EFFECT OF ACCELERATED AGING ON SEEDS OF *PINUS ROXBURGHII* SARG.

MUHAMMAD TAHIR LAEEQ, ASSTT. SILVICULTURIST PAKISTAN FOREST INSTITUTE, PESHAWAR.

ABSTRACT

To study the effects of accelerated aging on seeds of chir pine (*Pinus roxburghii* Sarg.) three seed lots from different localities were subjected to AA at 41°C for 24, 36, 48, 60, 72, 96, and 120 hours. The AA time affected the seed germination and PV significantly and all the three seed lots were found significantly different from each other. Moisture content of seeds continuously increased with increasing AA time. Lot A had the highest vigor followed by lot B, while lot C was the lowest in vigor.

INTRODUCTION

High cost of various forest operations in regeneration and establishment of forest lands necessitate the production of the high quality planting material. Thus, utilization of high quality seeds provides a foundation for ensuring an economically successful future forest crop. Sustained supply of quality seed through proper storage is an important factor in successful implementation of afforestation programs. The purpose of seed storage is to maintain the highest possible seed quality for the desired period of time by minimizing the rate of deterioration and preserving seed vigor.

Vigor is an important character of seed which relates to seed quality and storability. Vigor is defined by the Association of Official Seed Analysts (AOSA) as "those seed properties which determine the potential for rapid uniform emergence and development of normal seedlings under a wide range of field conditions" (AOSA, 1983). The information about vigor is important in making economic decisions regarding the cost of seeds, earliness of planting, quantity of seeds to plant, and the anticipated uniformity of stand.

Vigor tests for seeds are important, since the actual field emergence of a seed lot may be less than the percent germination determined by the standard seed germination test (AOSA, 1983) which is carried out under optimum conditions of temperature and moisture. These conditions are seldom available in the field. Moreover, the germination test fails to account for the progressive nature of seed deterioration. These weaknesses have developed interest in vigor testing to provide information about the quality of seed lots not revealed by the standard germination test (Copeland and McDonald, 1985). A number of tests are presently used to evaluate the vigor of seed. The Accelerated Aging Test (AAT) is one of the stress tests for seed vigor (AOSA, 1983). The basis for this test is that seeds of high vigor can tolerate high temperature and high humidity conditions, while seeds of low vigor are not as tolerant of these conditions and lose their germinative capacity earlier than high vigor seeds. In the AAT the seeds are subjected to high temperature (40 to 45°C) and high relative humidity (almost 100 percent) for varying lengths of time after which a germination test is conducted.

Chir pine (*Pinus roxburghii* Sarg.) is one of the most important timber species of Pakistan. Large quantities of seeds of this species are collected and stored for raising nurseries. The quality of seeds during storage period could be

affected by storage conditions and it should be monitored on regular basis. Association of Official Seed Analysts and International Seed Testing Association have recognized its authenticity as a vigor test for a variety of seeds (AOSA, 1983). Bonner (1984) conducted this test for a number of forest tree species including *P. taeda* and *Quercus* spps. and identified AAT as a potential and useful test for forest tree seeds. In this study three seed lots of chir pine collected from three different localities were used to study the effects of accelerated aging on seeds and find out the suitability of AAT for chir pine seeds.

MATERIALS AND METHODS

Three seed lots of chir pine (*P. roxburghii* Sarg.), collected from the localities of Danoi, Marghozar, and Mingora and designated as lot A, B, C, were utilized in the studies. Before the start of AAT the seeds were rinsed in water for 30 seconds to remove traces of fungicides/insecticides and then surface dried with blotting paper. Before starting the AAT the initial moisture content was determined. The procedures suggested by AOSA (1983) were adopted for the AAT. One hundred randomly selected seeds were placed on bronze wire mesh in plastic containers 14 x 14 x 5 cm in size. Forty ml of distilled water were added to each container and a lid put in place. There were four replications of aging containers for each of the three seed lots within each of the seven aging time periods (24, 36, 48, 60, 72, 96, and 120 hours). These containers were placed in a Stults accelerated aging chamber which was set to maintain a constant temperature of 41°C. After the predetermined accelerated aging treatment time the seed containers designated for that particular aging time were removed from the aging chamber. A zero aging time served as a control for each seed lot. Moisture content of seeds after each aging treatment was also determined.

Stults cabinet-type wet box germinators were used for the germination test. Two hundred seeds selected randomly from plastic aging containers after each aging time treatment were placed on Kimpack (K-22) as germination media. The germination was carried out at alternating temperatures of 20°C and 30°C with dark and light periods of 16 and 8 hours, respectively. Germination of seeds in each replication and for all treatments was recorded daily. Percent germination and Peak Value (PV) for each treatment was determined. Percent germination was the average percentage of normal seedling germination of four replicates at the end of the prescribed period for germination (30 days). PV is the maximum mean daily germination (cumulative percentage of total seed germination) divided by number of days elapsed since sowing date reached at any time during the period of the test (Czabator, 1962).

