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successfully concluded by the growing of a paddy crop giving upto 3,000 lbs. of grain per acre in two years' time.

Soil Erosion Soil erosion in this province is not such a serious menace as in the U. S. A. except perhaps on the hills where promiscuous clearing of forest and cultivation of hill slopes has caused some trouble. In the black soil area of the central plateau sheet erosion causes some damage by the reason that the land is naturally undulating and favours the carrying off of the surface soil during heavy and sudden downpours of rain. It must not be forgotten that after all erosion is a natural phenomenon and has both its disadvantages and advantages. The disadvantages are the loss of surface soil to the local farmer and the advantages are the building up of the great deltas out of the washed down material. Sheet erosion in the central plateau is however being combated by the advocation of the putting up of small "bunds" at frequent intervals down the contour, when the valuable fine fractions of soils are not carried away but deposited in the region of the bunds and thus preventing loss of soil and what is more a better conservation of the available moisture In the hills, the Nilgiri Hills mainly, the cultivation of hill sides of more than a certain slope is being prohibited and also recommendations made to potato growers mainly to cultivate in ridges and furrows along the contour and not against it.

A Novel Method of Improving the Germination of *Prosopis juliflora* Seeds

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Prosopis juliflora, commonly known as mesquite or algaroba, is a tree recently introduced into this country. Its pods have a thick and spongy pericarp containing syrupy matter which is said to be of high nutritive value and is relished by all kinds of stock in America (Kunhi Kannan, 1928). On the karoo in South Africa sheep and goats are fed with the pods. Sometimes the pods are collected and ground to serve as cattle food. The tree is said to produce timber suitable for furniture and the flowers form a good honey-bee pasturage.

The Madras Agricultural Department has advocated the use of this plant for a live fence. It is suitable for this purpose as the seedlings make fairly quick and thick growth and are provided with sharp thorns. The plants are deep rooted and come up well with scanty rainfall. A considerable percentage of the seeds of *Prosopis juliflora*, however, are 'hard' or impervious to water under conditions favourable for germination. The following are the results of a few trials made at the Millet Breeding Station, Coimbatore, to find out an easy method of inducing germination in these hard seeds.

Prosopis juliflora belongs to the Leguminosae and in this family hard seededness is a common feature; it has been observed in nearly all its cultivated species (Harrington, 1916). Hard seeds that have remained impermeable even after continued boiling may be observed when most of the pulses are cooked whole. According to Rees (1910) this impermeability is produced by the laying down of fatty or waxy substances in the cuticle. Nelson (1926) is of the opinion that hardness is the result of the evaporation and deposition on the seed surface of the watery fluid surrounding the seed in the immature pod. Stutz (1933), however, observes that in alfalfa, seeds did not become hard coated while on the plant itself but that the condition set in only after storage.

Several methods have been tried to overcome hardness in seeds, particularly of clover and alfalfa. Among these, scarification or abrading the seed coat is a well known method (Rees, 1910, Harrington, L. C., Stewart, 1926). In tea and *kolingi* (T. Purpurea) glass papering by hand has been recommended by Chandrasekhara Iyer (1940). To obtain the optimum degree of scarification as also to minimise the labour involved several machines have been designed and are in use particularly in America. Scarification, however, is likely to produce a varying percentage of damaged seedlings and also to reduce the longevity of the seeds in storage (Graber, 1922). Application of dry heat has been tried with success in the case of alfalfa by Staker (1925) and Stewart (1926). Hot water treatment for overcoming hardness is mentioned by Rees, l. c., and Chandrasekhara Iyer, l. c. Midgley (1926) observed that hard seeds of alfalfa germinated when kept in a moist condition for several months. Busse (1930) tried freezing air-dry alfalfa seeds in liquid air (−190°C) and found that the impermeable seeds had become permeable. Alternations of temperature caused the softening of impermeable clover seeds (Harrington, l c., and Midgley, l. c.). Davies (1928) tested the effect of high pressure (2000 atmospheres) on impermeable seeds of clover and alfalfa and obtained increased percentages of germination.

Chemical methods aimed at breaking down the seed coat or dissolving the 'fatty', 'waxy' or 'varnish-like' deposition on the seed coat have been tried with varying amounts of success. Rees, l. c., tried chloroform, ether and hot alcohol, of which he found chloroform the best. Sulphuric acid has been tried by several workers in the treatment of hard seeds but mostly for the microscopic examination of impermeability.

A very interesting method for inducing permeability was discovered by Hamley (1932) who working with *Melilotus alba* (sweet white clover) found that light impacting in the region of the strophiole produced softening of the seeds. The simplest way of effecting this was by shaking the seeds in a bottle.

Of the various methods enumerated above, scarification and impacting were chosen for trial with *Prosopis juliflora* seeds as being likely to be simple and cheap if found successful. Sound, hand threshed seeds were

used in these tests and the germinations were made in earthern pots filled with soil. Counts taken represent the number of seedlings that appeared above the soil surface. Table I gives the germinations obtained by different methods of injuring the seed coat.

