# EFFECTS OF FLOODING PECAN SEEDLINGS DURING DORMANCY, BUD BREAK, AND ACTIVE GROWTH

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## PREFACE

This study was conducted to determine the effects of seasonal flooding on plant growth, elemental absorption and translocation on pecan seedlings grown in the greenhouse.

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# CHAPTER I

## INTRODUCTION

Pecans [Carya illinoensis (Wangneh.) C. Koch] are native to Oklahoma. Native orchards are typically located along creeks and rivers in deep alluvial soils. These sites are subjected to frequent natural flooding and high water tables for short periods of time during the spring and fall. Soil flooding restricts aeration of the soil which in some species decreases elemental absorption, leaf expansion, and induced stomatal closure, leaf epinasty, leaf chlorosis and necrosis, inhibits root growth or induces root death causing a reduction in photosynthesis and growth (3, 7, 9, 12, 16, 20, 21, 22, 23, 26, 27).

Pecans are intermediate in their flooding tolerance compared to Fraxinus pennsylvanica (Green Ash), Taxodium distichuym (Baldcypress), and Acer saccharinum (Silver Maple) seedlings (13). Alben (1) found that flooding during summer and fall caused leaf scorch and leaf epinasty of 'Stuart' pecans. Photosynthetic rates of seedling pecans were reduced, and leaf number, leaf area, leaf and root dry weight decreased with partial root death occurring after 31 days or more of root flooding (15, 28).

Prolonged flooding affects physiological processes such as photosynthesis, respiration and growth in the plant; however, not all plants respond in the same manner (4, 5, 10). Flood tolerance mechanisms of some species of trees include the formation of adventitious roots, production of hypertrophied lenticels, and aerenchyma (3, 6, 8, 11, 12, 23).

Flooding can have a great impact on the plant's ability to grow and produce fruit. Dormant flooding does not seem to affect the plant's ability to resume growth normally (19). Whereas, tree growth and yield of plants were most sensitive to waterlogging when they were actively growing (17, 18). The effects of waterlogging on reduction of tree growth lasted long after the trees were removed from waterlogged conditions (2, 10, 17, 18, 19).

Flooding of the soil rapidly and dramatically alters both the physical and biological environment of plant roots. Gaseous exchange is greatly restricted under flooded conditions (13). Plants and microorganisms deplete the $O_2$ that is in soil and water within a few hours after flooding or waterlogging. Along with $O_2$ being depleted, respiration of plants and microorganisms increases concentrations of $CO_2$ present. This is followed by desiccation of plant roots and changes in stomatal aperture, transpiration, photosynthetic rate, and absorption of water (13).

The mechanisms by which root flooding or waterlogging influences the elemental absorption and translocation are complex, depending on the soil type, soil conditions, and plant response characteristics to flooding. Plant response generalizations can be derived from controlled research but must be carefully placed into environmental and physiological contexts that they apply. Responses of flood-tolerant species differ from species intolerant of flooding (24, 15).

There has been a limited amount of research done on flooding of pecans. With information on the long and short term effects of seasonal flooding, producers can make decisions on site selection and water management of pecan orchards. This is the first in a series of flooding studies on pecans.

CHAPTER II

# MATERIALS AND METHODS

Pecans were germinated in a 300 ug/liter aerated solution of gibberlic acid. The germinated seeds were planted, one seed per container, into three-liter containers on 23 November 1985. The seeds were planted three cm deep into a mixture of fire hardened calcite clay (Turface) amended with 3530 $g/m^3$ Osmocote slow release fertilizer (18N-2.6P-10K), 4694 $g/m^3$ of dolomite, 882 $g/m^3$ P, 480 $g/m^3$ $FeSO_4$ (25% Fe), 92 $g/m^3$ $MnSO_4$ (27% Mn), 21 $g/m^3$ $CuSO_4$ (25.4% Cu), 3.5 $g/m^3$ $NaBO_3$ (20.5% B), 0.5 $g/m^3$ $Na_2MoO_4$ (39% Mo), 39 $g/m^3$ $ZnSO_4$ (36% Zn). The containers were placed in a greenhouse with 21C night temperature and 27C day temperature. The seedlings were allowed to grow until 31 March 1986, then transferred to a growth chamber, at a temperature of 2C, to receive their chilling requirement. Seedlings were manually defoliated 2 days after being transferred to the growth chamber. All seedlings were returned to the greenhouse 30 June 1986.

