SUITABILITY OF ASPEN PLANTING STOCK FOR ESTABLISHMENT IN THE SOUTHERN ROCKIES

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Abstract.-- Four aspen (*Populus tremuloides* Michx.) seedling stock types were planted at two high elevation sites in southern (1982) and northern (1983) New Mexico. Each study independently evaluated early (May) and late (July) plantings, and stock types: bareroot and 164-cm^3, 350-cm^3 and 870-cm^3 containers. Site and planting date influenced stock type performance. July is the superior planting date for container seedlings. Survival was generally highest among the 164-cm^3 and 350-cm^3 stock types with July planting improving survival on the southern site and growth on the northern site.

Additional keywords: *Populus tremuloides*, hardwood stock type, fire fuel break, forestation.

INTRODUCTION

The geographic range of quaking aspen (*Populus tremuloides* Michx.) in western North America spans more than 40 degrees latitude. More than 200,000 hectares are occupied in New Mexico, Arizona and the adjacent San Juan Basin (Jones and Trujillo 1975) where aspen forests provide many human benefits and renewable resources.

An important benefit of aspen is its role in redirecting the course of wildfire. In the southern Rockies, aspen has a lower fire potential than conifer types, and can provide a critical fuelbreak. Aspen flammability has been estimated to be less than half that of adjacent conifers (Fechner and Barrows 1976). This might explain why wildfires spreading from high elevation conifer forests have been observed to die out in aspen. Healthy aspen stands are regarded by fire managers as relatively fireproof. It follows that maintenance and establishment of aspen are useful

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fire management practices, particularly in mountain resort areas where ignition is likely and the potential for loss of resource value and life is great.

At present, land managers in the Southwest do not have an understanding of the steps necessary to grow aspen seedlings reliably and efficiently, or of those steps leading to fuelbreak establishment. Through a U.S. Forest Service-Eisenhower Consortium cooperative research project begun in 1981, we have developed or refined greenhouse, nursery, site preparation and weed control practices leading to aspen establishment. This paper reports the effects of aspen stock type on planting success.

METHODS

Two separate experiments were established, one in the Sacramento Mountains of south-central New Mexico in 1982, the other 1 year later in the Sangre de Cristo Mountains, 3 degrees latitude and 360 km to the north. The southern site (elevation 2,650 m) annually receives about 700 mm of precipitation, 550 mm of which are lost to evapotranspiration. The northern site (elevation 2,870 m) is more moist, averaging 900 mm precipitation and 400 mm evapotranspiration.

Aspen seeds were collected in early June 1981 from open-pollinated clones growing from 2500 to 2600 m elevation about 15 km northeast of Santa Fe, New Mexico. Seeds were processed by Harder's (1970) method and stored in the manner described by Benson and Harder (1972). Container seedlings were greenhouse grown for 17 weeks. Bareroot seedlings were produced in accordance with methods described by Benson and Einsphar (1962) and Benson and Dubey (1972). Stock types compared in the studies are described (Table 1).

Table 1. Description of four aspen stocktypes planted at two experimental sites.

Container Volume	Production Growing Density	Ht. (cm) $\bar{x}$ / range	Cal. (mm) $\bar{x}$ / range
164 cm^3	514/ m^2	34/ 28-40	4.0/ 2.2-4.4
350 cm^3	290/ m^2	45/ 35-60	4.1/ 2.2-4.5
870 cm^3	200/ m^2	55/ 45-65	4.8/ 3.6-5.2
Bareroot	130/ m^2	70/ 62-85	5.4/ 4.0-5.8

Sites were rototilled about 20 cm deep before planting with power augers. Seedlings were arranged in 3 m X 5 m, 40-tree rectangular plots in five replications at each site. Periodic hand weeding controlled weeds. Duplicate split-block experimental designs were used for both studies. At each site, main treatments tested May and July planting dates and subtreatments tested the stock types.

Survival and growth 1 year from planting were evaluated. At the southern site, only height growth was monitored, but in the north, stem caliper was also measured. Arcsine transformations were performed on the survival percentages before analysis (Little and Hills 1978). Treatment effects were compared with the protected LSD ($p \leq .05$). Relative growth rate (RGR) was calculated to determine changes in seedling height or caliper or both over time. A positive RGR reflects seedling growth relative to the seedling's size at planting. Negative RGRs indicate moderate to severe stem dieback with replacement by a resprout. RGR was calculated as follows:

$$RGR = \frac{m_2 - m_1}{m_1} \times \frac{1}{t_2 - t_1} \times 100$$

where

RGR = relative growth rate

m_1 = initial size at planting

m_2 = second measurement

t_1 = time at first measurement (in years)

t_2 = time at second measurement (in years)

RESULTS

Southern Site

Stock types were evaluated within each planting date (Fig. 1) because the planting time X stock type interaction was significant. One-year survival was higher for July-planted stock (54%) receiving late summer seasonal rains, than for May-planted stock (43%). Soil moisture to a depth of 30 cm was 30% at May planting but fell to 15% by mid June. Among May-planted trees, 73% of the bareroot seedlings were alive 1 year after planting, but survival among container stock types was uniformly poor, averaging 32%. For the July planting, survival was highest among 164-cm^3 and 350-cm^3 stock, and lowest among bareroot and 870-cm^3 container stock (Fig. 1). All stock types suffered stem dieback (Table 2) caused by drought. Because of dieback, trees averaged about 60% less height and caliper than when planted.

Fig. 1. One-year survival of four aspen stock types planted May and July, 1982 in the Sacramento Mountains, NM. Letters indicate significant differences within each planting date, as determined by the protected LSD ($p \leq .05$).

