COMPARISON OF BARE-ROOT VERSUS TREE SPADE TRANSPLANTING OF BOULEVARD TREES

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Abstract. Dormant trees of green ash, black ash, hackberry and Amur cherry were transplanted along residential streets either by means of a 110 cm tree spade or bare-rooted and small trees were transplanted bare-rooted only. First season's shoot growth and leaf size of spaded trees was four to ten times larger than on comparable sized bare-rooted trees and approximately twice as large as small bare-rooted trees. Growth during the second season of small bare-rooted trees was greater than that of larger trees regardless of transplant method. Amur cherry was the only species in this study which showed losses due to transplant shock during the first year. One large tree each of green ash and black ash transplanted bare-rooted was lost during the second year.

There has been a shift in recent years towards the planting of boulevards with large caliper trees. Several advantages of large trees appear to be associated with their use in boulevard plantings even though the literature dealing with this topic is scant. Large trees are considered to withstand mechanical abuse and vandalism better than small lightly branched trees which traditionally have been planted. Snowplows, maintenance equipment and automobiles may cause only limited damage to a large tree, whereas similar contact with a small tree could cause total destruction. In addition, large trees are more visible so operators of vehicles and machines can avoid them more readily. The result of planting large trees seems to be a low loss to accident and vandalism, so that a high percentage of those trees planted actually reach maturity. Another major reason for the planting of large trees is to provide an instant landscape for people to enjoy (3). Small trees on the other hand require several years to approach a useful size for shade and beauty. The advent of mechanical tree spades which have facilitated the digging, moving and planting of large trees, has done much to stimulate their use.

Transplanting of large trees requires special care to ensure that sufficient numbers of functional roots are preserved to sustain the extensive trunk and network of side branches. Cool (3) reported that a 10-year average mortality rate of bare-rooted boulevard trees planted by the city of Lansing, Michigan, was 41%. Trees that were transplanted by a 110 cm mechanical tree spade had only a 5% mortality rate. In contrast to these results, some nurserymen (2) maintain that trees up to 3 inches in caliper can be transplanted in a bare-rooted condition with no loss of viability as compared to balled and burlapped trees provided that they are properly stored and handled prior to planting.

Preaus and Whitcomb (4) recently compared various transplanting methods including tree-spade dug trees planted into tree-spade dug holes, tree-spade dug trees planted into hand dug holes, balled and burlapped trees planted into hand dug holes and trees pulled from moist soil via pin and clevis and planted into hand dug holes. They found overall that the balled and burlapped method of transplanting produced the best visual grade and the most new growth during the first season. Tree-spade dug trees which were planted into hand dug holes performed better than those planted into tree-spade dug holes, The advantage of the former was explained in terms of better root contact with and penetration into the surrounding soil. The pull method of digging gave satisfactory results for those species with flexible roots. This method was utilized in an attempt to retain many of the fibrous roots which are severed during other digging methods.

The varying conditions of climate, soil type, and plant species need to be considered when evaluating the success of transplant methods. This study was undertaken to evaluate survival and growth following tree-spaded and bare-rooted transplanting of large trees and to compare the performance of these trees to that of small trees under the dry conditions of the Canadian prairies.

Materials and Methods

The following four species of trees were utilized in this study: Patmore green ash, (*Fraxinus pennsylvanica* 'Patmore'), Fallgold black ash (*F. nigra*

'Fallgold'), hackberry (*Celtis occidentalis*), and Amur cherry, (*Prunus maackii*). All trees were grown at the Morden Research Station to a caliper of 40 to 70 mm depending on species. The small Patmore green ash and Fallgold black ash were purchased from local nurseries as 1.5 to 2.00 m trees; the small hackberry and Amur cherry trees were grown at the Morden Research Station to a height of 1.75 to 2.50 m.

Dormant trees were transplanted from the nursery to residential boulevards about 2 km away in the town of Morden on May 3, 1978. The three transplant methods included were: 1) large caliper trees transplanted with a 110 cm tree spade; 2) large caliper trees transplanted bare-rooted; and 3) small trees transplanted bare-rooted. The trees of each species were planted as a block containing 8 trees of each treatment randomized among treatments. After planting, the large bare-rooted trees were staked and all trees were watered thoroughly. Any subsequent waterings were done at the discretion of personnel from the Town of Morden.