Experimental treatments included control (non-flooded); or flooded for 28 days at dormancy, bud break, or during active growth. Dormant flooding treatment began 1 June 1986, while trees were held at 2C. The trees were flooded in individual containers of water with a constant water level 2 cm above the soil line. Upon termination of the dormant flooding treatment, all trees were transferred to the greenhouse on 30 June 1986.

Trees flooded during bud break were immediately flooded when transferred to the greenhouse, and drained after 28 days. Flooding during active growth began 30 July 1986 and continued 28 days.

The factors observed were leaf area, epidermal conductance, number; dry weights of leaf, stem, and root; seedling height; and elemental concentrations of leaves, stems and roots.

Leaf area was measured, after leaf number was determined, with a Li-Cor 3100 area meter. Leaf epidermal conductance was calculated from leaf resistance measured with the Li-Cor 700 transit porometer. The leaves, stems, and roots were washed to remove debris then dried at 80C, for 72 hours, in a drying oven prior to dry weight determination. Plant materials were ground to pass through a 20-mesh screen (Wiley mill). The ground samples were stored in air-tight glass jars until analyzed for elemental concentrations. The macro-Kjeldahl method was used to determine N. P was determined colorimetrically with Bausch and Lomb Spectromic 2000 and Perkin-Elmer 303 atomic absorption spectrophotometer was used to determine K, Ca, Mg, Zn, Fe and Mn.

Statistical design was such that seven trees in each treatment could be terminated for measurements of growth and elemental analysis after each treatment and up to 112 days after draining. Trees were blocked by visual appearance prior to treatment assignment. Treatments were arranged in a randomized block design with seven single-tree replications at each of five sampling dates. Data were analyzed using the *t* test at the 5% level.

# CHAPTER III

# RESULTS

## Seedling Performance

The dormant flooding and control treatments were not significantly different throughout the entire study (Table I). Trees flooded during bud break had significantly fewer leaves and reduced leaf area compared to the control and dormant flooding treatment (Table I). Tree height, trunk diameter and leaf and trunk dry weights after 28 days of flooding during bud break were lower than the control treatment.

After trees had been returned to drained conditions for 28 days, trees flooded during bud break had a less leaf area, smaller trunk diameter and reduced leaf, trunk and root dry weights compared to the control. Leaf number was not significantly affected from 28 days to 84 days after being drained which suggests that the main factor in decreasing leaf area was reduced leaf expansion. Leaf area, tree height, trunk diameter, leaf, trunk and root dry weights of trees flooded during bud break were reduced after trees were returned to drained conditions for 56 days compared to control trees. Eighty-four days after trees were returned to drained conditions, trees flooded during bud break showed a reduction in leaf area, leaf, trunk and root dry weights, a smaller trunk diameter and shorter trees.

