2000

Root Growth and Development of Float Tobacco Transplants Before and After Transplanting

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Agronomy notes

Vol. 32, No. 1, 2000

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INTRODUCTION

In the production of float tobacco transplants, the seedling produces at least two different kinds of roots. The "media" roots are those that grow in the soilless medium within the float tray cell. They have a normal branched appearance similar to roots produced on soil-bed grown transplants. The "water" roots grow through the soilless medium in tray cells and into the nutrient solution below the float tray. They tend to be very fragile and less branched than roots growing in the soilless medium. In removal of seedlings from tray cells during transplanting, "water" roots are usually badly damaged or destroyed, which could affect establishment of transplants in the field since the most critical period in the development of tobacco plants occurs immediately after transplanting. When these young plants are removed from the protective environment of the float bed system and are subjected to radically different and sometimes adverse field conditions, stress on the juvenile plants is created. Field establishment of these young plants is dependent upon growth or new formation of the "media" and "water" roots.

To maximize establishment of transplants, it is important to know how the "water" roots and the "media" roots develop in the float system and their contribution to transplant establishment during the first few weeks after transplanting. The objectives of this study were: 1) to characterize the growth of "media" and "water" roots on tobacco seedlings in the float system, and 2) to assess tobacco transplant growth with or without "water" roots, at two and four weeks after transplanting.

MATERIALS AND METHODS

Plant culture

Tobacco plants were grown in a greenhouse at the University of Kentucky, College of Agriculture, Lexington, KY. Pelleted burley tobacco seeds, *Nicotiana tabacum L.* cv. NC-129 were sown in trays and floated on beds of nutrient solution. The growing medium was a non-fortified, peat/vermiculite medium (Southern States Brand). Polystyrene trays (13½'' by 26¾'') were used, each containing 200 cells. The cells were open-ended with a volume of 27 cc in an inverted pyramid shape. Trays were manually filled with premoistened medium. Seeding of the pelleted seeds was done with a vacuum seeder into a dibble or depression in the medium (round shape with 0.5'' depth). Care was taken during seeding to ensure that one seed was placed in each cell and that the seed was at the bottom of the dibble. Temperature at the tray level was maintained at 70 to 75° F. The water tank was fertilized with 100 parts per million nitrogen from 20-10-20 (N-P-K) water soluble fertilizer.

Development of seedlings in float tray cells was evaluated 20, 24, 28, 32 and 40 days after seeding. For evaluation, 10 seedlings were removed from the trays with care at each of the evaluation dates in order to preserve and not injure either "media" or "water" roots. Root tissue was carefully separated from the soilless medium by gently

washing. Roots were evaluated using a computer imaging and analysis program specifically designed for root measurements. Seedlings had reached transplant size by 40 days after seeding.

Assessment of transplant growth after transplanting

Seedlings were grown as described above and transplanted into round-plastic pots (8'' top diameter; 5½'' bottom diameter, 8¾'' height) filled with 6 lbs. of a 2:1 soil:sand sterile mixture, by cutting the cells and carefully removing seedlings to preserve both the "media" and "water" roots. Each pot was divided into upper and lower parts by a water-permeable barrier made of black landscape fabric. To separate and identify new root production from the "water" roots and from the "media" roots, seedlings were transplanted above the barrier either with intact "water" roots attached or with "water" roots totally removed. Intact "water" roots were threaded through a small hole in the middle of the barrier so that they were placed in the lower part of the pot. Twenty-four seedlings were transplanted and randomly placed on benches in a greenhouse and watered regularly (½ gallon/pot/day). At two and four weeks after transplanting twelve seedlings were evaluated for root development by cutting the pots open and carefully washing the soil:sand mixture from the roots. Roots were separated into those growing above the physical barrier called upper part, and those found below the physical barrier, called lower part. The washed roots were measured using the computer imaging and analyzing program.

