Effect Of Transplant Method And Fertilizer Application On Growth Of *Acer rubrum* C. and *Fraxinus pennsylvanicum* L.[1]

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ABSTRACT. --*Acer rubrum* L. 'October Glory' (red maple) and *Fraxinus pennsylvanicum* L. 'Marshall Seedless' (green ash) were planted in an asphalt parking lot using standard horticultural practices with a factorial combination of treatments that included two planting stocks (bare-root and balled and burlapped) and two fertilizer levels (a control and 1.36 kg of 18-10-10 fertilizer along with 1.36 kg dolomitic limestone per tree.) After two years BR red maple growth was generally greater than for height growth; and shoot growth of fertilized BR trees was much greater than shoot growth of any other red maple treatment. Among the green ash treatments, control BR trees grew better than B&B trees. The fertilization depressed growth of BR green ash and there were no significant differences between growth of fertilized BR and B&B trees.

Recent attention has been focused on the parking lot as a major cause of urban blight. Thermal discomfort, rapid water run off and pollution load are a few types of problems created by vast impervious asphalt surfaces asphalt surfaces (Robinette, 1978.) Trees planted within a parking lot have the potential of ameliorating these deleterious conditions (Heisler, 1974.) Microclimatic changes, changes in quality and quantity of water runoff (Pham, 1978,) will not be drastically altered immediately after the introduction of trees, but these benefits should increase as the canopies of these trees expand over the years. It is axiomatic that these trees must survive and thrive if they are going to produce ameliorating effects, but the parking lot environment creates a number of stress conditions that could adversely effect both survival and growth rate.

Little is known concerning growth and development of shade trees introduced into the urban environment. Few statistically designed research efforts have been conducted to study species adaptability, planting techniques, nutrient needs, survival and growth rate of trees planted in the stressed condition.

[1]Metro. Tree Impr. Alliance (METRIA) Proc. 3~70-76, 1980.

The objectives of this study were to compare the survival and growth rate of the two shade tree species, Acer rubrum L. and Fraxinus pennsylvanicum L., planted in the asphalt parking lot; to compare the handling methods of bare root versus balled and burlapped; and to evaluate the effects of adding fertilizer at the time of planting trees in disturbed soil. The results will be used to aid in developing guidelines for urban and suburban communities for the introduction of shade trees into their physical environment. These guidelines seek to improve the physical quality and enhance the esthetic properties of our communities through the selected use of plant material.

MATERIALS AND'METHODS

The parking lot chosen for this study is located on the campus of Cook College, Rutgers University, No. 98. It is 191 m long and 50 m wide wide, encompassing an area of 0.966 hectare (2.39 acres.) The lot was constructed on an area of poorly drained Nixon series soil.

The planting sites were established in the parking lot utilizing a diamond pattern (Fig l., Nelson, Porter 1976.) The sites were constructed by excavating a 5.4 m area of pavement to a depth of approximately 45 cm. Four railroad ties were permanently enclosed around the planting hole to act as curbing. The planting hold was then filled with planting soil to approximately 15 cm above the asphalt level. The planting soil came from the 20-84 cm layer excavated during construction of the lot in 1972. Thirty two planting sites were located on the lot, allowing a ratio of one tree per ten parking stalls, leaving approximately 18 m between trees.

Sixteen Acer rubrum L., 'October Glory' and 16 Fraxinus pennsylvanicum L. 'Marshall's Seedless were purchased from a local nursery. The trees' caliber were 3.0-4.0 cm at 30 cm above the soil line. Half of the trees of each species were balled and burlapped and half were bare-root.

The trees were planted on April 23, 1976 according to standard nursery practices. Pruning was performed by following guidelines established by New Jersey Federation of Shade Tree Commission.