TABLE I

THE INFLUENCE OF ROOT FLOODING DURING DORMANCY, BUD BREAK, AND ACTIVE GROWTH ON PECAN SEEDLING PERFORMANCE

| Flooding treatment | Days after being drained | Leaf no. | Leaf area ($cm^2$) | Tree height (cm) | Trunk dia. (mm) | Dry weights (g) leaf | Dry weights (g) trunk | Dry weights (g) root |
|---|---|---|---|---|---|---|---|---|
| | | | | 28 days[y] | | | | |
| None | Control | ---- | ---- | 31.3a[z] | 5.7a | ---- | 2.2a | 12.2a |
| Dormant | 0 | ---- | ---- | 31.2a | 5.8a | ---- | 2.6a | 13.8a |
| | | | | 56 days | | | | |
| None | Control | 12.1a | 1261a | 53.6a | 7.0a | 6.7a | 3.3a | 13.7a |
| Dormant | 28 | 11.4a | 1321a | 56.9a | 7.1a | 6.9a | 3.8a | 14.7a |
| Bud break | 0 | 8.1b | 387b | 44.5b | 6.0b | 2.2b | 2.3b | 13.3a |
| | | | | 84 days | | | | |
| None | Control | 14.9a | 2347a | 60.5a | 8.5ab | 15.5a | 6.6a | 23.1a |
| Dormant | 56 | 13.1a | 1993ab | 54.8a | 9.2a | 13.6a | 7.0a | 26.2a |
| Bud break | 28 | 13.0a | 1372b | 51.0a | 7.5b | 8.3b | 4.6b | 17.2b |
| Active growth | 0 | 13.3a | 2069ab | 56.1a | 8.2b | 13.7a | 6.5a | 16.0b |
| | | | | 112 days | | | | |
| None | Control | 13.4a | 2539a | 52.7a | 10.4a | 19.5a | 9.7a | 55.7a |
| Dormant | 84 | 14.9a | 2110a | 54.2a | 9.3ab | 17.1a | 8.5a | 48.6a |
| Bud break | 56 | 12.9a | 1038b | 40.0b | 8.3b | 7.3b | 5.2b | 27.5b |
| Active growth | 28 | 12.3a | 1979a | 52.7a | 9.6ab | 15.2a | 8.2a | 33.2b |
| | | | | 140 days | | | | |
| None | Control | 13.1a | 2376a | 52.5ab | 10.8a | 19.7a | 10.2a | 68.1a |
| Dormant | 112 | 14.4a | 1785ab | 56.1a | 9.4ab | 14.8ab | 7.3ab | 61.1a |
| Bud break | 84 | 13.3a | 1244b | 44.6b | 9.1b | 9.4b | 6.4b | 42.1b |
| Active growth | 56 | 13.7a | 1708b | 51.7ab | 10.3ab | 12.4b | 7.4ab | 34.9b |

[z]Mean separation within columns and termination dates by Duncan's multiple range test, 5 percent level.

[y]Days from start of dormant flooding treatment. Trees were flooded 28 days when either dormant, during bud break, or in active growth. Seven trees of each treatment were terminated and averaged at 28 day intervals until 140 days after dormant flooding.

Root dry weights were reduced after being drained from 0 to 56 days of flooding during active growth compared to control treatment. Fifty-six days after the trees had been drained from being flooded during active growth leaf area with root and leaf dry weights also being reduced.

## Leaf Elemental Concentrations

Concentrations of leaf N were significantly lower at 28 and 84 days after being drained from flooding during dormancy, but were lower through out the 112 days compared to the control treatment (Table II).

TABLE II

THE INFLUENCE OF ROOT FLOODING DURING DORMANCY, BUD BREAK AND ACTIVE GROWTH ON LEAF ELEMENTAL CONCENTRATIONS OF PECAN SEEDLINGS