RESULTS AND DISCUSSION

Root growth and development in the float system

Twenty days after seeding, the "media" root system was just beginning to develop with < 1 ft. of root length per plant measured (Figure 1). The most rapid growth of "media" roots occurred between 24 to 32 days after seeding and coincided with a period of rapid shoot growth. At transplant time, the "media" roots were a long, branched system that represented 65% of the total (media + water roots) seedling root length. Development of the "water" root system lagged about 8 days behind the "media" roots (Figure 1). There were no "water" roots formed by 20 days after seeding. Four days later, "water" roots were just beginning to grow out the bottom of the trays. "Water" roots were readily visible in the float water by 28 days after seeding and by day 40, the bottom of the trays was totally covered with "water" roots. The growth rate of "water" roots (based on percentage of change) between day 32 and 40 after seeding was greater, demonstrating that "water" roots had a fast growth rate in the nutrient solution in the float system tank just prior to transplant.

A root system comprised of greater length of small diameter roots should be more efficient for water and nutrient uptake due to greater surface area. Average "media" root diameter increased between 28 and 32 days after seeding with a maximum value at 32 days after seeding (Figure 2). However, after day 32, media roots tended to have a smaller average diameter. Average "water" roots diameter increased from day 24 to day 32 but did not increase after 32 days. To help explain this decrease in average diameter, the root length contribution from two diameter classes was measured. Fine "media" roots (≤ 0.002'' in diameter) continued to increase in length between 32-40 days (Figure 3A), whereas coarse roots > 0.002'' did not increase (Figure 3B). Both fine and coarse "water" roots continued to increase in length between 32 and 40 days. Coarse roots made up 50% of the "water" root system, but comprised only 20% of the "media" roots.

Root growth after transplanting

The landscape fabric barrier placed in the middle of the pots was used to separate "media" roots from "water" roots. The total root system of plants was divided in two regions: upper (above the barrier) and lower (below the barrier) parts. Some "media" roots, after touching the fabric, grew laterally toward the outer edge of the pot, around the edge of the barrier, and downward into the bottom area where the original "water" roots were located. These roots were considered to have originated from the "media" root despite being found below the barrier, but were included in the "lower" root total.

The plants with "water" roots had

significantly greater shoot dry weight (8.8 g/plant) than plants with water roots removed (7.4 g/plant) two weeks after transplanting. There was no significant difference in total root length in the upper part of the pots for plants with or without "water" roots attached (Figure 4A). However, the lower part had significantly greater root length when the "water" roots were left intact at transplanting. Even though more roots were present in the lower part of the pot, most of them were the original "water" roots attached to the young transplant, with very few new root initiations. Little or no lateral root growth was observed from "water" roots, while "media" roots exhibited a highly branched and well distributed root system.

Four weeks after transplanting, there were no significant differences in shoot dry weight. Most of the 'water" roots present were dark brown in color and did not appear as healthy as "media" roots (Figure 5). No significant differences in root length were measured for upper, lower or total roots (Figure 4B). In fact, most of the roots found in the lower part of the pots, in both treatments, were "media" roots that grew downward along the pot wall. These roots were counted as lower roots. The greater root length (approximately 20 ft.) per plant with "water" roots was largely due to the size of the original "water" roots attached on the tobacco seedling at transplanting. Overall, these results indicated that the presence of intact "water" roots on tobacco seedlings did very little to improve the establishment of the transplants under the controlled greenhouse conditions of this experiment.

CONCLUSIONS

"Media" roots comprised 65% of the total seedling root length at transplanting time. Two weeks after transplanting, seedlings with intact "water" roots had a slight growth advantage, although there was no new root initiation from the "water" roots. By four weeks after transplanting the original "water" roots had turned brown, and no new root initiation was observed. There was no growth advantage for seedlings planted with intact water root, suggesting that "water" roots did not serve a function in the establishment of transplants under controlled greenhouse conditions. The results of this study suggest that the loss of "water" roots during transplanting does not seriously affect transplant establishment.

