Journal of Tropical Forest Science 11(2):503–506 (1999)

NOTES

EFFECT OF ETHEPHON ON DORMANCY AND GERMINATION OF LOBLOLLY PINE (*PINUS TAEDA*) SEED

K. Vanangamudi*, J. S. Zope & W. W. Elam

Department of Forestry, School of Forest Resources, Mississippi State University MS 39762, United States of America

Elucidation of the role of ethylene in seed germination and dormancy of loblolly pine (*Pinus taeda* L.) is not only of scientific interest but of economic interest as this pine is one of the most economically important tree species in the Southern United States. In 1984, it was the predominant species used in reforestation of about 100 000 acres in 11 states of the U.S. (9 states in the Southeast among the 11) (USDA Forest Service 1985). Genetically improved, costly, seed-orchard produced seeds were used to produce over 1.3 billion seedlings in the United States and over half of them were loblolly pine. The relative cost may be reduced through improved efficiency in the usage of genetically improved seed.

Loblolly pine seed is dormant stratification-requiring orthodox seed. The recommended pre-germination treatment is cold stratification (33–41°F in a moist medium) for 30 to 60 days (USDA Forest Service 1974). A treatment which would shorten this period is desirable. This study was designed to determine the influence of ethephon concentration (2-chloroethyl phosphonic acid), an ethylene-producing chemical, on the germination of loblolly pine seed lots, having different moisture contents.

Loblolly pine seed lots designated LO 064, LO 065 and LO 067 possessing 54, 50 and 37% germination respectively were stored for two months at 2 °C prior to the study. The seed lots were treated to attain three moisture levels, i.e. control (dry seed) for low moisture content (8.9 to 9.8 %), soaked overnight (20.1 to 20.5%) and stratified at 3 °C in a moist medium for 30 days (24.3 to 25.0%) (USDA Forest Service 1974). Moisture contents were determined gravimetrically using the oven-drying procedure and expressed as a percentage of the fresh weight (Bonner 1979). The seeds were surface sterilised with 2.7% sodium hypochlorite for 5 min to avoid external contamination followed by repeated and thorough washing with distilled water and then dried to remove surface moisture. The seeds were then soaked in ethephon concentrations of 1, 10, 100 and 1000 ml l^{-1} for 3, 6, 12 and 24 h.

Completely randomised design was used for the study. Four replicates of 25 seeds each were germinated on moistened cellulose sheets (Kimpak). During each 24 h cycle, the seeds were exposed to 8 h light at 30 °C followed by 16 h darkness at 20 °C in a germinator (AOSA 1981). Germination was counted three times a week for 28 days. Abnormal seedlings were recorded and ungerminated seeds were cut to determine the dormant and dead seeds.

All parameters differed significantly among the seed lots, seed moisture, ethepon concentration and soaking time in ethephon (Table 1). Statistical significance was observed in some of their interactions for germination, ungerminated seed, abnormal seedlings and dead seed as shown in the table.

The seed lots responded differently to ethephon. Seed lots LO 064 and LO 065 responded better than LO 067 (Figure 1). The seed lots were obtained from different

**Author for correspondence. Address: Seed Science and Technology, Forest College and Research Institute, Mettupalayam 641 301, Tamil Nadu, India.*

seed orchards and possessed wide differences in the extent of dormancy as revealed from the initial seed quality evaluation. Besides the low germination, LO 067 also had the highest ungerminated seed percentage even after stratification and ethephon treatment. Though no research reports are available in tree species, ethylene studies on weed species have shown that the response of seed to ethylene is dependent on factors such as the nitrate content of the seed. According to Egley (1984), Saini *et al.* (1986) and Saini and Spencer (1987), seed nitrate content modulates the dormancy-breaking effect of ethylene. Probably, this concept may also be applicable to tree species.

Table 1. Statistical significance for germination test in loblolly pine seed as influenced by seed lot, seed moisture, ethephon concentration, soaking time in ethephon and their interactions*

	Germination	Ungerminated seed	Abnormal seedlings	Dead seed
Seed lot (SL)	**	**	**	**
Seed moisture (SM)	**	**	**	**
Ethephon conc. (EC)	**	**	**	**
Soaking time (ST)	**	**	**	**
SL X SM	ns	ns	ns	*
SL X EC	**	ns	ns	ns
SL X ST	ns	ns	ns	**
SM X EC	**	ns	**	ns
SM X ST	ns	**	ns	ns
EC X ST	**	ns	ns	**

* Statistical significance for two-way interactions are furnished only;
* Significant at 0.05 probability; ** Significant at 0.01 probability;
ns Not significant.