| Flooding treatment | Days after being drained | N % | P % | K % | Ca % | Mg % | Zn ug/g | Fe ug/g | Mn ug/g |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 56 days[y] | | | | |
| None | Control | 3.35a[z] | .31a | 0.90b | 0.97ab | .50ab | 75a | 107a | 1264a |
| Dormant | 28 | 3.16b | .32a | 1.07a | 1.21a | .56a | 72a | 212a | 1424a |
| Bud Break | 0 | 2.05c | .22a | 1.16a | 0.64b | .40b | 57a | 35a | 1162a |
| | | | | | 84 days | | | | |
| None | Control | 2.69a | .30a | 1.22a | 6.59a | .65a | 106a | 508a | 1558a |
| Dormant | 56 | 2.48ab | .27b | 1.25a | 5.66a | .57ab | 80b | 444ab | 1169ab |
| Bud Break | 28 | 2.85a | .33a | 1.25a | 4.86ab | .46b | 74bc | 280ab | 907bc |
| Active Growth | 0 | 2.19b | .26b | 0.80b | 3.53b | .45b | 53c | 154b | 714c |
| | | | | | 112 days | | | | |
| None | Control | 2.68a | .23b | 0.84a | 1.48b | .57b | 89a | 768ab | 1370b |
| Dormant | 84 | 2.36b | .24ab | 0.94a | 2.24a | .86a | 113a | 1361a | 1998a |
| Bud Break | 56 | 2.48ab | .26a | 0.91a | 2.19a | .83a | 120a | 1354a | 2147a |
| Active Growth | 28 | 2.28b | .20c | 0.72a | 0.95b | .49b | 52b | 206b | 951c |
| | | | | | 140 days | | | | |
| None | Control | 2.40ab | .21ab | 0.65a | 1.61ab | .66a | 101ab | 637ab | 1531a |
| Dormant | 112 | 2.25ab | .25a | 0.71a | 2.15a | .80a | 149a | 1084ab | 1821a |
| Bud Break | 84 | 2.49a | .23ab | 0.68a | 2.05ab | .76a | 114ab | 1164a | 1665a |
| Active Growth | 56 | 2.13b | .19b | 0.57a | 1.08b | .48a | 58b | 269b | 1126a |

[z]Mean separation within columns and termination dates by Duncan's multiple range test, 5 percent level.

[y]Days from start of dormant flooding treatment. Trees were flooded 28 days when either dormant, during bud break, or in active growth. Seven trees of each treatment were terminated and averaged at 28 day intervals until 140 days after dormant flooding.

Dormant flooding increased K concentrations after 28 days of trees being drained. Fifty-six days after being drained trees flooded during dormancy were significantly lower in P and Zn, while showing an increase in Ca, Mg and Mn. Elemental concentrations were not affected after being unflooded for 112 days compared to the control.

Twenty-eight days of flooding during bud break resulted in a significant reduction in N and an increase in K but did not effect N level after the trees were returned to drained conditions (Table II). Flooding during bud break decreased Mg, Zn and Mn concentrations after being drained for 28 days but increased P, Ca, Mg, and Mn concentrations 56 days after being returned to drained conditions compared to the control treatment. All other elemental concentrations were not affected 84 days after being unflooded compared to the control.

Twenty-eight days of flooding during active growth and evaluated immediately lowered all elemental concentrations compared to the unflooded trees. Trees flooded during active growth then drained for twenty-eight days significantly reduced P, Zn and Mn while all other elements were not significantly different than the unflooded treatment. None of the elements were affected 56 days after being drained from active growth flooding of trees compared to the control treatment.

## Trunk Elemental Concentration

Trunk elemental concentrations of N, P, K, Ca, Mg, Fe and Mn were not affected, but Zn was reduced after 28 days of flooding during dormancy compared to the control (Table III). K was reduced after trees had been drained for fifty-six days while N, P, Ca, Mg, Zn, Fe and Mn were not significantly different than the control treatment. Eighty-four days after trees were drained following dormant flooding there was an increase in Ca and Fe but all other elements were not significantly different from the unflooded trees.

Flooding during bud break and evaluated immediately reduced N, P, K and Mg, while Ca, Zn, Fe and Mn were not affected compared to the control treatment (Table III). Fifty-six days after trees were drained following flooding during bud break concentrations of Ca and Mn increased compared to non-flooded trees. All other elements evaluated did not show a significant difference at each termination date after bud break flooding compared to the control.

Twenty-eight days of flooding during active growth decreased all elements tested except N compared to the unflooded treatment, while only decreasing Zn twenty-eight days after the trees were returned to drained conditions (Table III). Trees that were drained for 56 days after active growth flooding did not show any significant difference in elemental concentrations compared to the control treatment.

