EFFECT OF DIFFERENT CONTAINER TYPES ON GROWTH OF BLACK LOCUST (*ROBINIA PSEUDOACACIA* L.) SEEDLINGS

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ABSTRACT

In view of the imporance of black locust (*Robinia pseudoacacia* L.) in afforestation programmes in northern Pakistan, four different trials of containers were used to see their effect on the growth or biomass of young seedlings of the species. Deepot was efficient to allow longer and better developed root system as compared to other containers. Total biomass of seedlings in deepot by mid-fall was also greater. Seedlings raised in polythene bag competed with deepot seedlings till late summer but the former excelled in most of the growth parameters in subsequent period.

INTRODUCTION

In Pakistan, there are two planting season viz. spring and monsoon. Outplanting of bare root deciduous seedlings, including black locust, in possible only in spring. Two-years-old seedlings are produced by sowing in spring, top clipping the following spring i.e. after one year in the flat and transplanting at a 9×9 inches spacing on ridges where they remain for another year. This practice is fairly costly in terms of time and space, yielding only 60% of the seedlings that were originally sown. One way to address the problem is to produce seedlings in sutiable containers for optimum biomass. This study, therfore, foucsed on determining the effect of kind, size and shape of containers on the growth of black locust seedlings.

LITERATURE REVIEW

The size and shape of containers do effect the quality of seedling of tree species. Matching the container size to the natural shape of the root distribution may stimulate both top and root growth. Klingoman and King (1983) showed that not only volume of container but its diameter had an effect on the dry weight of shoot and root. In a study comparing the effect of rigid green plastic containers and poly bags on seedling growth, Whitcomb (1983) found that root spiraling occurred in the rigid container when it reached the bottom. In poly bag, the root tips died when they were trapped in the folds at bottom and lateral roots formed, increasing fibrousness.

The shape of the container is also important in affecting future growth of the seedlings (Tinus and McDonald, 1979). A narrow deep container is more compatable with the growth habit for forest seedlings. The rigid wall containers with internal vertical ribs or grooves and bottom holes train the roots down and help egress through the holes. A large increase in volume associated with slight increase in diameter of a container, though, affects plant growth, economically limits increase in container diameter. Barnett (1974) found that growth in a 3/4 inch (2 cm) diameter tube was less than in the slightly larger one but no growth advantage was noticed in a tube with diameter greater than one and a quarter inch (3 cm) for loblolly pine. However, Cunningham and Geary (1989) found that large differences in container diameters and lengths caused only small differences in seedling shoot height and root collar diameter of *Eucalyptus camaldulensis*. They found marked increase in seedling shoot and root dry weights with the increase in diameters or lengths of the container. The container length also influence and shoot:root ratio. Keelas and Edgar

(1979) noticed a direct effect of container volume, rather than depth on shoot height of *Eucalyptus regnans*. On the other hand, Carlson and Endean (1976) found no effect on shoot length, shoot and root dry weight of white spruce by increasing the container volume 4 times (from 133 cm^3 to 524 cm^3) while holding the length:diameter ratio to 3:1 respectively. After changing length:diameter ratio to 1:1, there was significantly higher total dry biomass than the plants grown in 3:1 or 6:1 containers.

Kinghorn (1974) suggested that by using flat bottom pots and plastic bags, whether perforated or not, larger tops could be grown but the roots may be so coiled in the bottom resulting in the production of non-functional roots which may upset the shoot:root balance.

The ultimate aim of a nursery technique or seedling husbandry is to raise quality seedlings to ensure beteer survival and performance after outplanting. The aim of this study was not in the context of performance of seedlings after outplanting but to provide information on the effect of container types on seedling growth and form in the nursery.

MATERIAL AND METHOD

Different types of containers were used to investigate their effect on growth of black locust (*R.pseudoacacia*). These included plastic bags with 48 perforations of 5mm in diameter. These bags were fitted in collars in a way that their bottoms were touching the bench. There were two kinds of hard plastic containers: one ray leach supercell and another deepot, each with four holes at the base. These containers were fitted in their usual frames. The fourth kind was Spencer-Lemaire book planter (a compact batch of 6 containers). Rubber bands were tied around an entire batch. All the containers were filled, leaving 1 cm at the top for water (Table 1).

Table 1. Type of containers and their sizes

Name of container	Length × top diameter (cm)	Volume $(cm)^3$
Polythene bag	20 × 6.0	675
Deepot	25 × 6.25	640
Ray Leach cell	21 × 4	160
Sp. Lemaire	14 × 3 × 2.5	70

One pre-treated seed was sown in each container. The containers were randomly assigned to each of four replications and mist sprayed twice a day until germination was complete. Watering was continued according to need of the seedlings.