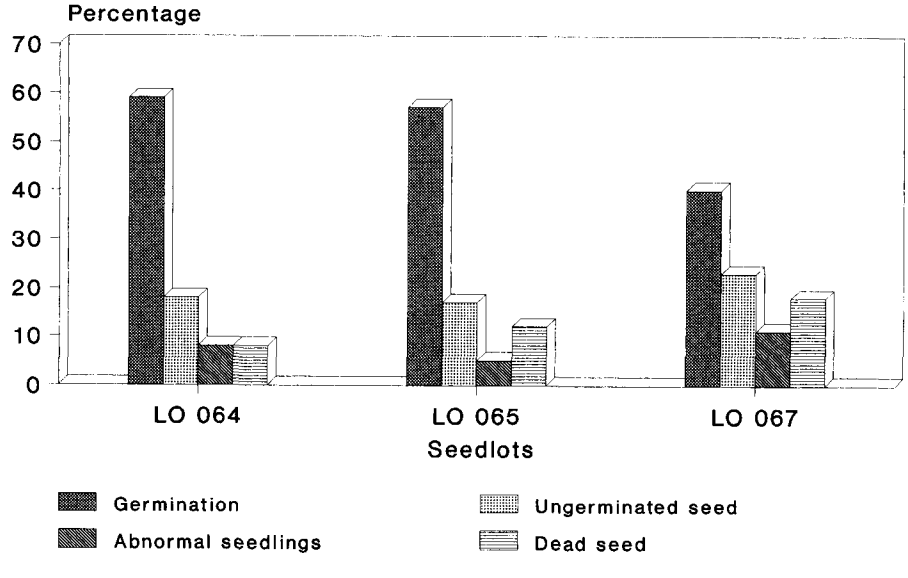

Figure 1. Response of seedlots to ethephon in loblolly pine

Low moisture seed and soaked-overnight seed responded similarly but stratified seed responded best to ethephon (Figure 2). According to Sinska and Gladon (1984), application of ethephon to the seed stratification medium increased the germination of apple seed. Though there was not much difference in the moisture content between soaked-overnight and stratified seed, the better response of stratified seed to ethephon might be due to physiological changes during stratification.

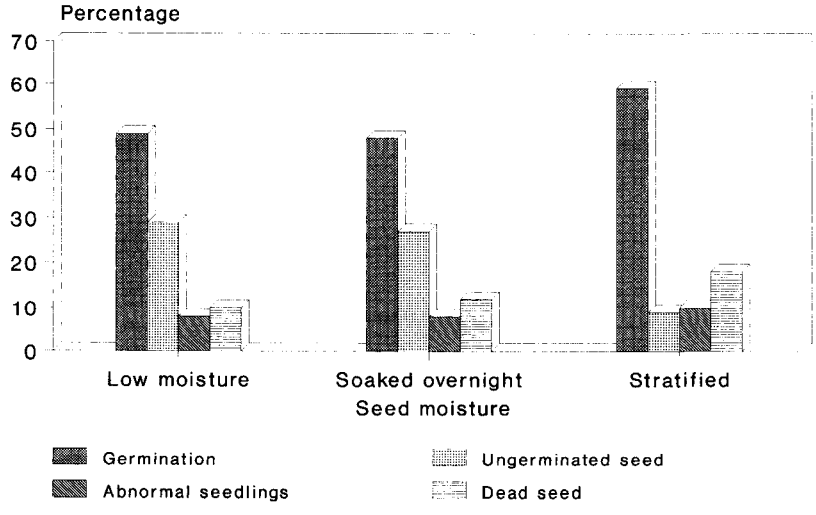

Figure 2. Response of loblolly pine seeds with different moisture to ethephon

The optimum ethephon concentration used in this experiment to enhance the germination of loblolly pine seed was 100 ml l^{-1}. The highest concentration reduced the germination percentage and increased the percentages of the abnormal seedlings and dead seed (Figure 3). Sinska and Gladon (1984) in apple and Saini and Spencer (1987) in *Chenopodium album* also recommended 100 ml l^{-1} ethephon to break the dormancy.