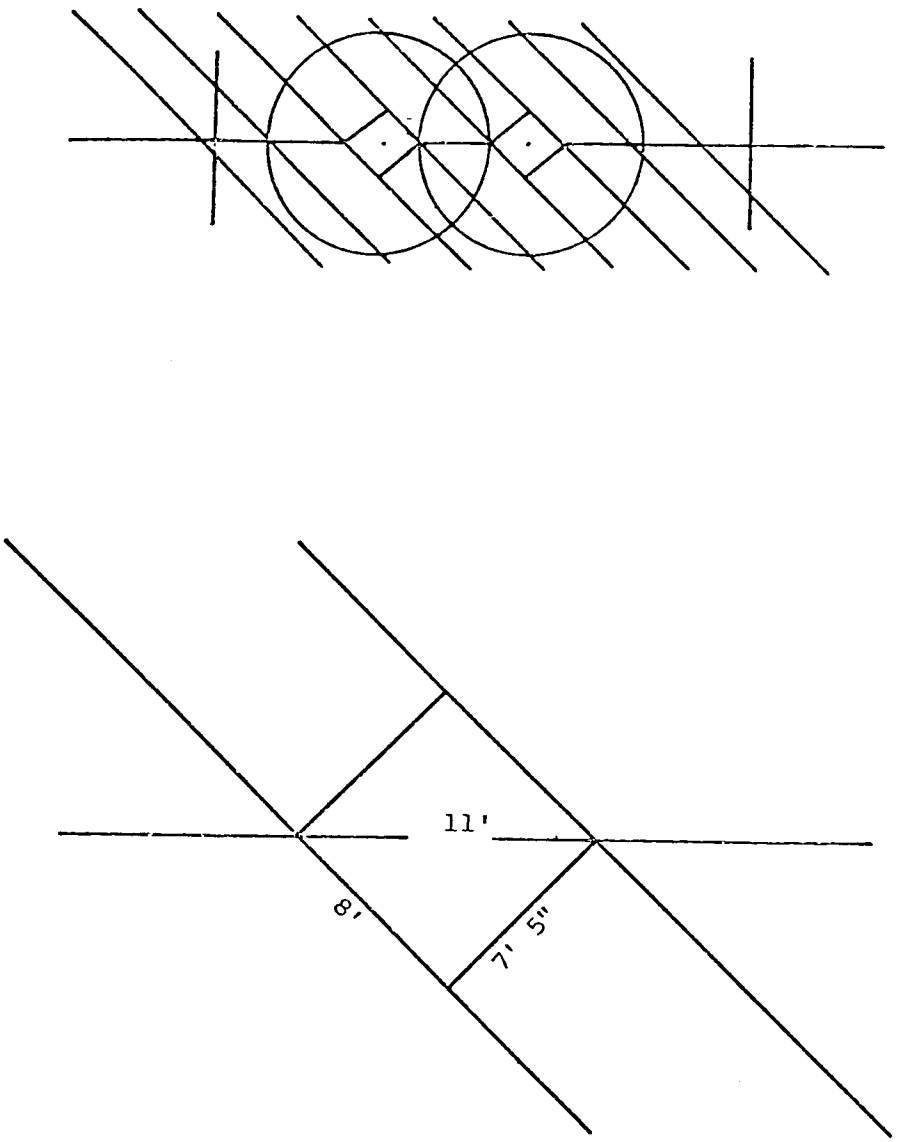

Fig. 1. Diamond planter pattern used within the diagonal parking stalls on Cook College parking lot #9B.

The fertilization and lime treatment within the project consisted of an application of a complete inorganic fertilizer (grade 10-10-10) and the addition of pulverized dolomitic limestone (min. $CaCO_3$ 51.5%, min. $MgCO_3$ 44.0%) versus no additional soil amendments.

The soil amendments were based on a nutritional study conducted by Dr. Pham Chuong prior to the beginning of this project (Pham, 1978.)

Dr. Pham Chuong related the existing nutrient status of the planting soil with acquired results based on growth responses from the nutritional study and calculated the treatment rate to be: 1.36 kg of the pulverized limestone.

The soil amendments were hand mixed in the appropriate planting site with approximately 0.3 m^3 of planting soil. Mixing took place immediately prior to the planting of each of the treated sites.

