ACID TREATMENT TO OVERCOME SEED DORMANCY

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Many growers experience problems germinating seed of tree and shrub species with hard or impermeable seed coats. For hard seedcoated species the usual method of overcoming these problems is by a long period of warm stratification to allow natural breakdown of the seedcoat. Species with an impermeable seedcoat can be scarified mechanically by abrasion of the testa to allow water absorption. A quicker, more reliable method that has been advocated for many years is the immersion of seed batches into concentrated sulphuric acid (H_2SO_4) to break down the seedcoat. Sulphuric acid has different effects, depending upon whether the seedcoats are impermeable or hard.

Impermeable Seedcoats. The effect on impermeable seedcoats, such as can be found in legumes, was illustrated by Liu *et al* (6) by using a scanning electron microscope on seeds following acid treatment. The surface of these seeds consists of an impermeable, waxy cuticle layer on the exterior, beneath which is found a palisade layer of cells. Acid treatment dissolves the waxy cuticle and the ends of the cells beneath so allowing imbibition of water. Conventional scarification by abrasion tended to cause some injury to the seeds being treated resulting in decreased vigour and viability. They also found that immersion of the seeds in boiling water ruptured and separated the macrosclerid layer thus permitting the entry of boiling water to the embryo, thereby reducing viability.

Acid treatments of up to 2 hours resulted in an increase in germination over the control. For *Gleditsia triacanthos* germination was 98% compared with 32%, for untreated seed. For *Gymnocladus dioicus* germination was 95% compared with 4% for the control.

The immersion time for some legume species can be quite lengthy. Garner (4) found that even after 90 min. acid treatment germination of *Koelreuteria paniculata* remained low compared with mechanical scarification. Frett & Dirr (3) needed an 8 hour treatment to improve germination of *Gymnocladus dioicus* seed.

Hard Seedcoats. The effect of acid treatment on hard seed-coated subjects was shown by Roberts (7). He found that by reducing the width of the seedcoat using concentrated sulphuric acid, the time required for warm stratification of subjects, such as Rosaceae, could be substantially reduced.

By reducing the width of the seedcoat by a third, the percentage germination of *Rosa dumetorum* 'Laxa,' after 30 days at 24°C

followed by 12 weeks at 4 to 5 °C was 80% compared with only 50% without acid treatment.

Hilton, *et al* (5) compared the effects of acid scarification (H_2SO_4), mechanical scarification, and immersion in sodium hydroxide (NaOH), on the rosaceous subjects, *Amelanchier* and *Sorbus*. *Amelanchier laevis* seeds were immersed for 15 minutes in sulphuric acid, whereas seeds of *Sorbus aucuparia* and *Sorbus decora* were treated for 10 min. Mechanical scarification was done by abrading the seed coats of both species with sandpaper until the cotyledon was exposed at one place. The last treatment involved soaking the seeds of all species in a saturated solution of NaOH for 20 min. Seeds of both species were then subjected to stratification periods ranging from 30 to 120 days.

Maximum germination of all species occurred after 120 days stratification period at 2 °C following acid treatment. The negative effect of mechanical scarification compared with the control was attributed to the inward leaching of growth inhibitors to the embryo thus prolonging dormancy, although mechanical damage may also have been a factor.

Flemion (1) worked on several *Crataegus* species. She found that with acid treatments of up to 3 hours, followed by various temperature regimes, one can reduce the period of warm treatment. By using sulphuric acid, the warm period requirement to obtain 80% germination was reduced from 12 weeks to 3 weeks prior to cold stratification.

Flemion was probably one of the first authors to emphasise the importance of safe technique when using sulphuric acid. The following procedure is one that I have used for a number of mainly Rosaceous species.

TECHNIQUE FOR ACID TREATMENT

Operator equipment. The most important aspect of acid treatment is operator safety. The following items are essential:

1. Respirator—Fitted with cartridges for gas filtration.
2. Perspex face shield—To provide protection from splashing. This should be kept lowered, with head held down while operations are taking place.
3. Rubber gloves/gauntlets.
4. Full protective suit with heavy duty plastic apron.
5. Rubber wellington boots.