T avoid confounding effect of containers and fertilizers, medium dose of the latter was applied only 3 times to ensure survival of plants till the end of the experiment. The first random sample of 4 plants from each container type (treatment) was obtained in late summer and the second sample of 6 plants in mid-fall or growth analysis.

The experiment was laid out in a randomized block design with 4 treatments (containers). Analysis of variance was computed in the SAS personal computer package to find out the significance of container size/shape on the growth of the seedlings. Waller-Dunkan K. ratio (100) was used to compare the means at 0.05 level of significance.

The relationship between the volumes of containers was: one polythene bag = one deepot = 4 ray leach = 9.5 Spencer-Lemaire. In late summer, when growth was in progress, significant difference was observed in root length and total dry weight. The treatments explain at least 63% of variability in parameters as estimated with ANOVA for late summer and 73% for mid-fall.

RESULTS

Root length (cm) was minimum in Spencer-Lemaire seedlings and significantly different than ray leach and deepot seedlings by late summer (Fig.1). By mid-fall, it was significantly higher in deepot seedlings than the seedlings in rest of the containers. Similarly root weight was higher in deepot in mid-fall.

By late summer shoot length of seedlings in polythene bags was significantly higher than Spencer-Lemaire and ray leach seedlings (Fig.2). In mid-fall, it was significantly more in deepot than Spencer-Lemaire and ray leach seedlings.

The difference in shoot biomass was not significant between seedlings of polythene bags and deepots by late summer. It was higher in polythene bag seedlings than Spencer-Lemaire and ray leach container seedlings. In mid-fall, shoot biomass of deepot seedlings was higher than that of Spencer-Lemaire and ray leach.

Diameter of seedlings in polythene bags was at least 20% more and significantly higher than the seedlings in rest of the containers by late summer (Fig.3). Whereas by mid-fall it was 67% less and lower in Spencer-Lemaire seedlings.

Total plant biomass was lowest in Spencer-lemaire seedlings by late summer (Fig.3). In final sampling it was higher in deepot seedlings than that of the seedlings in Spencer-lemaire and ray leach.

DISCUSSION

The containers in this experiment were different in size as well as in shape. It was hypothesized that bigger size containers will produce bigger seedlings as container volume is directly related to the size of seedlings (Tinus and McDonald, 1979, Kellas and Edgar, 1979). Nevertheless, the length and diameter of containers was found more important than volume alone (Carlson and Endean, 1976). Cunningham and Geary (1989) further reported that small differences in shoot-height and diameter of seedlings of *Eucalyptus camaldulensis* by increasing diameter and length of containers.

Nearly all growth parameters wre maximum in seedlings with highest volume of the growting medium, though not proportionate to the increase in volume. Seedlings in Spencer-Lemaire were under stress from the very beginning due the to small volume (70 cm^3 of containers which was apparently not enough to meet their nutrient requirements. There was a very marginal increase in diameter between late summer and mid-fall sampling.

Seedlings in deepots had maximum growth rate in all parameters between late summer and mid-fall. In terms of percentage, there was 33% increase in shoot length, 97% in diameter, 170% in shoot dry biomass and 470% in root dry weight. These seedlings grew 2 times more in total dry biomass compared to seedlings in polythene bags and ray leach supercells.

On the basis of volume of growing medium it was expected that seedlings in the polythene bags would excel in growth. The results, however, indicated that these seedlings ranked second when adjudged on the basis of growth per unit volume of the medium and also on the basis of rate of growth (expressed as percent increase over original weight). The plausible reason could be the transparent nature of polythene tube that allowed growth of algae inside along the bag walls. The algae probably retained more water and caused stagnation resulting in inhibition of root respiration and normal root growth. This was evident from the root length which was disproportionately smaller to the container volume. On the other hand, tapering nature of deepots helped in guiding the roots downward. Tinus and McDonald (1979) proposed that narrow deep containers would be more suitable for growth of forest seedlings. However, the result of this experiment did not indicate that reduced root length of polythene bag seedlings was due to the nature and colour of the material of the polythene bag or its shape.

In terms of growth per unit volume of growing medium, ray leach supercells were the most efficient. Volume of growing medium in deepots was 4 times more than that of ray leach, whereas total dry biomass of seedlings was less than double. Carlson and Endean (1976) did not produce bigger white spruce seedlings by inceasing container volume 4 times while keeping the taper of the container constant.

