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GRASS AND TREE ROOT RELATIONSHIPS

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Plants growing in natural or man-made landscapes are continually competing with other plants. Despite the appearance of vertical separation by different growth forms of above ground plant parts, beneath the soil surface the root systems of these plants interwine extensively.

It is the exceptio to find a home lawn, park or golf course where an expanse of turfgrass exists without woody plant competition. Nearly all turfgrass research conducted to date has been done on field plots in fully exposed areas. Likewise, most woody plant research, trees and shrubs, has been done without the presence of turf, usually under clean cultivation.

What I have attempted to do, is to study these two plant groups when they are growing together: competing. This is no easy task, as many interrelated factors are involved, such as light, water, nutrition and possibly chemical inhibitors. Shade has been listed as the primary reason grass does not do well beneath trees. There is no doubt that shade has an effect on grass performance but what about other possible factors?

EXPERIMENTAL PROCEDURE

In order to study tree-grass relationships without light becoming a limiting factors, a new, "connecting pot technique," was developed. In this system a tree was planted in one container with a portion of its root system extending out of that container and into adjacent smaller pots. The smaller pot can then be seeded, sodded, or sprigged. This approach allowed determination of the effects tree roots have on various aspects of grass growth and likewise, the effect of the grass on the tree root development. The trees were placed at random on a platform, with the smaller pots arranged beneath. In this way, all pots, regardless of treatment, received the same amount of shading. The results obtained are, therefore, independent of light effects.

Two tree species were used: silver maple, *Acer saccharinum* and honeylocust, *Gleditsia triacanthos*. These were chosen based on observation of their effect on grass. Silver maple is very shallow rooted, and is difficult to maintain quality turf beneath. Honeylocust is deep rooted and is one of the easiest trees to grow grass beneath. Common Kentucky bluegrass was used as the test grass.

These experiments were begun at Iowa State University in January, 1967. Upon joining the staff at the University of Florida, I continued to use the same plants to keep from adding another variable to the study. I feel the results can basically be applied to all grasses and trees over a wide range of conditions.

Experiments were conducted as follows:

a. The grass to establish first.
b. the root system of trees and grass to invade the soil mass at the same time.

RESULTS

When the grass was established first, and tree roots were forced to invade soil containing well developed grass roots, there was no change in the grass response as measured by clipping weights, sod weights, root weights, root to shoot and counts of stem per pot. Fertilizer and water were added as needed. From this, one would conclude that on a short term basis, even under low light conditions, the turf was able to function as though tree roots were not present, if it were established first. This is probably the case for the first one to two years following the planting of a tree in an area of established turf. However, a grass root, even though considered a perennial,

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does not live for an extended period of time. Rather, new roots are continually replacing older ones.

Tree roots, on the other hand, are basically much longer lived, growing in length and diameter. Over a period of years, as grass roots die, the tree roots become better and better established by replacing the grass roots in the soil volume.

To test this, an experiment was established where tree and grass roots were forced to invade a volume of soil at the same time. This would simulate conditions where grass roots had died and new grass roots and tree roots were vieing for that particular soil area.

GRASS ROOT YIELDS WERE REDUCED BY AS MUCH AS 59% BY SILVER MAPLE ROOTS.

The effect of the grass was very striking under these conditions. Grass root yields were reduced by as much as 59% by silver maple roots and 35% by honeylocust roots as compared with a control pot having no tree roots (Figure 1.) On the other hand, grass sod yields were reduced, but not so drastically. As root competition increased, the grass maintained approximately the same production of sod with a greatly reduced root system. The root to shoot ratio shifted, making the grass much less resistant to wear, drought, attacks from disease and insects and restricting the supply of nutrients. This is how the tree wins out over a period of time.

The question arises, can we fertilize the grass on the soil surface and favor it's development over that of the trees? Tree roots are more shallow than previously thought. A few anchor roots may penetrate the soil 10 feet or more, but most functional tree roots are in the upper 6 inches of soil. Many of these roots are at the soil surface and may actually be growing in the duff and litter of the grass. Because of this, surface fertilization benefits the tree as well as the grass. To get an equal response from grass where tree roots are present, results suggest a considerably larger amount of fertilizer should be applied (Figure 2). What this increase in fertilizer rate should be remains to be worked out through further experimentation. Probably at least a 30-50% increase in nitrogen should be used where tree roots are vigorously competing with the turf. This increase should include an area at least 1½ times the distance from the base of the tree to the spread of the outer most branches. For example: if the distance from the base of the tree to the outer most branches was 30 feet, then the fertilizer applied should be increased by 30 to 50% out of a distance of 45 feet from the base of the tree. This does not apply to palms.

EFFECT OF TURF ON TREES

When the grass was allowed to establish first and the tree roots were forced to invade soil containing well developed grass roots, although there was no effect on the grass, the reduction in silver maple roots produced was

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very striking. However, honeylocust roots remained unchanged (Figure 3). The reason for this contrast lies in the location of the tree roots. The shallow silver maple roots were attempting to grow in the zone of maximum grass roots, while the honeylocust roots remained in the bottom of the pot where grass roots were least concentrated and were thus only slightly reduced.

This effect no doubt plays an important part in the rate of establishment and subsequent growth of newly planted trees in areas of established turf. By maintaining an area void of grass and weeds, 8 to 10 feet in diameter, around newly planted trees wherever possible, their growth rate may be increased several times.

This area can be maintained by mulching, plastic and ornamental gravel, or herbicide sprays such as paraquat. Under no circumstances should the soil in this area be cultivated as many new roots would be destroyed. The first 3 growing seasons are probably the most important in aiding the tree. After that time it appears the tree can adequately compare with turf.

In the course of the experiment to measure the relationships of grass and tree roots invading a volume of soil at the same time, the effect on the tree-root development was measured. When the tree and grass roots had an equal chance to invade the soil mass, instead of the tree roots being reduced in volume by the grass, they were slightly increased (Figure 4). This further points to the conclusion that once the tree becomes established it no longer needs to be isolated from grass competition.

CONCLUSIONS

1. Established turf is not substantially affected by tree root competition for the first season following invasion.
2. Later, however, as grass roots die and are replaced by new roots the effect of competing tree roots becomes more pronouced. The tree roots slowly increase their concentration in the soil.
3. To maintain turf at a given nutritional level under conditions of root competition from trees, the amount of nitrogen applied should be increased by 30 to 50%.
4. The area influenced by an established tree extends at least 1½ times the distance from the base of the tree to the outer most branches.
5. Root development by newly planted trees is greatly influenced by the presence of established turf.
6. An area 8 to 10 feet in diameter shuld be maintained around all newly planted trees wherever possible.
7. Once the tree becomes established, after about 3 years, the tree roots are able to compete sufficiently well with the turf that only regular fertilization of the soil surface is needed.

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