RODENTS DAMAGE PRIMARY- AND SECONDARY-NEEDLED PONDEROSA PINE SEEDLINGS

Rodent damage accounts for nearly 50 percent mortality and is similar for primary- and secondary-needled ponderosa pine containerized seedlings in New Mexico.

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Rodent depredation is an important factor in limiting ponderosa pine *(Pinus ponderosa* Laws.) seedling survival in the Sacramento Mountains, New Mexico (*2, 4*). In conjunction with drought injury, rodents are major contributors to seedling mortality, which is often greater than 70 percent.

There is usually more damage to containerized stock than to bareroot nursery stock (2). In contrast to 2-0 nursery stock, greenhouse-grown, containerized seedlings are typically planted when less than 1 year old (6). Containerized seedlings are frequently dominated by primary needles at planting time because secondary needles generally do not appear prior to second growing season bud burst (5). Primary-needled seedlings are typically faster growing because of greater photosynthetic efficiency (1). A study by DeVelice (3) showed that ponderosa pine with primary needles at 1 year were significantly taller (21.4 cm vs. 14.8 cm) than seedlings with predominantly secondary needles. Fast growth rates create seedlings with succulent stem tissues, whereas stems of slower growing secondary-needled seedlings become ligneous. Succulent stems may make primary-needled seedlings more attractive to rodents than those with secondary needles.

The practice of planting containerized seedlings is becoming increasingly popular (*10*), and much research is needed to ensure high survival and growth potential. Since variation in ontogenetic needle development exists among containerized seedlings of the same age, close examination of such variation may lead to improvement in planting stock quality. This note compares rodent damage on containerized ponderosa pine seedlings having either primary or predominantly secondary needles.

Materials and Methods

Seed was collected from squirrel caches in seed zone 840 of the Sacramento Mountains, New Mexico (*8*). Seedlings were greenhouse-grown in 65-cubic-centimeter Ray Leach tubes filled with a 2:1 (v/v) mixture of peat and vermiculite. The seedlings were grown under 24-hour equivalent lighting and were watered and fertilized three times per week. Relative humidities averaged 56 percent and temperatures varied from 21 to 29° C.

The field study was initiated when the seedlings were 6 months old. At that time, approximately 10 percent of the seedlings were strictly primary needled, 50 percent exhibited a mixture of primary and secondary needles, and 40 percent were dominantly secondary needled. Only primary-needled and dominantly secondary-needled seedlings were selected for field planting (fig. 1).

Plantings were conducted at two sites in the Sacramento Mountains during August 1977. One plantation was located at an elevation of 2,150 meters in Bear Canyon; the other plantation was at an elevation of 2,300 meters near the village of Sacramento. Both plantations are on north-facing aspects with 8-10 percent slopes and have deep, well-drained, fine-textured soils. The plantations are located in openings of fire origin within the ponderosa pine zone.

The plantation experimental design was a randomized block consisting of seven treatments within five contiguous blocks. Within each block, five seedlings were planted for each treatment. Primary- and secondary-needled seedlings were planted on 1-meter spacing and two of the treatments (the remaining five treatments were part of another study) in columns 5 meters long and rows 1 meter wide. The treatments were randomly placed within each block. A total of 25 seedlings of each treatment were planted per plantation. Site preparation consisted of scalping a 0.5-meter by 0.5-meter area for each seedling. Each

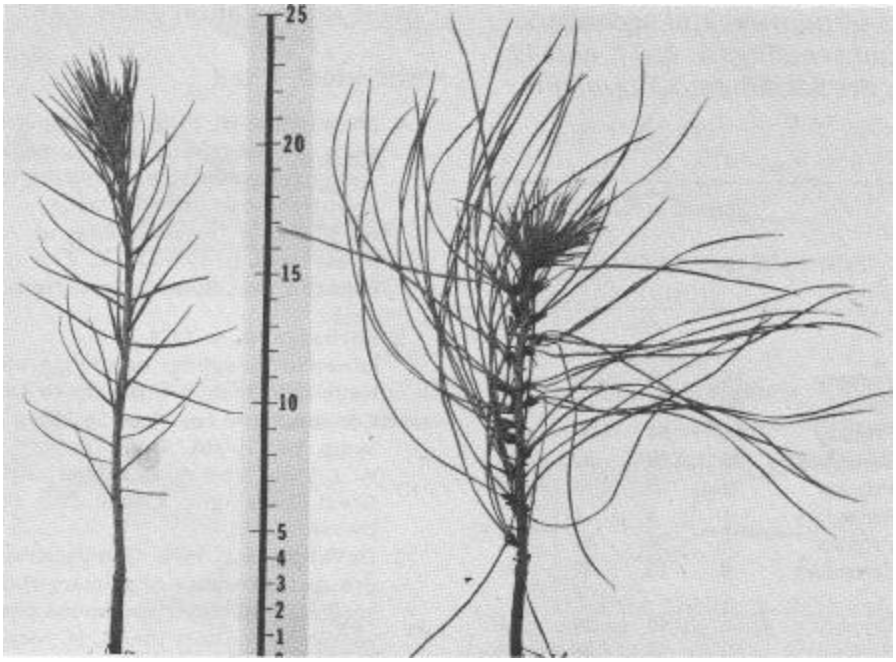

Figure 1.—*Primary- (left) and secondary- (right) needled ponderosa pine containerized seedlings at 1 year (scale in cm).*

plantation was 7 meters by 25 meters.

Seedling survival and mortality were evaluated 5, 8, 11, and 19 months after planting. The following four seedling condition classes were used in the evaluation: (1) Living, no rodent-damage; (2) living, rodent-damaged; (3) dead, no rodent-damage; and (4) dead, rodent-damaged. If a seedling in the living, rodent-damaged class subsequently died, it was relegated to the dead, rodent-damaged class following death, with rodent-damage the assumed cause of death.

