GERMINATION STIMULATION IN PINUS PINASTER.

by E. R. Hopkins.

SUMMARY.

Continued poor germination results with Pinus pinaster seed, of Portuguese origin, coupled with recent adverse nursery conditions have indicated the need to provide better germinating conditions for nursery management.

Trials were initiated in 1958 to test the effectiveness of germination stimulation procedures in overcoming the problem. Tests carried out covered treatments incorporating two different periods of seed soaking accompanied with a subsequent seven weeks' stratification period. The seed was sown with and without drying.

Treatments used in the trial were designed on the basis of earlier results obtained by the Department during the period 1940-1952, and a prescription outlined by David for Pinus pinaster seed in France.

The project was carried out on a large scale (150 lbs. of seed) with a view to developing a suitable technique for the bulk handling of the annual nursery requirements. A scheme of operations suggested for handling southern pine seed was modified for the present purposes.

Treatments were successful at all stages of testing over a germination period of 8½ weeks in both sand flats and nursery beds. Rate of germination and total germination percent were materially improved by treatments over this period.

The most successful and practical treatment tested consisted of an 8 day seed soaking in water at room temperature followed by a seven week stratification period at 36°F. Seed was dried before sowing. The following results were obtained:-

	Germination percent for time in days after sowing							
	7	14	21	28	35	42	49	56
Control	-	-	6%	28%	42%	51%	56%	61%
Treatment	-	1%	31%	55%	62%	70%	72%	74%

Results are significant at the 0.01 level of probability in all cases.

This performance should be increased appreciably by extending the stratification period to twelve weeks as was found optimum by David.[3]

INTRODUCTION:

Portuguese Pinus pinaster seed has consistently provided poor germination performance under State nursery procedures. This behaviour is not entirely local and has been reported from overseas sources familiar with pinaster handling.

The major problem withthe seed in nursery management is the slow and uneven rate of germination coupled with a general low germination percent. In the former case it is not unusual for the seed to be still germinating in the beds eight weeks after time of sowing and in exceptional seasons, germination periods up to twelve weeks have been recorded. Total germinations, as determined by sand flat tests at Collier, vary from 50% to 80% and generally average between 50% and 60%.

The main disadvantages experienced with slow and varied germination, apart from the resultant uneven planting stock obtained, is the difficulty of efficiently using a follow up mineral oil weedicide spray on the beds and the increased susceptibility of the seedlings to damping off. Seeds that remain in the soil for three to seven weeks prior to germinating are extremely susceptible to any soil pathogens present. Weak germination vigour can also increase the damage due to damping off pathogens. Both Hamel and Gnangara nurseries have experienced considerable losses in Pinus pinaster due to damping off and unknown causes in recent years. It is considered that these losses would be appreciably reduced by using improved seed.

Gibson[1] has also pointed out the possible increased damping off risks due to heavily sowing seed of poor germination to obtain reasonable emergent populations.

During the period 1940-1952 work was initiated by the Department in an attempt to provide a standard stimulation procedure to improve nursery germination performance. Numerous trials including hot and cold soaking, mechanical abrasion, chemical dipping and both moist and dry cold storage were carried out. Results were generally confusing and conflicting. The following main points did arise from this work -

(1) Stratification (cold, moist storage) was generally beneficial.

(2) Cold soaking may be beneficial.

(3) The problem with Pinus pinaster is not one of a true seed dormancy but largely the result of a high percentage of non-viable and weak seeds present in seed supplies.

In 1958 it was decided, in the face of the poorer nursery returns of recent years, to follow up this work with a bulk test in order to prescribe a general treatment for future sowings. Methods of handling large quantities of seed were adapted from a procedure outlined by P. C. Wakely for Southern pine seed.[2] Treatment techniques followed those outlined by David[3] working with Pinus pinaster seed in France.

Materials and Methods.

150 pounds of seed was soaked and placed into storage. Six treatments were tested -

(1) 8 days' water soaking at room temperature followed by 7 weeks' moist cold storage at 36°F. Seed sown moist.

