BRANT *et al.* 1971) and thereby induces germination in a portion of the dormant lot. Similar treatments have been used successfully to make hard seed permeable in species such as black locust, *Robinia* (WILSON 1944).

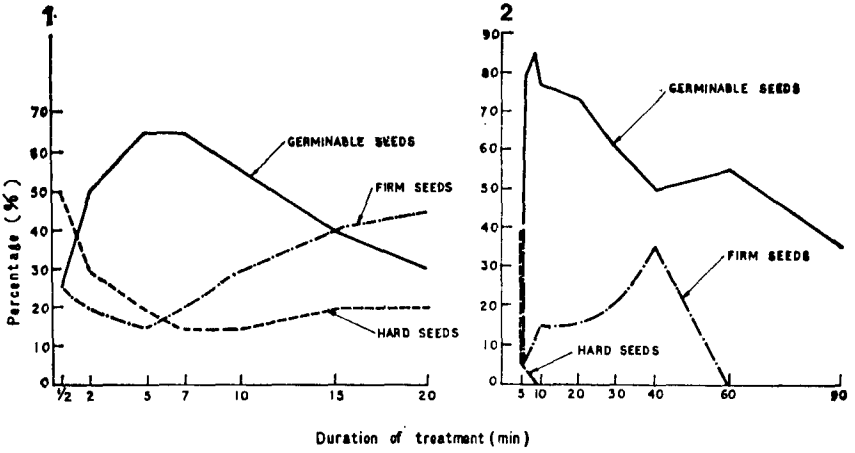

Fig. 1. Effect of hot water treatment on dormant seeds. Seeds were immersed in hot (boiled) water for upto 20 min and then allowed to germinate. Firm seeds denote seeds that imbibed water but failed to germinate; hard seeds neither imbibed water nor did they germinate; germinable seeds are those that germinated. Observations (3rd-day count) are means of 3 replicates of 25 seeds each.

Fig. 2. Effect of sulphuric acid treatment on dormant seeds. Seeds were treated with concentrated sulphuric acid for upto 90 min with constant shaking at 25 °C, thoroughly rinsed with water and then allowed to germinate. Other explanations as in Fig. 1.

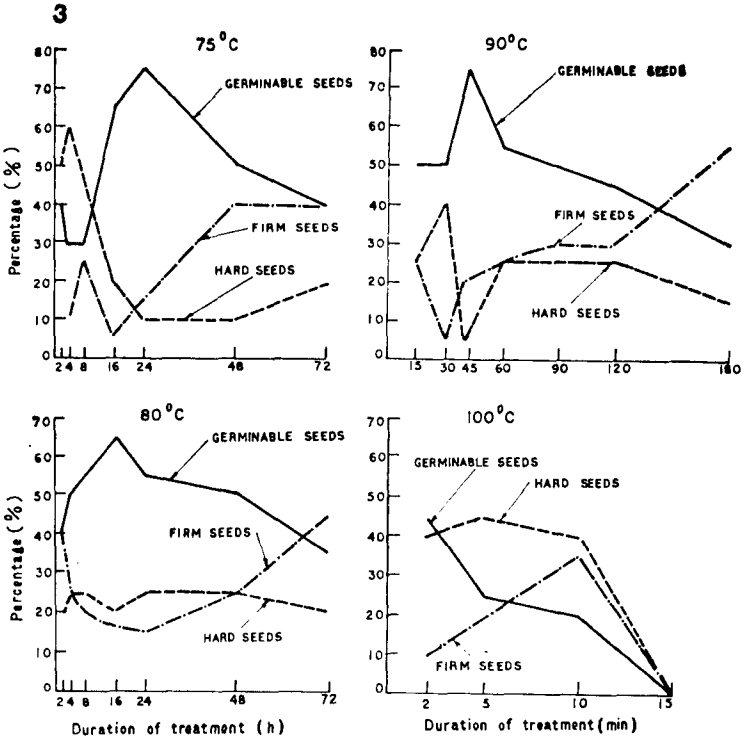

Fig. 3. Effect of heat treatment on dormant seeds. Seeds were exposed to 75, 80, 90 and 100 °C in hot-air ovens for different periods and then allowed to germinate. Other explanations as in Fig. 1.