TABLE I. **Germination percentages of scarified seeds**

Treatments	4th day	5th day	6th day	7th day	8th day	9th day	10th day	11th day	12th day	13th day	14th day	Total.
i. Sand papered end opposite to radicle until cotyledons were seen . .	–	–	94	3	–	–	–	–	–	–	–	97
ii. Cut with knife on flat side	91	–	1	–	–	–	–	–	–	–	–	92
iii. Made small scratch with sand paper . . .	88	2	–	1	–	–	–	–	–	–	–	91
iv. Pounded with sand . .	79	6	1	1	–	–	–	–	–	–	–	87
v. Rubbed on Cuddapah slab .	72	8	1	–	1	–	1	–	–	–	1	84
vi. Untreated .	1	14	13	6	6	5	1	–	3	1	–	50

It will be seen that all the treatments have given satisfactory germination. In i, ii and iii, however, the seeds have to be individually treated and therefore these methods cannot be recommended except for very small samples. For larger quantities of seed, pounding with sand would appear to be the most practical way of sacrifying the seed coat for improving the germination.

The results of impacting seeds of *Prosopis juliflora* are given in Table II. As in the scarification experiments sound, hand-threshed seeds were used. Samples of 100 seeds were put into an eight ounce bottle and were shaken vertically at the rate of twice per second.

TABLE II. **Germination percentages of impacted seeds**

Treatments	4th day	5th day	6th day	7th day	8th day	9th day	10th day	11th day	12th day	13th day	14th day	Total.
i. Shaken for 1 minute .	–	7	8	16	13	–	–	–	8	10	2	64
ii. " 3 " .	–	27	13	17	3	–	–	–	11	3	4	78
iii. " 5 " .	–	45	21	7	9	2	4	1	3	–	1	93
iv. " 10 " .	–	56	28	6	5	1	–	1	–	–	–	97
v. " 15 " .	–	68	19	7	2	1	–	–	–	–	–	97
vi. Untreated . . .	–	14	15	6	10	9	2	2	2	2	–	60

It will be seen from Table II that shaking the seeds for ten minutes or more has resulted in rapid and satisfactory germination. The 15 minutes' treatment was repeated with a one pound sample of seed put into a square tin and shaken at the same rate. The germination obtained was 95 per cent

within a period of one week The response of *P. juliflora* seeds to impacting is thus very similar to that of *M. alba.* The hard seeds present in the samples of *P julitlora* have evidently softened as a result of the impacts received in the shaking. No attempts were made to discover the mechanism of this softening; however, a brief summary of the findings in *M. alba* may be of interest.

Hamley, l. c, found that it was possible to distinguish permeable areas on the seed coats of clover and alfalfa by a short treatment with osmic acid. It was observed that in soft seeds whose coats have not been injured, absorption of water took place through the strophiole. By histological examination he was able to show that in hard seeds the strophiolar cells are in a state of tension which when upset produces softening through a split occurring between these cells It was conjuctured that this fracture could be produced by a small impact in the neighbourhood of the strophiole. For this purpose it was not thought feasible to tap every seed in the strophiolar region individually, but if the seeds are thrown about in a hard container, softening would occur if a sufficient number of impacts are given so that one blow at least would strike at or near the strophiole.

It would be interesting to find out if hardness occurring in our common leguminous seeds can be overcome by this method, and if so whether the mechanism of softening is similar to that in *Melilotus alba.*

Summary Poor germination in *Prosopis juliflora* seeds is due in part to the occurrence of 'hard' or impermeable seeds. In the samples tested, over 40 per cent of the seeds failed to absorb water. It was found that this could be remedied by shaking the seeds in a metal or glass container for about fifteen minutes at the rate of twice per second. Seeds so treated gave over 95 per cent germination. Abrading the seeds by pounding them with sand was also found to be a successful, but less easy, method.

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Literature cited

1. Busse, W. F. Bot. Gaz., 89 : 169--179. 1930.
2. Chandrasekhara Ayyar, S. N. Madras Agri. jour. 28:342—345 1940.
3. Davies, F. A. Am. jour. Bot., 15: 433—436, 1928.
4. Graber, L. F. Jour. Am. Soc. Agron., 14;298—302, 1922.
5. Kunhi Kannan, K. Agri. Jour Ind., 18:144—147, 1923.
6. Hamley, D. H. Bot. Gaz., 93: 345--375, 1932.
7. Harrington. G. T. Jour. Agri. Res., 6:761—796, 1916.
8. Midgley, A. R. Jour. Am. Soc. Agron. 18:1087, 1926.
9. Nelson, A. Nature, 118;804, 1926.
10. Rees, B, Jour. Dept. Agri. Victoria, 8:770—773, 1910.
11. Staker, E. V. Jour. Am. Soc. Agron., 17:32—40, 1925.
12. Stewart, G. jour. Am. Soc. Agron, 18:743—760, 1926.
13. Stutz, H. Dissertation, Univ. Hamburg, 1933, (Biological abstracts No, 8975, 1935).