Other equipment/materials. It is important to avoid items made from metals. All utensils should be constructed from rubber, plastic, or glass.

1. Concentrated sulphuric acid (H_2SO_4).
2. Washing soda—For acid neutralisation.
3. Plastic sieve—For holding seed batches during immersion.

4. Glass thermometer—For temperature monitoring during treatment.
5. Plastic spoon.
6. Plastic containers—One for acid immersion, the other for neutralisation.
7. A large plastic tub—For final rinsing of the seed after treatment.

Site selection. The area should be concrete and must slope into a soakaway into which waste products can drain. The site should not be situated where there is a high water table, and it must be well separated from water courses. There should also be a plentiful supply of water, and it is advisable to have a hose pipe available which should be kept running continuously during treatment.

Preparation. Damp or wet materials should not come into contact with the concentrated sulphuric acid at any stage or a dangerous reaction may occur. It is, therefore, essential that only dry seed should be used. Any trace of dampness in the seed may also result in damage to the embryo resulting from acid penetration.

Before treatment, seed lots should be subdivided into smaller batches that can be placed into the plastic sieve for immersion. With large batches of seed there is a danger of overheating of the acid during treatment. The volume of sulphuric acid used should be three to four times the volume of seed, to ensure adequate coverage of the seed and to prevent overheating.

Acid treatment: immersion. The appropriate quantity of acid should be placed into the first plastic container. The seed batch should then be carefully lowered into the acid, and remain there for the specified immersion time. A thermometer should be used to monitor the temperature at regular intervals and, if there are any sudden temperature rises, the process should be stopped immediately. A plastic spoon should be used to gently stir the seed occasionally during treatment to prevent clumping of the seed and the formation of any hot spots.

Neutralisation. After immersion of the seed for the appropriate time period, the sieve with the seed should be transferred to the second container which should contain a saturated solution of washing soda to neutralise the acid. This solution should be changed regularly to ensure effectiveness of neutralisation.

Rinsing. The seed should then be transferred to a large tub, into which there should be a steady flow of water, to give the final rinsing. The seed can then be drained and mixed with peat and sand, ready for stratification or other treatment.

Assessment of optimum immersion time. Before treating whole lots of seed it is advisable to undertake tests to find out the optimum treatment time. If samples of seed are cut open after various immersion periods, the optimum can be assumed to be when a

percentage of the seedcoat has been removed, but not so much that the embryo is nearly exposed.

SUMMARY

Acid treatment, using concentrated sulphuric acid, has been shown to be useful for reducing the warm period requirements for those tree and shrub species with hard seed coats. For species with impermeable seed coats, acid scarification may give better germination than by using mechanical scarification. It should be remembered however that a safe and responsible work procedure is essential when carrying out this potentially hazardous technique.

LITERATURE CITED

1. Flemion, F. 1938 Breaking the dormancy of seeds of *Crataegus* species *Contrib Boyce Thompson Inst* 9(5) 409

2 Fordham 1965 Germination of woody legume seeds with impermeable seed coats *Arnoldia* 25.1

3 Frett, J L and M A Dirr 1979 Scarification and stratification requirement for seeds of *Cercis canadensis* (redbud), *Cladrastis lutea* (yellow wood) and *Gymnocladus dioicus* (Kentucky coffee tree) *Plant Propagator* 25(2) 4

4 Garner, J L 1979 Overcoming double dormancy in golden rain tree seeds *Plant Propagator* 25(2) 6

5 Hilton, R J., A S Jaswal, B J E Teskey, B. Barabas 1965. Rest period studies on seeds of *Amelachier, Prunus*, and *Sorbus Can Jour. Plant Sci* Vol 45 79

6 Liu, N Y , H Khatamian, and T A Fretz 1981 Seed coat structure of three woody legume species after chemical and physical treatments to increase seed germination *Jour Amer. Soc Hort Sci* 106(5).691

7 Roberts, L 1979 Practical aspects of the acid treatment of rose seed *Plant Propagator* 25(4) 13