Bob Pearce

Extension Tobacco Specialist

Fig.1: Development of tobacco roots from day 20 to day 40 in a float system

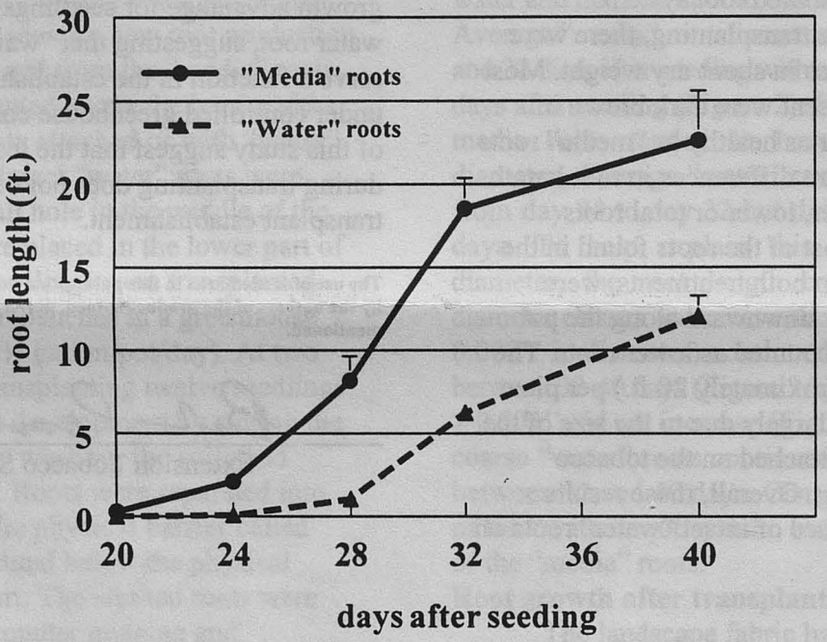

Fig.2: Average diameter of tobacco seedling roots from day 20 to day 40 in a float system

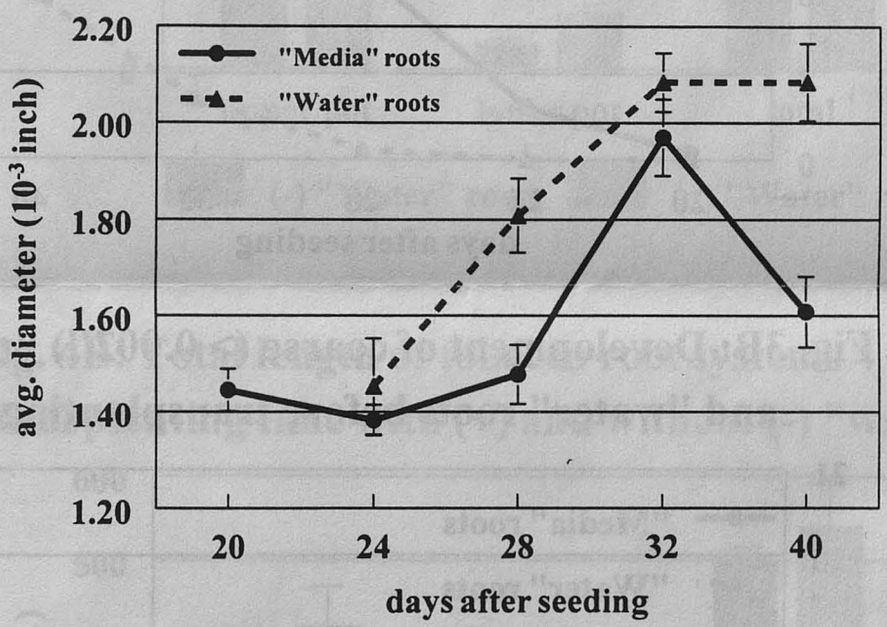

Fig. 3A: Development of fine (< 0.002") "media" and "water" roots before transplanting