To compare the results of germination of seeds after aging with germination under less then ideal conditions, 200 seeds of each seed lot were sown in plastic tubes and placed in a glasshouse where temperature, humidity and light were not regulated. Two times a day irrigation through a fine water spray was provided to keep the soil moist. Germination was recorded daily and percent germination and PV were determined. The data were analyzed by using the statistical package of SAS (Anonymous, 1987).

RESULTS AND DISCUSSIONS

Effect on germination

The three seed lots were found significantly different from each other (Table 1) in their response to AA. Lot A had the highest average seed germination percent over time (74.9) followed by lot B (43.6) with lot C having the lowest germination percent (16.7). When comparing

germination percent of each seed lot within AA time regime, each seed lot was significantly different from the other at every level of AA time. Each seed lot maintained its position with respect to each other and exhibited a downward trend of germination with increase in AA time. The AA time significantly affected the germination capacity of seeds (Table 2). The aging time of 60 hours was not significantly different from 72 hours. While the rest of the aging hours were significantly different from each other. The highest germination percent (59.3) was obtained before any AA, while the lowest (26.3 %) was after an AA time of 144 hours. The analysis of variance indicated a strong interaction between time and seed lot ($p=0.0001$). It is quite evident from the above data that lot A was highly vigorous as compared to the other two lots. Lot C was the lowest in vigor. The seed lots can be differentiated on the basis of responses to AA. Ram and Wiesner (1988) reported in their studies that seed lots differed from each other in germination values after the AA test, and the decline in germination is related to the degree of deterioration of the seed lots viz. germination of high vigor lots remains high and low vigor lots show a marked decline in germination.

Effect on seed moisture content

In the initial stages of AA up to 36 hours of aging time there was a rapid increase in seed moisture content (Figure 1). Later on it increased gradually and continuously with the increasing AA time.

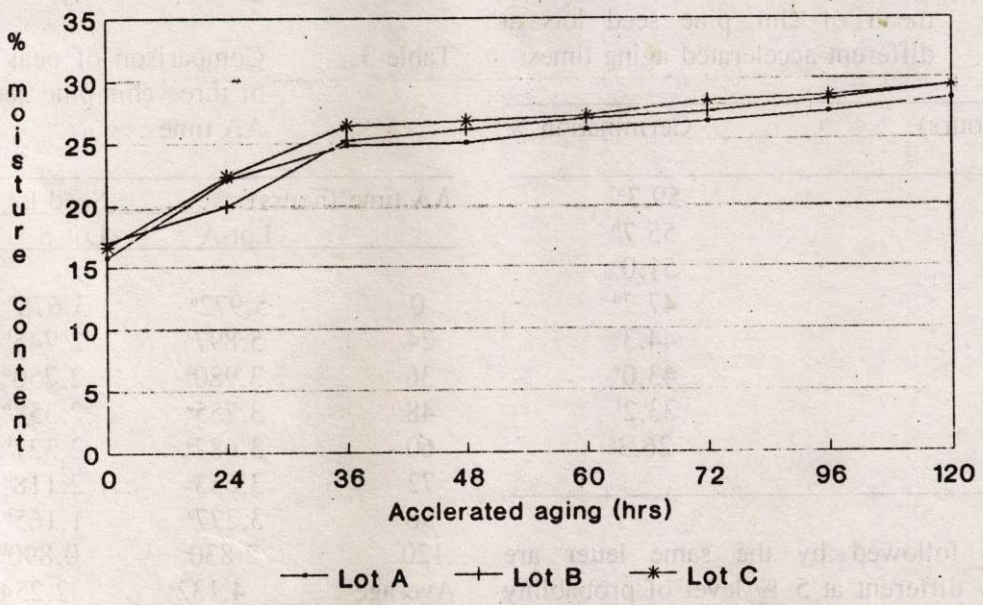

Figure 1. Moisture content of 3 chir pine seed lots at different AA times.

Table 1. Comparison of germination percent mean of three chir pine seed lots within AA times.

AA time (hours)	Seed lot		
	Lot A	Lot B	Lot C
	germination %		
0	87.5[a]	63.5[b]	27.0[c]
24	92.0[a]	53.5[b]	21.5[c]
36	84.5[a]	49.5[b]	19.0[c]
48	77.5[a]	49.0[b]	16.5[c]
60	72.5[a]	47.5[b]	13.0[c]
72	71.0[a]	45.0[b]	13.0[c]
96	65.0[a]	22.0[b]	12.5[c]
120	49.5[a]	18.5[b]	11.0[c]
Average	74.9[a]	43.6[b]	16.7[c]

Means not followed by the same letter are significantly different at 5 % level of probability by the LSD test within each row.

Table 2. Combined germination percent mean of chir pine seed lots at different accelerated aging times.

AA time (hours)	Germination %
0	59.3[a]
24	55.7[b]
36	51.0[c]
48	47.7[d]
60	44.3[e]
72	43.0[e]
96	33.2[f]
120	26.3[g]

Means not followed by the same letter are significantly different at 5 % level of probability by the LSD test.