Seasonal growth was measured on 5 branches at the end of the 1978 and 1979 growing seasons and the mean was determined for each season (Table 1). The leaf area of 10 leaves per tree was measured in the field with a Li-Cor portable area meter (Lambda Instruments) and the results are presented in Table 1. The survival of the trees was recorded in May 1979 and May 1980 (Table 1), following transplanting by 1 and 2 years respectively.

Results and Discussion

Tree growth. Growth in 1978 of all species except Amur cherry was significantly greater for spaded trees than for trees transplanted bare-rooted whether large or small (Table 1). This general response could be expected because spaded trees allow for considerable numbers of small feeder roots to remain undisturbed within the fertile nursery soil ball that was spaded. The effects of transplanting method on growth were less distinct in the second year. Growth of spaded trees tended to be slightly greater than growth of large bare-rooted trees, although this trend was not significant for any species. These results indicate good establishment and strong recovery were experienced by surviving large bare-rooted

Table 1. Seasonal growth, leaf area, and survival of trees moved by spade and bare-rooted as large and small trees in 1978.

	Seasonal growth (cm/stem)		*Leaf area (cm² 10 leaves)*		*Number surviving*[1]	
Species	*1978*	*1979*	*1978*	*1979*	*First year*	*Second year*
Green Ash						
Large — tree spade	32 a[2]	54 b	272 a	211 a	8	8
Large — bare-root	15 b	39 b**[3]	180 b	176 a	8	7
Small — bare-root	12 b	121 a**	168 b	197 a	8	8
Black ash						
Large — tree spade	38 a	30 a	456 a	417 a	8	8
Large — bare-root	15 b	50 a	278 b	401 a	8	7
Small — bare-root	15 b	66 a**	294 b	497 a	8	8
Hackberry						
Large — tree spade	18 a	168 ab**	263 a	149 a**	8	8
Large — bare-root	4 b	76 b**	90 b	100 b	8	8
Small — bareproot	8 b	262 a**	140 b	152 a	8	8
Amur cherry						
Large — tree spade	10 a	45 a*	134 a	83 a**	5	5
Large — bare-root	3 a	34 a*	70 b	61 a	3	3
Small — bare-root	6 a	97 a*	69 b	76 a	4	4

[1] Eight trees per transplant method.

[2] Values within the same species and year followed by the same letter are not significantly different at P = 0.5.

[3] Evaluations between 1978 and 1979 were compared using a T-test. Significant difference is given at P = 0.5 (*) and P = .01 (**).

trees within one year.

Growth was generally better in 1979 than in 1978. Significantly improved growth was recorded for small trees where growth of green ash increased from 12 to 121 cm, black ash from 15 to 66 cm, hackberry from 8 to 262 cm and Amur cherry from 6 to 97 cm. These results indicate the resiliance of small trees to recover from transplanting shock. Large bare-rooted trees also showed a marked increase in growth in the second year which was significant for all except black ash. Improved growth of spaded trees was variable in the second year with the only significant increases being for hackberry and Amur cherry.

The large trees have many points from which growth takes place so that growth measurements fail in describing the overall fullness of a tree. It is noted that there was variable fullness among the large trees, however, a lack of fullness seemed to be most prevalent among the trees which had been transplanted bare-rooted. Presumably, on those trees under stress, certain buds did not break to produce normal growth.

Leaf area. Leaf area (Table 1, Figure 1) of spaded trees was greater than that of bare-rooted trees for all species in the year of transplanting. This measurement indicates, as did the seasonal growth measurements, that spaded trees sustained less transplanting shock than bare-rooted trees. The differences in leaf area between methods of transplanting were not significant in 1979 except for hackberry where large bare-rooted trees had smaller leaves than either small bare-rooted or spaded trees.

The variability within treatments of leaf area and seasonal growth was increased due to the variable watering of grass and trees by homeowners. This effect was anticipated prior to transplanting but it was felt this effect would normally occur in a boulevard planting and would be difficult to prevent. It was noted in particular that large bare-rooted trees responded to watering by marked increases in growth and leaf size.

Tree survival. No losses were experienced the first year in three of the species regardless of the method of transplanting (Table 1). In the second year one large bare-rooted tree in each of green ash and black ash succumbed. A number of Amur cherry trees did not survive the first year, including 3, 5 and 4 losses from tree spaded, large bare-rooted and small bare-rooted, respectively. The buds of Amur cherry broke into leaf only several days after the trees were transplanted. This caused heavy evapotranspirative stress which may account for the poor survival.

