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EFFECT OF HEAT & COLD TREATMENTS ON THE GERMINATION OF LEUCAENA GLAUCA, BENTH

A method, of improving the germination of Leucaena glauca

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Leucæna glauca is a small tree belonging to *Mimisoidæ* having very wide distribution in the tropics. In this Province, it is largely found in the Circars growing in between hedges, fences and in waste lands in black clayey soils. The leaves and seeds form, good fodder and the thick stem and branches are used as fuel. The plant is quick growing and attains a highest of 10—12 feet within three years. It is deep rooted and spreads quickly and responds readily to pruning.

Recently the department of Agriculture, Madras has initiated a drive for raising this plant in all *porambokes*, waste lands, roadsides, fences etc., in view of its quick growth; and has advocated its use as a green manure plant to augment the manurial resources of this Province to increase the yield of paddy and exploit its use as fuel. At present large quantities of seed are being collected by the Agricultural Department for distribution to the ryots.

The plant fruits profusely and each fruit contains 15 to 25 seeds. The seeds are dark brown in colour and possess a shining hard testa or seed coat. It gets propagated alround its immediate vicinity by self sown seeds in all uncultivated areas. But the seeds when collected and sown are found to germinate very slowly and the germination genarally does not exceed over 10 per cent. Repeated trials carried out with different samples harvested and stored for different periods, have conclusively proved that the seeds are very poor germinators, when sown as such. This is mainly due to the impervious hard shining seed coat.

Several methods have been tried in the past by investigators to overcome impermeability and hardiness of seed coat in lucerne, indigo, oats, millets etc. Among these scarification or wearing down the seed coat is a well known method Reus (1910) Harrington (1916) and Stewart (1926). Davies (1928) tested the effect of high pressure on impermeable seeds of lucerne and obtained increased percentage of germination. Midgley (1926) observed that hard seeds of alfalfa germinated, when kept in moist condition for several months. Alteration of temperature and liquid air etc., have been used by Busse (1933) and Harrington (1916) and Midgley (1926) to induce permeability. Chandrasekhara Iyer (1940) has recommended sandpapering for scarifying Kolingi (*Tephrosia purpurea*) and tea. Nambiar (1944) found that germination could be improved by scarifying *Pterospis Suliflora* seeds by shaking them

with sand in metal containers. Amlong and Naundorf (1937) soaked seeds of different varieties of oats and radish, in β-indolyl acetic acid of 0·001 concentration and obtained better germination and larger plants. Grace (1938), Mc. Rostie and Hopkins (1938) and Templeman (1939) are some of the investigators who have used hormones for pre-treatment of seeds to induce better germination. The Government Agricultural Chemists, Coimbatore has indicated that boiling water is effective in inducing germination of *Leucœna glauca*. Chemical methods for inducing permeability without devitalizing the embryo have also been attempted by Hamley (1932) Rees (1910) etc. Chloroform ether, sulphuric acid, alcohol are a few of the reagents tried by many investigators. Yet most of these methods were not practicable in view of the intricate technique, cost and time taken. In order to overcome these drawbacks, several machines have also been designed in other countries to minimize the labour involved and to obtain the optimum degree of scarification for uniform and proper germination.

Initially a few of the above methods were employed to test the germination of *Leucœna glauca* and judge their efficiency with the results of germination secured from all these treatments. Table 1 gives the germination obtained by employing five different methods to scarify the seed coat and induce permeability.

TABLE I.

Showing the Percentage Germination of Scarified Leucœna glauca Seeds.

Treatment.	% of germination.	Duration Watched.	Remarks.
1. Hydrochloric acid (5 Minutes) 40%	2	45 days	Initiated on 6—9—1947.
2. Sulphuric acid 98% (1 minute) ...	6	do	
3. Sand Pounding ...	3	do	
4. Shaking with sand ...	1	do	
5. Hot water at 60°C ...	41	10 days	
6. Untreated ...	2	45 days	

It will be seen that none of the treatments have given satisfactory germination excepting hot water. The germination as observed in all the other treatments clearly shows that these treatments had very little effect in scarifying the seed coat. None of the seeds treated with chemicals were found to germinate even after two months, indicating that they are detrimental to the vitality of the embryo and do not promote appreciable permeability without devitalising the embryo.

In view of the above results, all the other treatments were dropped and temperature treatment alone was taken up for further study and trial in order to test its effect on the germination of *Leucœna glauca*.

Effect of Heat and Cold Treatments

Moistened seeds of *Leucæna glauca* were kept in germination trays at laboratory temperature after pretreatment with hot water for five minutes in water raised to 40°, 50°, 60°, 70°, 80°, 90° and 100°C. and compared with untreated seeds were kept in Electrolux refrigerator for 10 days at 0°, 10° and 20°C to observe the effect of chilling on germination.

The following table illustrates the results obtained :—

TABLE II.

Effect of Temperature on the percentage of germination of Leucæna glauca.

S. No.	Treatment.	Number germinated per day.											Remarks.
		1	2	3	4	5	6	7	8	9	10	Total.	
1.	100°C. 5 Minutes	...	...	...	...	...	...	...	...	...	...	...	Seed coat bursts; over 40% of seeds got cooked.
2.	90°C. ,,	...	...	1	1	1	...	...	...	...	...	3	About 20% got cooked.
3.	80°C. ,,	...	...	37	16	6	7	3	1	2	2	74	None of the seeds had burst seed coats.
4.	70°C. ,,	...	...	45	18	7	3	1	1	2	1	78	do.
5.	60°C. ,,	...	...	43	7	...	1	1	2	1	1	56	do.
6.	50°C. ,,	...	...	26	6	2	1	...	1	...	1	37	do.
7.	40°C. ,,	...	...	20	...	8	2	...	...	...	...	30	do.
8.	30°C. ,,	...	...	16	...	7	...	...	...	...	...	23	do.
9.	20°C. ,,	...	...	...	...	...	...	...	...	...	...	...	Seed coats of a few were injured.
10.	10°C. ,,	...	...	...	...	...	...	...	...	...	...	...	do.
11.	0°C. ,,	...	...	...	...	...	...	...	...	...	...	...	Seed coat burst and over 30% were injured by chilling.

