frost-heaving. On the refuse, 39 per. cent of the seedlings were dead, but on the spoil, only 3 percent.

From these data, it was very_ evident that plastic containers were susceptible to frost-heaving and thus not suited for revegetation of bituminous coal-mine spoils.

Examination in the fall of 1972, after the third growing season, showed that survival rate of the container-grown red pines had continued to decrease (table 2). This trend was more apparent on the coal-breaker refuse where only seedlings in the peat pots had fair survival-59 percent, however, it was much higher than the survival for the hare-root seedlings-38 percent. This fact is worth stressing because other studies have shown complete mortality to poor survival of 2-year-old red pines planted on this same site.

The poor survival and meager 1972 height growth of all seedlings (including bare-root) on the coalbreaker refuse emphasize the adverse characteristics of this spoil.

On the strip-mine spoil, survival of individual container-grown seedlings and bare-root seedlings was much higher than their counterparts on the coal-breaker refuse. Total and 1972 height growth of seedlings was also greater on the strip-mine spoil.

Survival for bare-root red pines was 90 percent. and it can be assumed that the spoil characteristics *were* favorable for establishing vegetation. Of the containers, best survival was for peat pots and Jiffy-7's, 79 and 73 percent respectively: the other containers had survival below acceptable levels.

The 1972 height growth of the red pines in the peat pots exceeded that of bare-root seedlings by 3 cm and height growth in the Jiffy-7's for this year was only 2 cm less than the latter. The seedlings growing in the asphalt tubes, though they had poor survival, equaled the 1972 growth of the hare-root seedlings, and those in the large perforated plastic tubes also showed a respectable growth for the year.

Total height growth of the red pines in all containers, except Ontario tubes, compared favorably with the total height growth of the hareroot seedlings, considering that the container-grown red pines were 2 years younger.

The data. though limited, show that the larger containers have more potential for establishing vegetation on coal-mine spoils than the smaller ones. In particular, the peat pots and Jiffy-7's can provide adequate seedling survival and satisfactory growth on marginal to good quality spoils. Harsh or problem spoils may require amendment treatments and/or larger containers.

Frost-heaving of the Conwed plastic and Ontario-hype tubes was so severe that their use for afforestation on these spoils is not recommended.

Present economic considerations may prohibit large-scale production of containerized seedlings. However, the fact that plantable seedlings can be produced in 3 months could make this system attractive for small supplemental plantings or for largescale plantings should bare-root nursery seedlings be in short supply.

New Publications

Cooley, John H.,
1974. Planting technique and care of stock affect survival of planted red pine. USDA Forest Service Res. Note NC-159.

Careless planting was found to be the most important of several possible causes of excessive mortality of newly planted red pine. Distribution procedures and high shoot/root ratios were also implicated.

Knutson, Donald M4.
1974. Infection techniques and seedling response to dwarf mistletoe. Plant Dis. Reporter 58 (3) p. 235-238.

Coniferous seedlings less than 1 year old were successfully inoculated with *Arceuthobium* seeds which had been stored at 2° C and 75 percent relative humidity. The *Arceuthobium* seeds were germinated in 2 percent H, U and subsequently glued to the infection site with polyvinyl acetate. Aerial shoots of the dwarf mistletoe emerge in 100 150 days and flower in the second year. If pollinated, mature fruits result in 4 months.

Oliver, William W.
1974. Seed maturity in white fir and red fir. Pacific Southwest Forest and Range Exp. Stn., Berkeley, Calif. 12 p.. illus. (USDA Forest Serv. Res. Paper PSW-99)

White fir and red fir seed collected over a 2-month period in northern California was tested for germination of fresh and stratified seed. Ratio of embryo length to embryo cavity length was found to be the most useful index of seed maturity for white and red fir. Cone specific gravity also, was correlated with nearly all measures of seed germination. Data suggest that red fir cones should be collected as close to beginning of seed fall as possible. White fir cones should be collected within 3'/2 weeks of seed fall. White fir cones collected 4 weeks before seed fall can be artificially ripened, however. These cones yielded seed which germinated as completely and speedily as stratified seed from mature cones.