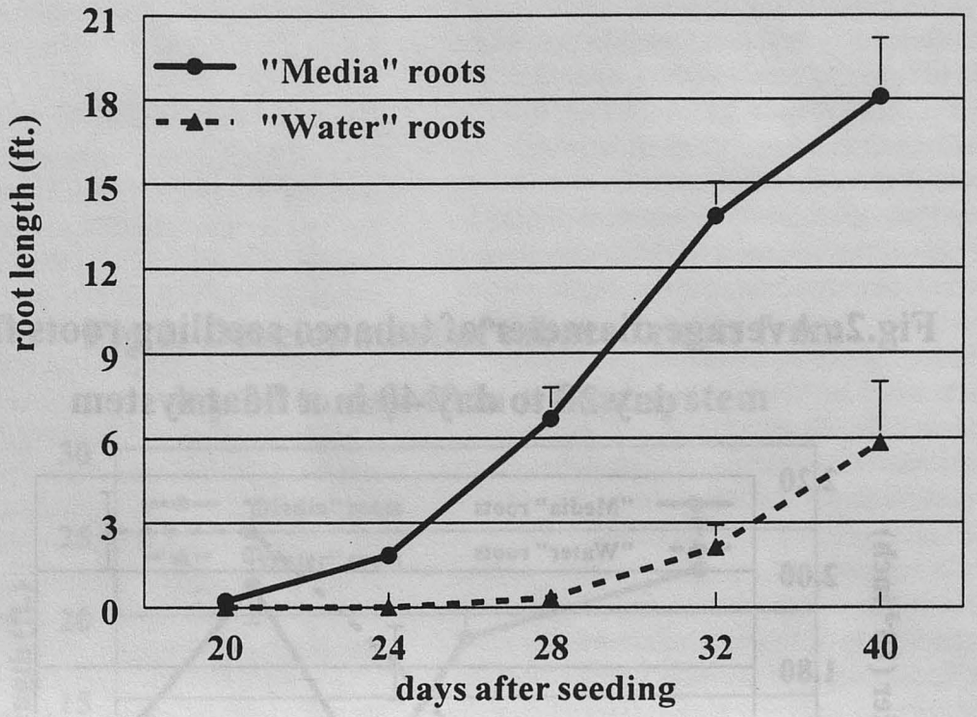

Fig. 3B: Development of coarse (> 0.002") "media" and "water" roots before transplanting

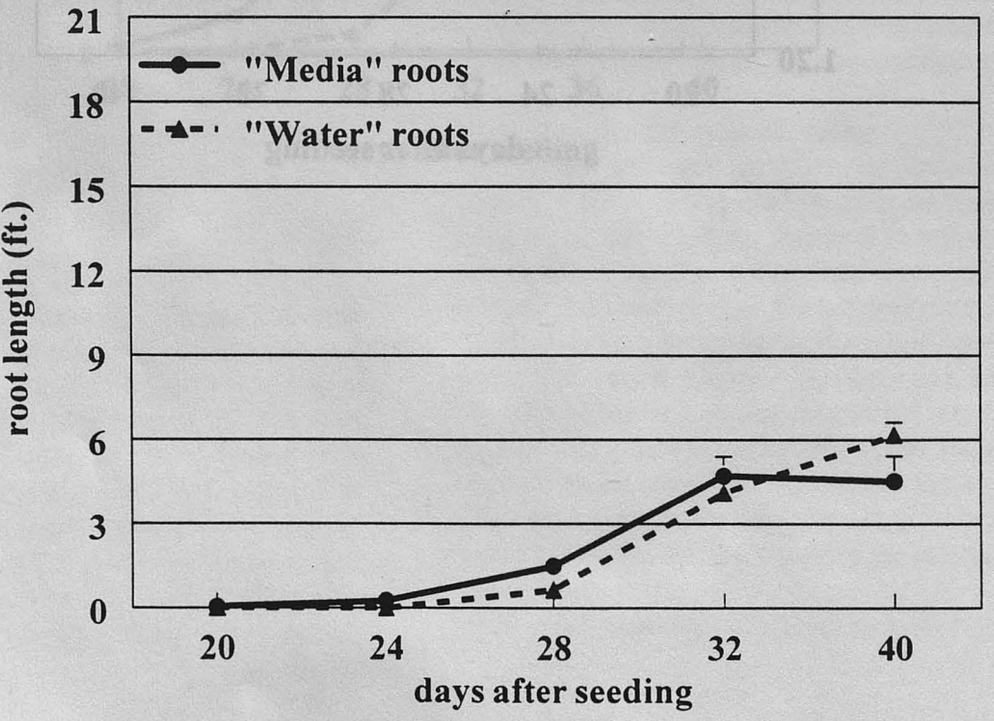

Fig. 4A: Total length of tobacco root systems 2 weeks after transplanting time with (+) and without (-) "water" roots