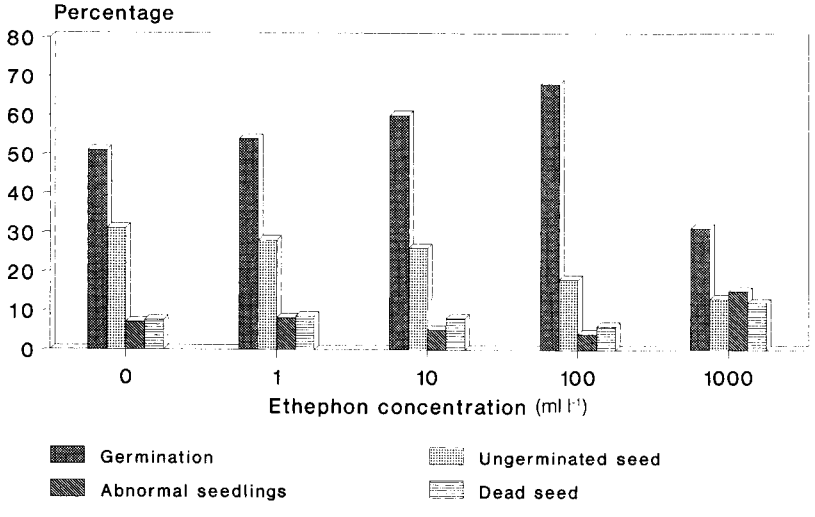

Figure 3. Optimum ethephon concentration to improve germination of loblolly pine

The optimum soaking time in ethephon was 6 h to improve the germination of loblolly pine seed. Beyond this time, the germination decreased while the number of abnormal seedlings and dead seed increased (Figure 4).

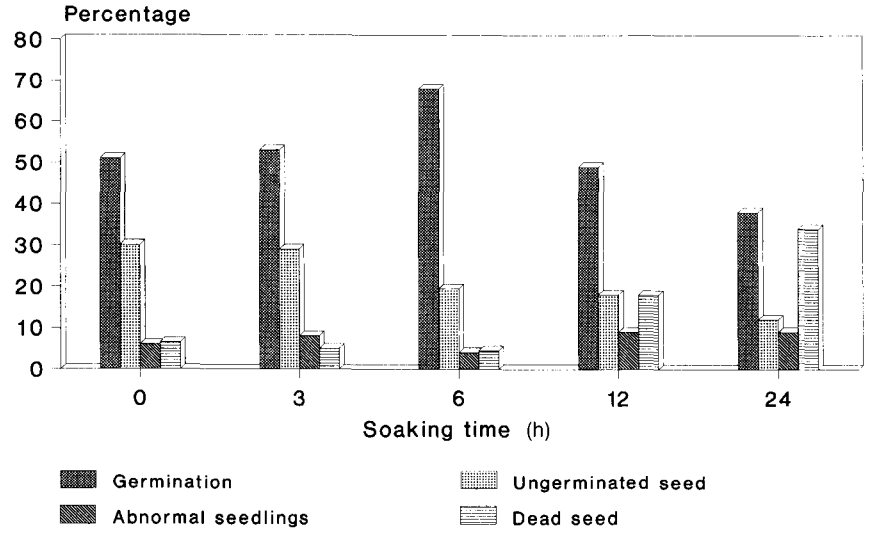

Figure 4. Optimum soaking time in ethephon to improve germination of loblolly pine

Acknowledgements

The first and second authors wish to thank USAID-ICAR (India), Winrock International, and their respective universities for providing the opportunity to undergo one-year training in Tree Seed Technology. The authors also wish to thank the Department of Forestry, School of Forest Resources, Mississippi State University, USA, for providing the facilities to carry out this research.

References

ASSOCIATION OF OFFICIAL SEED ANALYSTS (AOSA). 1981. Rules for testing seeds. *Journal of Seed Technology* 6:1–126.

BONNER, F. T. 1979. Measurement of seed moisture in *Liriodendron, Prunus* and *Pinus*. *Seed Science and Technology* 7:277–282.

EGLEY, G. H. 1984. Ethylene, nitrate and nitrate interactions in the promotion of dark germination of common purslane seeds. *Annals of Botany* 53: 833–840.

SAINI, S. H., & SPENCER, M. S. 1987. Manipulation of seed nitrate content modulates the dormancy breaking effect of ethylene on *Chenopodium album* seed. *Canadian Journal of Botany* 65: 876–878.

SAINI, S. H., BASSI, P. K. & SPENCER, M. S. 1986. Use of ethylene and nitrate to break seed dormancy of common lambsquarters (*Chenopodium album*). *Weed Science* 34:502–506.

SINSKA, I. & GLADON, R. J. 1984. Ethylene and the removal of embryonal apple seed dormancy. *Hort Science* 19:73–75.

USDA FOREST SERVICE. 1974. *Seeds of Woody Plants in the United States*, U.S. Department of Agriculture Handbook. 450 pp.

USDA FOREST SERVICE. 1985. *The U.S.D.A. Forest Service Planting Report*. U.S. Department Agriculture Forest Service. 40 pp.