Data collection extended over two complete growing seasons (April 1976 - December 1977.) All measurements were taken in the dormant period following the growing season (December 1976 - December 1977.) All growth parameters monitored during the course of the study were analyzed statistically to determine significant treatment differences by an analysis of variance. Duncan's multiple range at the .05 level were determined for each significant test.

Total tree height was measured from a permanently established point at the soil line. The annual height increment was determined by calculating the difference in total tree height between measurements taken at the end of each growing season. Initial tree height was taken when the trees were planted.

Shoot growth was monitored on six shoots per tree. Three shoots of similar diameter were chosen from the north and south side of the tree. The branches were selected from the mid crown and permanently tagged.

RESULTS

All of the trees survived the first two growing seasons. Growth the first season was generally much less than the second season by any measure for all treatments.

Analysis of variance for each of the growth responses with year added to the factors species, stock, and fertilizer showed significant interactions between the main effects. Further, the variances of the two species differed considerably, as did the variances of the two years. Hence, mean separation for each growth response was done by four separate analyses of the four treatments within each species and year group (Table 1.)

During the first growing season no significant differences in shoot growth were formed between control and fertilized B&B green ash. Shoot growth in BR decreased by fertilization. Fertilizatior during the second season continued to decrease shoot growth in the BR trees, whereas fertilization had no effect on the B&B green ash trees.

Shoot growth on BR red maple was increased by fertilization during the first growing season. There were no differences found during the second season, however, fertilization increased total shoot growth in the BR red maples over the two year period. This significant differences in annual or total shoot growth were found between B&B control and fertilized red maples during the two year test period.

Fertilization decreased height growth on BR green ash the first growing season. There were no significant differences found between the B&B green ash trees, nor in either the BR or B&B green ash during the second growing season.

CONCLUSION

The intitial establishment of green ash and red maple trees planted within the parking lot was 100% successful. Despite the potential stress of the parking lot environment, all trees survived the critical first two years following transplanting.

The fertilizer treatment response observed suggests that the reaction to fertilizer applied at transplanting is species dependent. The marked increases in shoot growth the first season and total shoot growth in BR red maple in response to the fertilizer treatment suggests that the addition of fertilizer at transplanting may be beneficial for red maple growth. On the other hand, fertilizer applied to the backfill for BR green ash decreased growth suggesting that BR green ash may be particularly susceptible to possible fertilizer injury. The ability of bare-rooted trees to utilize the inherent and added fertility of the backfill, presumably because of the fact that the feeder root system would have had to develop in the backfill, may also offer an explanation for the general increased growth observed in the BR trees compared to B&B trees.

Table 1.--Summary of treatment means and mean separation analysis. Within each group of four means for a given year and species combination, means with the same letter superscript or letter are not significantly different.

	SHOOT GROWTH cm			HEIGHT GROWTH cm		
Treatment	FIRST YEAR	SECOND YEAR	SUMMARY	FIRST YEAR	SECOND YEAR	SUMMARY
Red Maple						
B&B, Control	3	36^{a}	38	8^{a}	66	73^{ab}
B&B, Fertilized	3	45^{ab}	48	8^{a}	61	68^{b}
BR, Control	18	138^{bc}	155^{a}	18^{b}	103	121^{a}
BR, Fertilized	58^{a}	194^{c}	252^{b}	22^{b}	69	91^{ab}
Green ash						
B&B, Control	9	16^{a}	25^{a}	16	41	58^{a}
B&B, Fertilized	11	52^{ab}	62^{ab}	13	81	94^{ab}
BR, Control	20^{a}	88^{b}	108^{b}	26^{a}	86	112^{b}
BR, Fertilized	9	37^{a}	46^{a}	16	45	61^{a}

The ability of the trees in this experiment to survive and grow satisfactorily in the parking lot is undoubtedly the result of the modification of the planting site. Further research is needed to privide additional information on planting site specifications to improve the establishment of trees in our urban areas.

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