The above trials were repeated twice with different samples with a view to assess the effect of different temparatures and almost similar results were secured.

It was found that treatments at temperatures above 80°C as well as below 30°C have shown far lower percentage of germination than the others. Extremes are found not only to inhibit germination but also act detrimentally on the vitality of the seeds. A majority of the seeds treated beyond 90° and at 0°C showed bursting of the seed coat and at 100°C, a mealy fluid oozed out from burst seed coats indicating the cooked state of the cotyledons. This was subsequently confirmed after repeated trials even after pre-treatment with ceresan and mercuric chloride. Owing to the cooked effect at higher temperatures, the fungus found easy access through the broken seed coat despite all antiseptic

pre-treatment of the seed. From the above results it can be safely inferred that the extremes of temperature are detrimental to the germination of *Leucaena glauca* and that the seeds do not tolerate such degrees of extreme heat or cold.

In order to assess the effect of the length of time for inducing optimum permeability and germination, in subjecting the seed to heat and cold treatment, another trial was carried out. In this, the seeds were immersed in hot water of varying temperature immediately after removing the flame for varying lengths of time, viz. 5, 10, 15, and 30 minutes. At lower temperatures, the moistened needs were kept continuously for 24 hours at 0°, 10°, and 20° C. and alternately at the same temperature for 12 hours and the results are illustrated in Table III.

TABLE III.

The percentage of Germination of Leucaena glauca subjected at different temperatures to varying lengths of time.

Serial number	Treatment.	Percentage of Germination.					
		5 Min.	10 Min.	15 Min.	30 Min.	12 Hrs	24 Hrs.
1.	100°C	33	36	6	6	Alternative.	Continuous.
2.	90°C	30	39	37	32	...	...
3.	80°C	75	71	74	69	...	...
4.	70°C	80	76	71	71	...	...
5.	60°C	55	31	20	19	...	...
6.	50°C	32	32	29	19	...	...
7.	40°C	30	23	21	25	...	...
8.	30°C		Laboratory temperature.			18	
9.	20°C	...	...	...	...	27	21
10.	10°C	...	...	...	...	16	5
11.	0°C	...	...	...	...	3	...

From the above figures it will be noticed that beyond 80°C, at higher temperatures as well as with the increase in the duration of treatment beyond 5 minutes, generally the response in germination decreases. Temperature around 70—80°C., promotes over 75% germination against five min., pre-treatment. Soakings for further intervals do not give higher germination as the temperature of water goes down abruptly beyond the five minutes interval, once the flame is removed. A trial was made by field sowings to gather evidence regarding the range and extent of germination with heat treatment at 75°C over untreated ones to judge conclusively the efficiency of this method. Seeds of *Leucaena glauca* were immersed in hot water to 75°C for five minutes and were immediately sown in regular lines in the field along with untreated ones in alternate plots. The following table gives the results of germination.

Effect of Heat aad Cold Treatments

TABLE IV.

	Treat at 75°C for five minutes.	Untreated seeds (control.)
First day	...	...
Second day	...	...
Third day	...	...
Fourth day	11	28
Fifth day	26	27
Sixth day	127	23
Seventh day	146	23
Eighth day	42	25
Nineth day	55	...
Tenth day	17	...
Total ...	424	126
Percentage of germination ...	70·2	21·0

Treated seeds have given nearly thrice as much germination as the untreated seeds and have shown maximum germination within a week of sowing against a meagre percentage of germination obtained from untreated ones.

The seedlings germinated from untreated and treated ones grew in the normal manner and there was very little difference in their growth. Nor any injurious residual effect or symptoms due to heat treatment were noticed. The growth measurements taken at weekly intervals are given below :—

TABLE V.

	Seedlings from Treated seeds.	Seedlings from Untreated seeds.
	Mean growth extension in cms. of 100 seedlings.	
First week	3·4	3·6
Second week	1·8	1·4
Third week	2·9	2·5
Fourth week	3·1	3·1
Total	11·2 Cms.	10·6 Cms.

Summary and Conclusions. Poor and slow germination of *Leucaena glauca* is due to the or impermeable dark brown shining and glossy seed coat. In the several samples teated over 80 per cent failed to absorb water. It was found that this impermeability could be remedied by

soaking the seeds in hot water raised to about 75 to 80°C or by soaking the seeds in boiling water cooled to 75 to 80°C. Hence it is suggested that the seeds can be immersed in water for five minutes, by boiling and allowing it to cool down for sometime to get the optimum temperature for securing maximum germination, with least detriment to their vitality.

By the above procedure it is hoped that the entire quantity of seeds of *Leucaena glauca* collected can be utilised.

1. Of the several treatments attempted to scarify the seed coat, heat treatment alone was found effective.

2. Seeds of *Leucaena* glauca a valuable green leaf manure and quick growing plant possess a shining hard testa, which is impermeable to water.

3. Temperatures between 70—80°C were found to cause the seed coat to swell and increase permeability and thus facilitate over 75 percent germination.

4. Extremes of temperature beyond 80°C and less than 10°C cause bursting of the seed coat and these injure germination.

5. Immersing seed at longer intervals beyond 5 minutes in hot water of varying temperatures does not induce further permeability to any appreciable degree.

6. Heat treatment between 70 to 80°C for five minutes does not produce any injurious effect on the seeds.

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