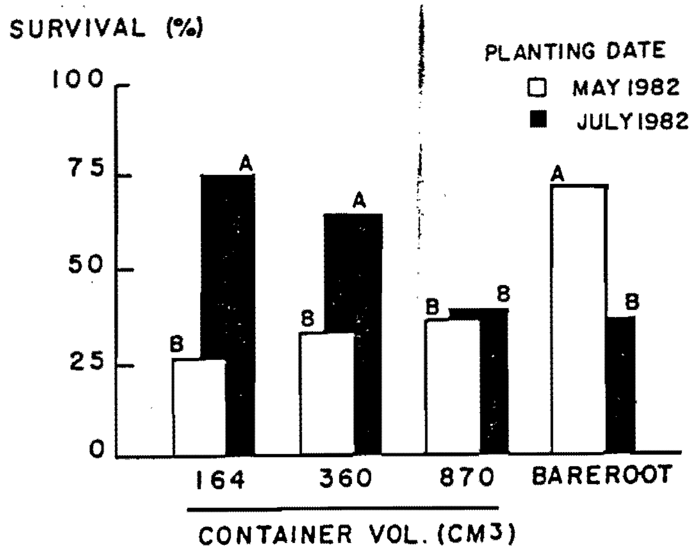


Table 2. Relative height growth (RHG) and relative caliper growth (RCG) of four aspen stocktypes 1 year from planting at two experimental sites.

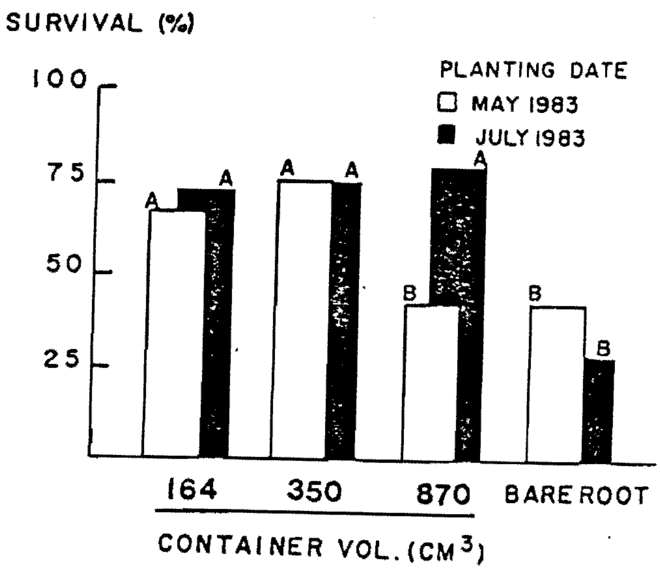
Stocktype	Southern Site		Northern Site			
	RHG (%/yr.)		RHG (%/yr.)		RCG (%/yr.)	
	May	July	May	July	May	July
Container						
164 cm^3	-58.2ab	-69.5c	12.6a	27.0a	37.2a	76.6c
350 cm^3	-72.1bc	-66.5bc	14.8a	23.6a	45.1a	105.5ab
870 cm^3	-76.6c	-48.2a	-22.9b	17.3a	17.2bc	81.0bc
Mean	-68.9	-61.3	1.44	22.6	33.1	87.7
Bareroot	-41.3a	-58.9abc	-39.9c	-65.8b	0.0c	-38.6d
Planting Date Mean	-62.0	-60.7	-8.88	0.48	24.8	56.0

Column values with the same letter are not significantly different ($p \leq .05$) as determined by protected LSD.

Northern Site

More moisture at this site yielded higher overall survival and growth than recorded for the southern site, although statistical comparisons between sites can not be made. Soil moisture to a depth of 30 cm did not fall below 24%. Overall survival was slightly higher for July-planted stock than May-planted stock (63% vs 57%). July-planted seedlings grew considerably better than May-planted stock (Table 2). Among May-planted stock, survival was highest for 164-cm^3 (68%) and 350-cm^3 stock (76%) and lowest for bareroot (42%) and 870-cm^3 container stock (42%) (Fig. 2). Among July-planted seedlings, survival across containers did not differ significantly (av. 74%) and was clearly superior to bareroot survival (27%). Container growth after July planting was also superior (Table 2). For the smaller container types, survival was similar for planting dates but more growth occurred after July planting.

Fig. 2. One-year survival of four aspen stock types planted May and July, 1983 in the Sangre de Cristo Mountains, NM. Letters indicate significant differences within each planting date, as determined by the protected LSD. ($p \leq .05$).



DISCUSSION AND CONCLUSIONS

Site and planting date influenced stock type performance. Survival across stock types planted at both sites indicates that the July planting date is superior to May. Specifically, survival and growth of container stock types were generally best when seedlings were planted in July rather than May. Among the 164-cm^3 and 350-cm^3 containers, July planting clearly improved survival at the southern site and growth at the northern site. May-planted bareroot stock performed satisfactorily at the southern site, apparently because transpirational surface area was minimal and growth was delayed during the May-June drought. However, in three of the four test plantings, survival among the smaller containers was considerably higher, averaging 70% or more. The 164-cm^3 container yielded greater than 75% survival on herbicide experimental sites found adjacent to stock type test areas (Fisher and Neumann, in press).

The overall more favorable first year response of the containerized stock corresponds with similar aspen field performance tests in Michigan (Okafo and Hanover 1978).

The stocktype recommended for establishing aspen in the southern rockies is the 164-cm^3 container. Survival of seedlings grown in 164-cm^3 containers was not exceeded by the larger containers produced at greater cost. The container seedlings used in this study bore fully expanded leaves. Possibly, container stock without leaves will have higher survival potential and this merits attention, particularly for planting droughty sites in early spring.

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