The data were analyzed statistically using chi-square (*9*).

Results and Discussion

In our original hypothesis, we expected a higher incidence of rodent damage on primary-needled seedlings because their succulence is greater than the more woody secondary-needled seedlings. However, at each evaluation date within a plot (table 1), the two seedling types showed no statistical difference for the various seedling condition classes. Results indicate that within an area, survival, death, and rodent damage are similar for primary- and secondary-needled seedlings. Radwan (*7*) observed that mammals select roughage foods occasionally, i.e., foods high in fiber and lignin usually associated with maturity. The rodents' may be eating the more mature secondary-needled seedlings as a source of roughage and the primary-needled seedlings as a more digestible food source. The rodents' lack of preference may also suggest that the two seedling types have similar nonstructural chemical composition (*7*), e.g., sugars, nutrients, oils.

Since no statistically significant seedling condition class differences were found for the two seedling types, the data for the seedling types were combined within a site. The combined data (primary- plus secondary-needled seedlings) are expressed graphically to demonstrate seedling condition class changes through time at the two planting sites (fig. 2).

For these combined data, there were significant differences ($P < 0.05$) within the seedling condition classes between the two planting sites. Generally, rodent damage was more severe at Bear Canyon, which resulted in fewer living trees with no damage—after 19 months, 26 percent of the seedlings were living without

Table 1.—*Seedling condition classes of primary- and secondary-needled ponderosa pine containerized seedlings 5, 8, 11, and 19 months after planting at two sites in the Sacramento Mountains, New Mexico*

Site	Condition class	Type	Percent in condition class			
			5 mo	8 mo	11 mo	19 mo
Bear Canyon						
	Living w/out rodent damage	Primary	36	0	0	0
		Secondary	60	4	4	4
	Living w/ rodent damage	Primary	56	64	36	28
		Secondary	36	76	52	36
	Dead w/out rodent damage	Primary	0	0	0	0
		Secondary	4	4	4	4
	Dead w/ rodent damage	Primary	8	36	64	72
		Secondary	0	16	40	56
Sacramento						
	Living w/out rodent damage	Primary	52	40	24	24
		Secondary	52	52	36	28
	Living w/ rodent damage	Primary	32	36	20	20
		Secondary	16	16	12	12
	Dead w/out rodent damage	Primary	4	8	24	24
		Secondary	0	0	16	24
	Dead w/ rodent damage	Primary	12	16	32	32
		Secondary	32	32	36	36

rodent damage at Sacramento and only 2 percent at Bear Canyon. This suggests that rodent damage can be quite variable among sites, which has been previously observed by Buchanan (2).

Seedling condition classes apparently approached stability 1 year after planting (fig. 2). Therefore, assessing seedling conditions after 1 year may be a reliable indicator of a site's reforestation potential.

Summary and Conclusion

Rodents had no apparent preference for the primary- or predominantly secondary-needled seedlings. Survival and rodent damage varied considerably at the two sites, but in both instances, survival (average 38 percent) is inadequate for economical reforestation. Rodent loss after 19 months was nearly 50 percent, indicating that some form of rodent control must be incorporated to meet reforestation goals.

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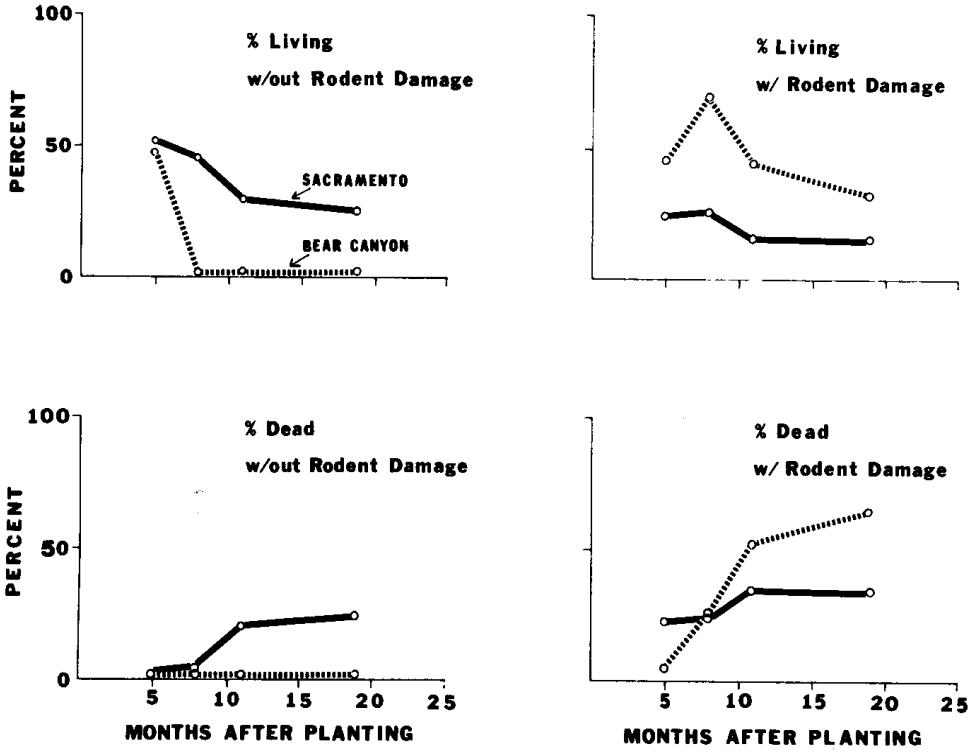

Figure 2.—*Seedling condition class changes through time for ponderosa pine containerized seedlings at two sites in the Sacramento Mountains, New Mexico.*

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