(2) 1 day's water soaking at room temperature followed by 7 weeks' moist cold storage at 36°F. Seed sown moist.

(3) Seed soaked for three hours immediately prior to sowing. Seed sown moist.

(4) As for treatment (1) + seed dried prior to sowing.

(5) As for treatment (2) + seed dried prior to sowing.

(6) Normal storage seed sown as per normal prescription.

All seed used in the trial was of the single batch, serial number 2110. 10 pound of serial 2109 was included purely to add bulk to the trial and was not subsequently tested for treatment effects except under nursery conditions.

Prior to soaking, seed was weighed into 5 pound lots and stapled into 15" x 12" calico bags to form a dry pack approximately 12" x 12" x 1½" in size. Each bag was labelled with an aluminium permo-tab to show the serial number and treatment information.

Soaking was carried out in a large enamel bath, ensuring that the water volume was at least four times the seed volume. 110 pound of seed was soaked for 8 days and 40 pound soaked for 1 day.

To hold the seed during storage, six galvanised iron bins, each of internal dimensions 24" x 16" D. and fitted with a loose lid, were purchased. A slatted wooden false bottom 3 inches deep with a hessian cover was constructed for each drum to permit bottom drainage and aeration throughout the cold storage period. Hessian covers prevented the sawdust packing medium from draining away with the water.

Clean pine sawdust, thoroughly moistened by 24 hours' soaking, was used as the moist stratification medium. Prior to packing, the sawdust was drained for 2 hours to remove surplus water.

Bins were packed with approximately four times the volume of sawdust to seed volume. A 2 inch layer of packing at least, separated each seed bag enabling 25 pounds of dry weight seed to be stored per bin.

The six bins were placed in cold storage on June 24th and removed on August 11th, a period of seven weeks. Temperatures were maintained between 35°F. and 38°F. and on the two occasions tested were constant (inside the bins) at 36°F.

Slight surface drying out was noticed after three weeks and rectified by lightly spraying the sawdust surface with water.

On removal from cold storage, hand samples were taken from each bag to provide a group seed sample for both the 8 day and 1 day soaking lots. From these samples, and untreated seed, germination trials for treatments (1), (2), and (3) were commenced on a basis of 8 replications and a 100 seed unit.

The remainder of the samples together with the bulk of the stratified seed were dried for a period of 18 hours in an electric drying frame normally used for seed extraction.

Germination tests for treatments (4), (5) and (6) were set up from the dried group sample and an untreated seed control held in the seed store. These tests were based on six replications of a 100 seed unit.

All germination tests were carried out at Como in sand flats with bottom watering.

Nursery inspections and counts were also made for the treated bulk seed at the various nursery centres.

Results.

(a) Sand-flat tests.

Percentage germination figures for the six treatments as recorded by counts up to sixty days from commencement of test are set out in Table I. These values are expressed graphically as a continuous record in Graph I. (Not available in this report).

Table I.

Treatment	Percentage germination for time in days										
	18	20	22	24	28	32	37	42	46	53	59
1.	13	23	39	51	57	62	65	67	69	70	71
2.	5	11	24	37	57	64	69	72	74	75	76
3.	0.	0.	3	14	26	32	41	46	48	51	54
4.	10	23	40	50	55	60	64	70	71	73	74
5.	3	8	15	20	27	38	51	64	69	72	73
6.	0	3	9	16	28	37	45	51	54	59	63

Graph II shows the percentage germination in the various treatments at intervals of 3, 5, 7 and 8 weeks.(Not available in this report).

Table II sets out an analysis of the various results for 3,6 and 8½ week germination periods.

Analysis of Variance.

Treatment	3 weeks Mean	Diff. for Significance	F.	6 weeks Mean	Diff. for Significance	F.	8½ weeks Mean	Diff. for Significance	F.
1.	32.0			67.2			71.5		
2.	15.8	0.05=8.57		71.3	0.05=10.73		76.7	0.05=8.10	
3.	1.3		21.84	47.0		7.42	52.5		11.01
4.	32.5	0.01=11.56		69.3	0.01=14.48		74.1	0.01=10.96	
5.	12.2			63.2			73.5		
6.	2.3			51.5			62.3		
	F. at 0.01 = 3.86			F. at 0.01 = 3.86			F. at 0.01 = 3.86		

(b) Nursery Results.