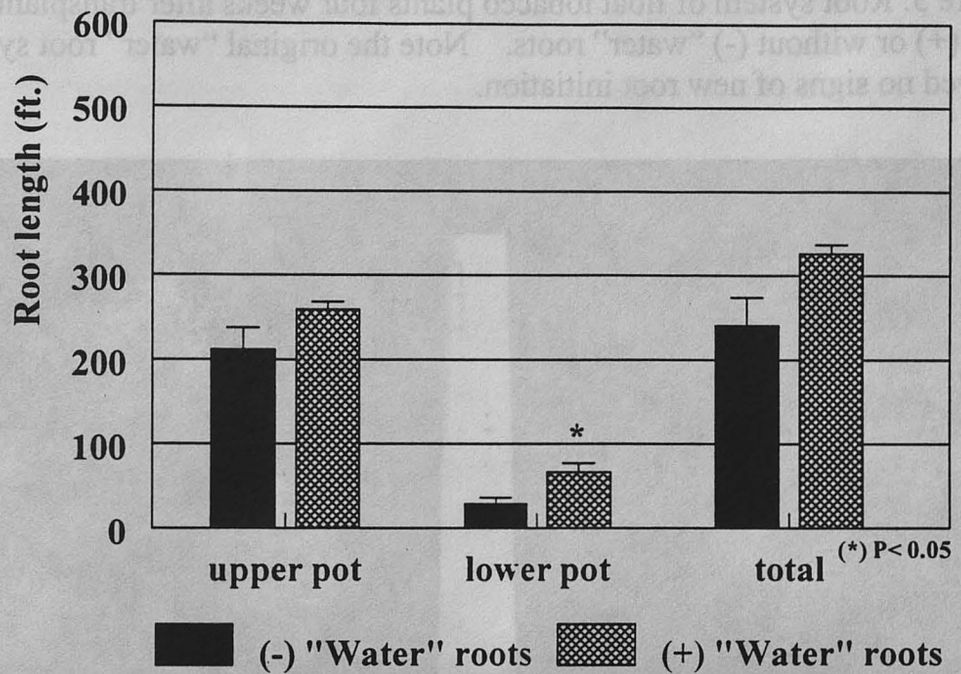

Fig. 4B: Total length of tobacco root systems 4 weeks after transplanting time with (+) and without (-) "water" roots

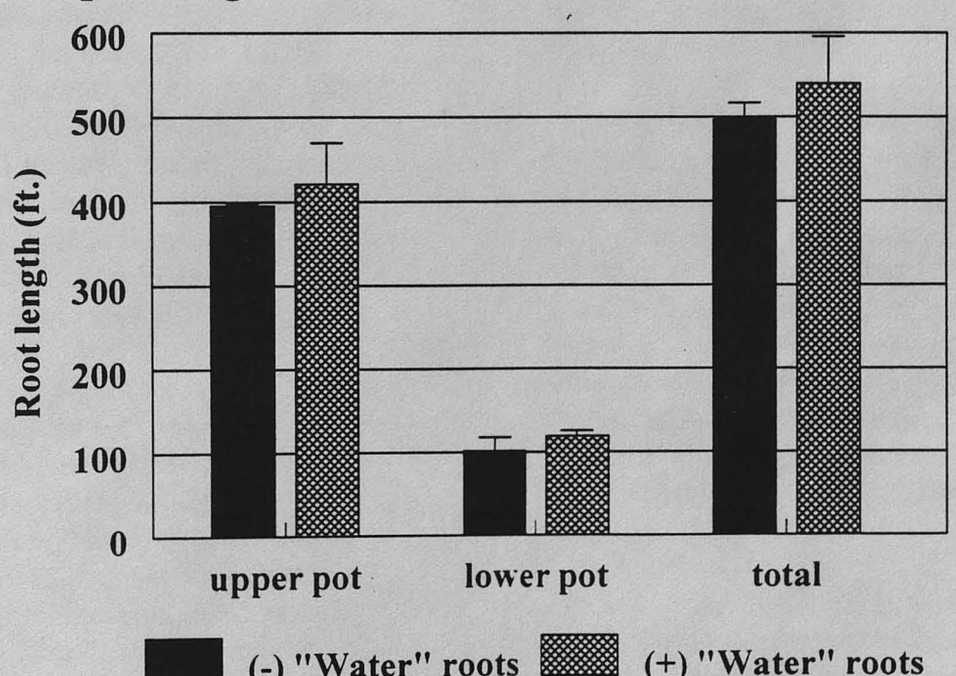

Figure 5. Root system of float tobacco plants four weeks after transplanting with (+) or without (-) "water" roots. Note the original "water" root system showed no signs of new root initiation.

(+) "water" roots (-) "water" roots

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