It is not the volume of the container that determines growth of the seedlings but diameter, depth and diameter/depth ratio also play an important role. Kingman and King (1983) reported that containers less than an inch, and 4 inches (10 cm) in diameter tended to produce smaller Shumard's red oak seedlings in terms of dry weight than those closer to 2 inches (15 cm). Similarly 8 inches (120 cm) deep containers produced bigger seedlings than 4 inch or 16 inches (40 cm) containers. In this study, top diameter of deepots and polythene bags was almost equal but length and taper of deepots was probably more effective in inducing growth in the seedlings.

The plants in the Spencer-Lemaire attained least values in all growth variables in both sampling with the exception of shoot length and diameter in the first sampling. Results of late summer sampling revealed that plants in polythene bags had the maximum growth in all dependent variables followed by deepot seedlings. In mid-fall the results reversed and the seedlings in deepots had the maximum response followed by polythene bags except for diameter and nodulation.

CONCLUSIONS

Physical characteristics of seedlings can be changed by altering the dimension of containers. For planting on drier sites, seedlings with a low shoot: root ratio are required and this will need deeper containers relative to diameter. Wide and short containers will produce seedlings which can be suitable for wetter sites and deeper soils because of smaller root biomass. However, increase in diameter of container, whenever required, should be accompanied by appropriate decrease in length or associated with taper, as greater container volume may result in little increase in seedling biomass but may substantially increase production cost. In this experiment growth of seedlings in polythene bags was not different than that of deepot seedlings, whereas, the ratio of cost of containers was 1:10 respectively. On an economic basis, polythene bags are prefereable to any of other containers used in this study assuming that performance of seedlings after outplanting will also be not different.

As black locust is not traditionally raised in operation for only 100 days, therefore, the results cannot be projected beyond certain reasonable time frame.