Table III contains the results of nursery counts carried out at Gnangara for both stratified and unstratified seed. These are indicated graphically in Graph III. (Not available in this report)

Table 111.

Serial No.	Nursery Bed	Seed Treatment	Date sown	Count per foot of Nursery Line 5 Sept 1958	12 Sept 1958	19 Sept. 1958	26 Sept 1958	3 Oct 1958	10 Oct. 1958	17 Oct 1958
1901	1	Unstrat.	8/8/58	0.8	4.0	7.6	11.1	11.0	10.5	11.6
1901	2	"	"	1.3	4.7	10.6	12.9	14.0	15.0	15.7
2110	2	Stratif.	13/8/58	3.8	9.7	13.0	14.2	13.7	15.0	14.5
2110	2	"	"	3.8	9.0	12.3	13.4	13.4	13.3	13.7
2109	3	"	"	2.8	7.7	12.7	14.6	14.0	13.3	14.5
2110	3	"	"	6.3	9.0	14.4	13.0	14.9	14.6	14.7
2109	3	Unstrat.	8/8/58	0.4	3.5	8.8	10.8	11.3	11.7	11.3
1901	2	"	"	-	6.0	9.9	13.8	15.0	16.1	16.1
1901	2	"	"	-	5.7	12.8	14.5	16.0	16.5	17.0

Discussion.

All treatments were of significant (0.01 level) advantage over all stages of the germination period. Eight days' cold soaking followed by the seven weeks' cold storage period and drying the seed proved to be the most satisfactory of the several combinations tested.

Total germination percentage was slightly increased by treatments over the period of counting. It is to be noted, however, that control seed was still germinating after 8½ weeks. The important point is that for a reasonable maximum germination period of 5 weeks, treated seed gives a more rapid and even germination than untreated seed.

The fact that results are consistent under both controlled and normal nursery conditions suggest that the treatment can be adapted as a general prescription for future P. pinaster seed handling.

Improved results are anticipated in future work. The method outlined by David states that a 12 week cold storage period is optimum. This was not possible in the present trial but future trials will be designed to allow for a minimum cold storage period of three months.

Procedure as outlined is satisfactory with one exception. It was noted that the 5 lb. seed bags, when wetted, swelled considerably and it is considered that a four pound dry lot would be more suitable to ensure even treatment during the cold storage period. Smaller lots would also provide a further safety factor against seed "heating" during the storage period.

Conclusion.

(1) Stratification with Pinus pinaster seed of Portuguese origin is beneficial to the subsequent germination behaviour.

(2) Of several treatments tried, all were highly significant in increasing the germinative energy of seed lots tested and over the period of the trial, increased total germination percentage considerably.

(3) The most suitable treatment for practical application is an eight day soaking in water of room temperature plus at least 7 weeks' cold moist storage at 36°F. Seed should be dried prior to distributing to nurseries. Extending the cold storage period to 12 weeks would probably result in an optimum benefit.

(4) Nursery counts and observations indicate that stratification is of practical general value in the nursery handling of this seed and in general adoption would -

(i) Decrease the quantity of seed sown per annum.
(ii) Provide strong, rapid and even germination.
(iii) Offer through (ii) a counter to damping off, inclement season and a sound basis for the continued use of P.R. 46 weedicide.

REFERENCES.

1. Gibson, 1956. Sowing density and damping off in pine seedlings. East Afr. Agric. J. 21 (3).

3. David R. and Guerindon, A. 1953. Stimulating effect of cold on the germination of seeds of Pinus pinaster. For. Abstr. 14 Nos. 274 and 275.

2. Wakeley, P.C. 1954. Planting the southern pines. U.S. Agriculture, Dept. off. Agriculture monograph no.18. page 55.

FOREST DEPARTMENT OF WESTERN AUSTRALIA

FOREST NOTES

NUMBER 1. FEBRUARY, 1959.

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