Effect on Peak Value

The AA treatment affected the PV of seeds significantly. The three seed lots were significantly different from each other on the basis of PV (Table 3). Lot A had the highest mean (4.132) followed by lot B (2.254), while lot C indicated the lowest PV (0.847). The PV of the seed lots at each AA time were found significantly different from each other. All the seed lots maintained their order of superiority throughout AA time. PV of each seed lot indicated a downward trend with the increasing AA time. As a chir pine seeds indicating the possibility of use of PV as an indicator of seed vigor of chir pine seeds. AA time and PV of chir pine seeds indicating the possibility of use of PV as an indicator of seed vigor of chir pine seeds. AA time and PV of chir pine seeds indicating the possibility of use of PV as an indicator of seed vigor of chir pine seeds. AA time and PV of chir pine seeds indicating the possibility of use of PV as an indicator of seed vigor of chir pine seeds.

Table 3. Comparison of peak value means of three chir pine seed lots within AA times.

AA time (hours)	Seed lot		
	Lot-A	Lot-B	Lot-C
0	5.972[a]	3.678[b]	1.350[c]
24	5.897[a]	2.745[b]	1.122[c]
36	3.980[a]	2.750[b]	0.975[c]
48	3.755[a]	2.358[b]	0.782[c]
60	3.687[a]	2.327[b]	0.682[c]
72	3.653[a]	2.118[b]	0.657[c]
96	3.277[a]	1.165[b]	0.610[c]
120	2.830[a]	0.890[b]	0.597[c]
Average	4.132[a]	2.254[b]	0.847[c]

Means not followed by the same letter are

significantly different at 5 % level of probability by the LSD test, within each row.

Glass - house germination

All the three seed lots were found significantly different from each other when germinated in the glasshouse (Table 5) as was found in the laboratory germination. Lot A had the highest germination percent (44.5) followed by lot B (31.5) while lot C had the lowest germination percent (21.0). The statistical analysis of PV of the three lots did not show any significant difference between lot A and B, while lot C was significantly different from lot A and lot B. Comparing the germination in the laboratory at optimum germination conditions to the germination in the field, it is clear that laboratory germination gives much higher germination than the one in the field.

The AA technique for testing the vigor level in pine seeds has already been found effective (Blanche and et al., 1988) and Marquez (1989). It seems that this technique is equally good for determining the vigor of chir pine seeds.

Table 4. Combined peak value means of chir pine seed lots at different accelerated aging times.

AA time (hours)	Peak Value
0 (control)	3.67[a]
24	3.25[b]
36	2.57[c]
48	2.30[d]
60	2.23[d]
72	2.14[d]
96	1.68[e]
120	1.44[f]

Means not followed by the same letter are significantly different at 5% probability level by the LSD test.

Table 5. Germination percent and peak value means of three chir pine seed lots germinated in the glasshouse.

Seed lot	Germination %	Peak value
Lot A	44.5[a]	1.265[a]
Lot B	31.5[b]	1.110[a]
Lot C	21.0[c]	0.587[b]

Means not followed by the same letter are significantly different at 5 % level of probability by the LSD test.

CONCLUSIONS

The accelerated aging time affected the germination of seeds. The three seed lots were found significantly different from each other on the basis of laboratory as well as glass house germination. The seed lots were found significantly different for PV also. Moisture content of seeds continuously increased with increasing AA time. Lot A had the highest vigor followed by lot B, while lot C was the lowest in vigor. Accelerated aging test can be used in differentiating different seed lots on the basis of their vigor level. However, further detailed studies are required to standardize the accelerated aging test to assess the vigor of chir pine seeds.

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REFERENCES

Anonymous. 1987. SAS (Release 6.04). SAS Institute Inc., Cary, NC 27512-8000, USA.

Association of Official Seed Analysts. 1983. Seed Vigor Testing Handbook. Contrib. No.32. 88 p.

Blanche, C.A., W.W. Elam, J.D. Hodges, F.T. Bonner, and A.C. Marquez. 1988. Accelerated aging of selected tree seeds. In: J. Werral, J. Loo-Dinkins, D.P. Lester, comp., eds. Proceedings 10th North American Forest Biology Workshop. University of British Columbia, Vancouver, B.C. pp.327-334.

Bonner, F.T. 1984. New forests from better seeds: the role of seed physiology. In: Seedling physiology and reforestation success (pp. 37-59). M.L. Duryea and G.N. Brown (eds.). Martinus Nijhoff/Dr. W. Junk Publ., Dordrecht, The Nederlands.

Copeland, L.O., and M.B. McDonald. 1985. Principles of seed science and technology, 2nd ed. Burges Publishing Co., Minneapolis, MN. pp.321.

Czabator, F.J. (1962). Germination value: an index combining speed and completeness of pine seed germination. Forest Science. 8:386-396.

Marquez-Millano, A.M. 1989. Changes in vigor, leachate conductivity, and fatty acid composition of seeds of Pinus eliottii Engelm. var. elliottii and P. taeda L. following accelerated aging. Ph.D. Dissertation, Department of Forestry, Mississippi State University. USA.

Ram, C. and L.E. Wiesner. 1987. Effect of artificial ageing on physiological and biochemical parameters of seed quality in wheat. Seed Sci. & Technol. 16:579-587.