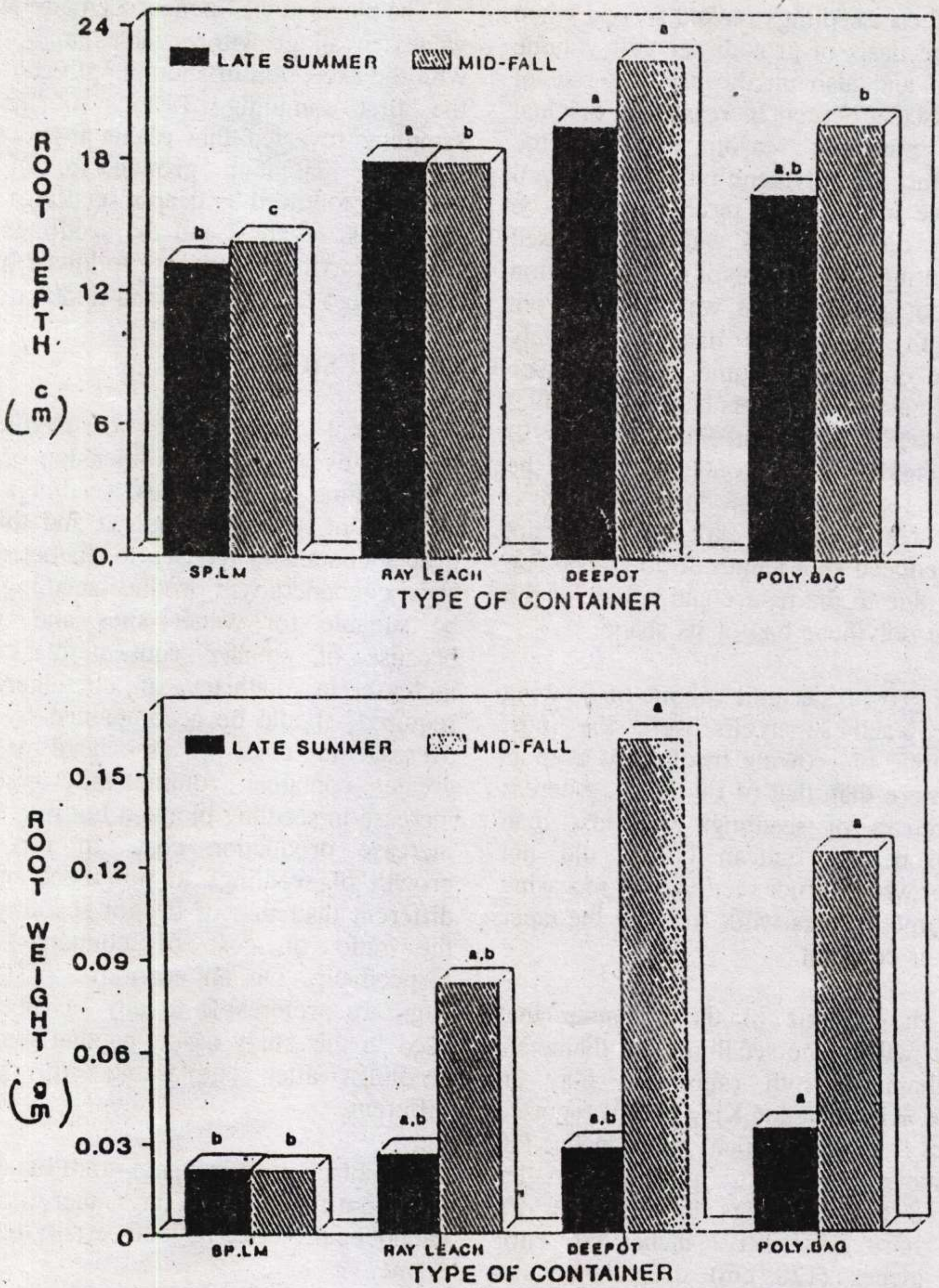

Fig.1. Effect of containers on root length and weight of black locust seedlings at 2 harvesting period.

*Bars of the same style with the same letters are not significantly different.

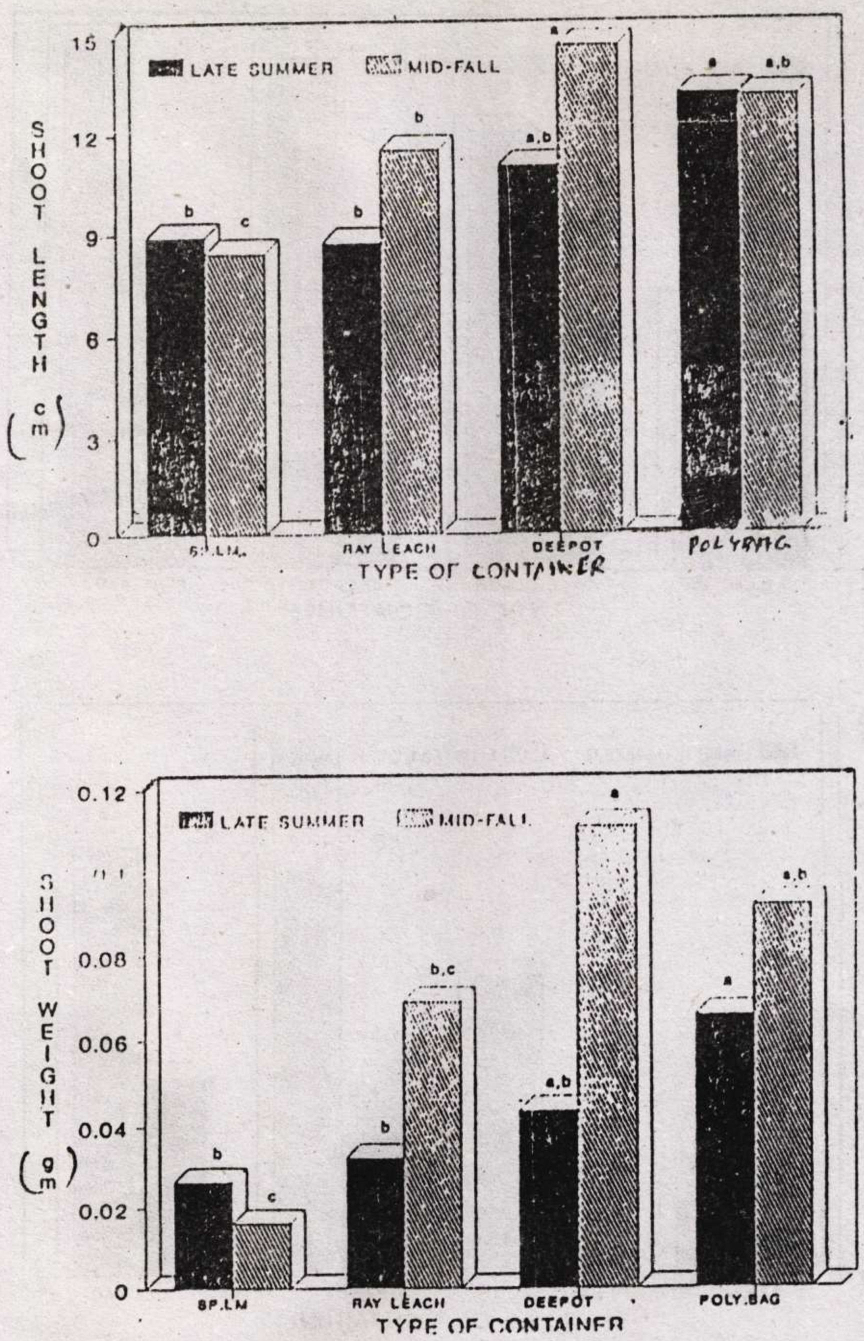

Fig.2. Effect of containers on shoot length and weight of black locust seedlings at 2 harvesting period.