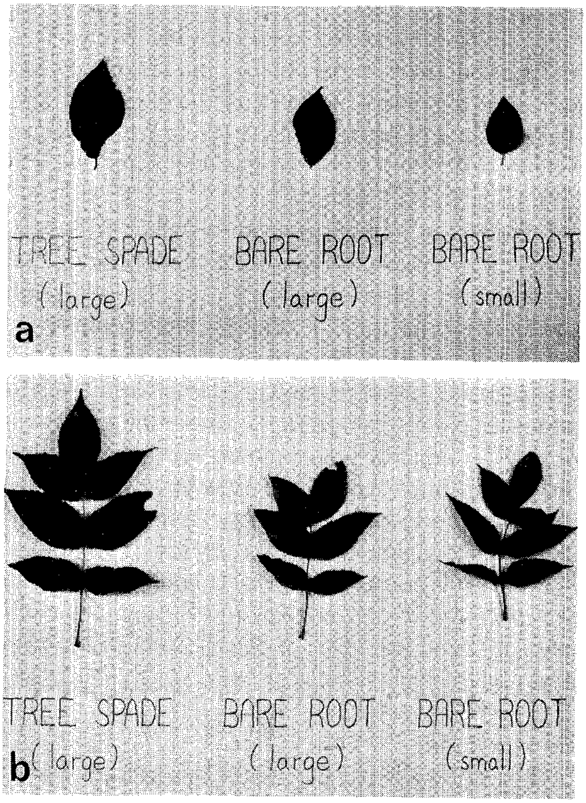

Figure 1. Leaf size of Amur cherry (a) and green ash (b) transplanted by tree spade and as bare-rooted large and small trees.

The oft heard statement among nurserymen that hackberry is difficult to transplant was not substantiated in this study in which bare-rooted and spaded trees gave 100% survival. The hypothesis (2) that well grown and properly handled bare-rooted trees can be established as well as balled and burlapped trees appears to be largely borne out by this study. However, while this hypothesis may be substantially correct it does not consider the improved growth response of spaded trees compared to similar sized bare-rooted trees. The heavy tree losses for bare-rooted moving reported by Cool (3) were not realized in the first two years of this study. This discrepancy may in part be accounted for by the facts that plantings were made in good soil in a residential area and that bare-rooted trees were moved from the nursery to the final planting location quickly and carefully.

Tree losses due to vandalism and poor acceptance by residents was not experienced as reported in other studies (1, 3). Although residents cared for the trees to varying degrees, there was no evidence of animosity towards the tree planting and no losses at all from vandalism to either large or small trees. On the contrary, many residents inquired about caring for "their" trees. Some residents were disappointed that a small tree was planted in front of their house while large trees were planted in front of their neighbors' houses. The positive acceptance of the trees was probably due to the sense of community involvement that citizens of small towns such as Morden often have.

Conclusions

The use of a mechanical tree spade significantly reduced the transplanting shock of large trees as seen mainly during the year of transplanting.

Special considerations were noted in using a tree spade including need to avoid buried electrical wires and gas lines. By making slight planting adjustments it was possible to use the tree spade for all sites.

General visual observations indicated that with good watering practices in good soil the advantage of tree spading is reduced. The converse would probably be true under poor conditions.

Small bare-rooted trees made an excellent recovery in growth during the second year. Vandalism and equipment damage were not severe in 1978 or 1979 in this particular area so the perceived disadvantages of using small trees were not expressed. The general homeowner response to the small trees was less favorable than to the large trees.

The careful handling and short distance in moving the bare-rooted trees may have resulted in better than expected performance in comparison with spaded trees. Since the large trees had been grown in very fine sandy loam soil, they developed extensive root systems. The advantage in transplanting well rooted trees would be realized most by the transplanting method imposing the most stress, namely bare-rooted transplanting.

Amur cherry was the only species in this study where there were losses due to transplanting shock during the first year. One caliper tree of each of the green ash and black ash transplanted bare-rooted was lost during the second year.

The effect of size of tree at transplanting time can only be fully evaluated over the course of many years. The evaluation of the performance of the trees used in this study is expected to continue into the foreseeable future.

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