Heat Treatment

Seeds were exposed to high temperatures in ovens maintained at 75, 80, 90 and 100 °C for various durations. The results presented in Fig. 3 reveal that the heat treatment brought about a considerable change in the seed coat permeability and germination behaviour in black gram and that the temperature response curve was time-dependent. Provided a suitable time period was not exceeded, considerable germination (75%) would be induced in the dormant seeds up to a temperature of 90 °C or even 100 °C. However, for best results 75—80 °C would appear suitable. At 100 °C considerable lethality was evident. The peak germination percentage occurred earlier and earlier with the increase in temperature. The percentage of germinable seeds appears to have an inverse relationship with the percentage of hard and firm seeds, particularly around the peak germination value. It would seem that part of the effect of heat treatment is realised through promotion first of the permeability of the seed coat thereby inducing germination and part of it is related in some manner to the process of germination not discernible from the present experiment.

Treatment with Sulphuric Acid

Seeds were treated with concentrated sulphuric acid for different durations ranging from 5 to 90 min with constant shaking at room temperature (25 °C). After treatment, the seeds were thoroughly rinsed in distilled water. Germination of dormant seeds treated for 8 min gave the highest germination percentage, although treatments from 6 to 20 min gave sufficiently high germination percentage (Fig. 2). However, at lower durations of treatment, although the percentage of germinable seed was high, germination was delayed (24 h), while increasing duration of the treatment enhanced the germination rate (18 h), but reduced the germination percentage. Acid treated seeds were typically dull in colour and since the acid corrodes the seed coat, increased duration of treatment probably might have dissolved the macrosclereide layer resulting in quicker germination.

The treatments were all successful in breaking dormancy in black gram seeds. In view of the immediate percentage reduction in dormant seed, the mechanical scarification treatment was considered to be the best, followed by acid scarification, heat treatment and boiled water treatment, in descending order. Although being successful, breaking the seed coat with a needle or a razor blade is impracticable on a large scale. Even when tried with an abrasive disc, unless very carefully carried out, the treatment may result in either an appreciable quantity of unscarified seeds or in an excessive amount of broken and injured seeds. Such injury may finally cause reduced vigor and fertility, and may result in stand failure or delayed establishment. In addition, injured seeds do not store well, declining quite rapidly in vigor and germinability.

Considering the ease of operation and execution in bulk-lots, the boiled water treatment would seem to be the safest to follow if the treatment duration is carefully maintained. While the sulphuric acid treatment is somewhat hazardous, the heat treatment is feasible with small seed lots. However, for obtaining higher percentages of germination, the boiled water treatment stands lowest in the category of treatments tried.

Acknowledgements

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BOOK REVIEW

DUDITS, D., FARKAS, G. L., MALIGA, P. (ed.): **Cell Genetics in Higher Plants.** — Akadémiai Kiadò, Budapest 1976. 251 pp., 61 figures.

A collection of materials of UNDP/UNESCO/ICRO Training course, held in summer 1976 in Szeged, Hungary, gets in a relatively short time into the hands of readers interested in the problematics of plant cell and protoplast cultures. The book is divided into two parts, similarly as was the course. The first part consists of 17 papers devoted to thematic fields of cell cultures, somatic mutagenesis, microspore cultivation, protoplast cultures (including protoplast fusions, transfer of organelles and macromolecules, somatic hybridisation). The second part is a detailed methodical "cookery-book" verified in practice by the participants of the course. The composition of the teaching staff which represented the contemporary world's elite in this field was itself a guarantee of high quality of the course and thus of its materials as well. The informative orientation of the course is reflected in the summarizing form of individual papers which are thus understandable even to non-specialists. A sober evaluation of application prospects of cell and protoplast cultures (Street, Potrykus), the inclusion of papers from thematically near areas (protoplasts of fungi — Ferenczy; mutagenesis and DNA transfer in *Arabidopsis* — Rédei) and the high methodical level of the experimental part (incl. *e.g.* plasmid incorporation into plant cells) — all that documents the good quality of the book which can be warmly recommended to all those interested in modern methods of experimental botany.

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