*Bars of the same style with the same letters are not significantly different.

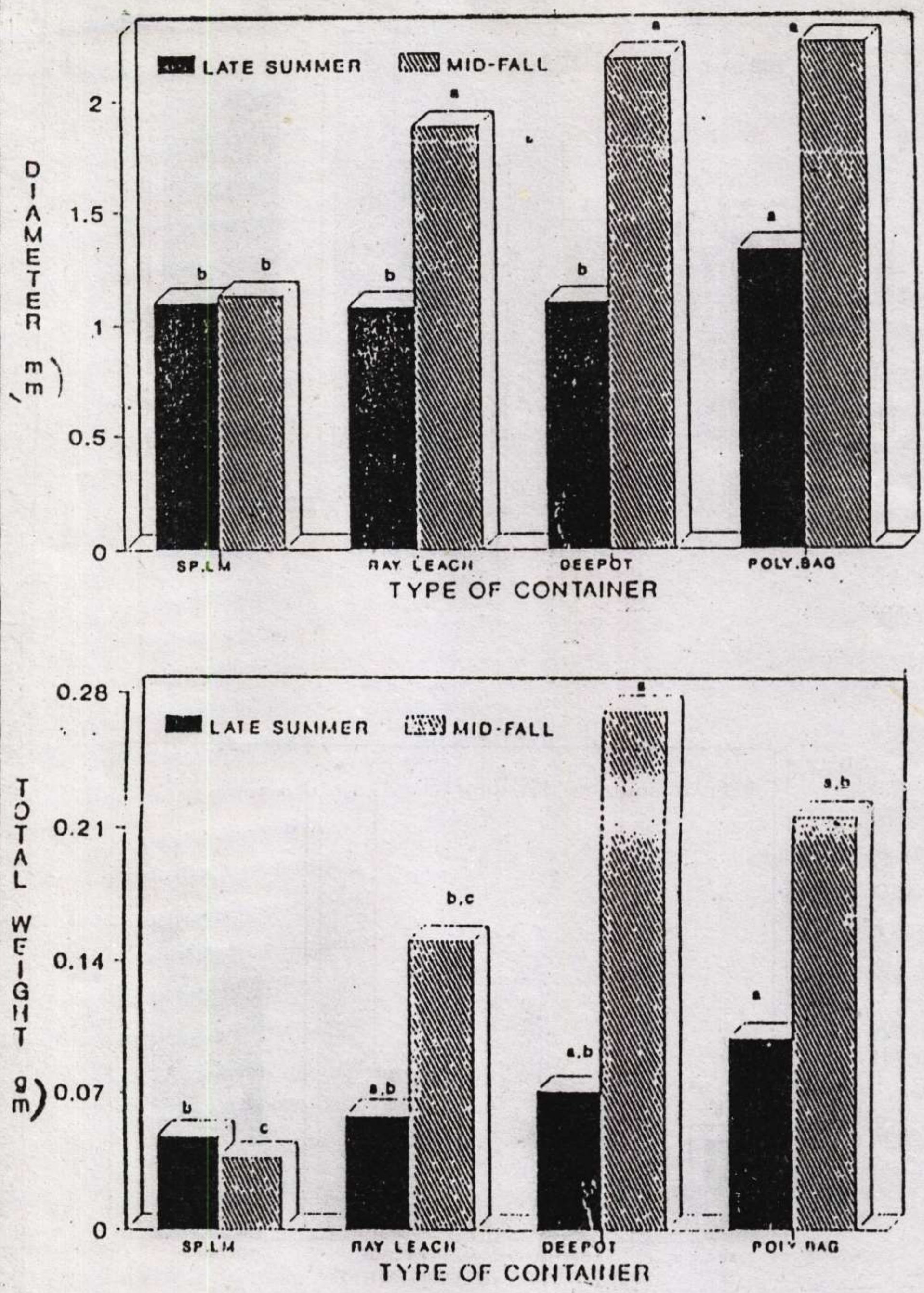

Fig.3. Effect of containers on stem diameter of black locust seedlings at 2 harvesting period.

*Bars of the same style with the same letters are not significantly different.