TABLE III

THE INFLUENCE OF ROOT FLOODING DURING DORMANCY, BUD BREAK AND ACTIVE GROWTH ON TRUNK ELEMENTAL CONCENTRATIONS OF PECAN SEEDLINGS

| Flooding treatment | Days after being drained | N % | P % | K % | Ca % | Mg % | Zn ug/g | Fe ug/g | Mn ug/g |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 28 days[y] | | | | |
| None | Control | .95a[z] | .12a | .59a | 0.59a | .23a | 106a | 101a | 615a |
| Dormant | 0 | .87a | .14a | .54a | 0.64a | .25a | 82b | 102a | 725a |
| | | | | | 56 days | | | | |
| None | Control | .99a | .12a | .86a | 0.58a | .25a | 90a | 61a | 282a |
| Dormant | 28 | .91a | .13a | .90a | 0.64a | .25a | 86a | 79a | 283a |
| Bud Break | 0 | .67b | .08b | .42b | 0.55a | .16b | 84a | 60a | 262a |
| | | | | | 84 days | | | | |
| None | Control | .76ab | .14a | .81a | 0.76a | .32a | 102a | 146a | 266a |
| Dormant | 56 | .58b | .10ab | .59b | 0.66a | .23ab | 74ab | 102ab | 244a |
| Bud Break | 28 | .83a | .11ab | .72ab | 0.67a | .28a | 95a | 133a | 328a |
| Active Growth | 0 | .60b | .08b | .34c | 0.38b | .14b | 54b | 47b | 77b |
| | | | | | 112 days | | | | |
| None | Control | .58a | .09a | .43a | 0.55b | .27ab | 94a | 133bc | 165b |
| Dormant | 84 | .57a | .10a | .48a | 0.71a | .32a | 120a | 247a | 220ab |
| Bud Break | 56 | .62a | .09a | .48a | 0.74a | .34a | 98a | 190ab | 266a |
| Active Growth | 28 | .58a | .09a | .51a | 0.46b | .21b | 62b | 73c | 166b |
| | | | | | 140 days | | | | |
| None | Control | .58a | .08a | .29a | 0.81ab | .27a | 92ab | 108ab | 384a |
| Dormant | 112 | .64a | .09a | .31a | 1.01a | .35a | 111a | 175a | 427a |
| Bud Break | 84 | .63a | .09a | .28a | 0.83ab | .33a | 98ab | 142ab | 443a |
| Active Growth | 56 | .58a | .08a | .31a | 0.72b | .26a | 62b | 64b | 368a |

[z]Mean separation within columns and termination dates by Duncan's multiple range test, 5 percent level.

[y]Days from start of dormant flooding treatment. Trees were flooded 28 days when either dormant, during bud break, or in active growth. Seven trees of each treatment were terminated and averaged at 28 day intervals until 140 days after dormant flooding.

## Root Elemental Concentrations

Root elemental concentrations of trees flooded during dormancy and evaluated immediately showed an increase in P, but all other elements were not affected compared to the control treatment (Table IV). Twenty-eight days after trees were drained showed an increase in Fe and an increase in Zn after fifty-six days of drained conditions compared to the non-flooded trees. Trees flooded during dormancy reduced N, P, K and Mn fifty-six days after being drained compared to the control. There were no significant differences between trees flooded during dormancy then drained for 112 days and the control treatment.

TABLE IV

THE INFLUENCE OF ROOT FLOODING DURING DORMANCY, BUD BREAK AND ACTIVE GROWTH ON ROOT ELEMENTAL CONCENTRATION OF PECAN SEEDLINGS

| Flooding treatment | Days after being drained | N % | P % | K % | Ca % | Mg % | Zn ug/g | Fe ug/g | Mn ug/g |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 28 days[y] | | | | | |
| None | Control | 1.57a[z] | .18b | 0.86a | .28a | .17a | 49a | 150a | 298a |
| Dormant | 0 | 1.59a | .21a | 0.82a | .31a | .18a | 54a | 156a | 289a |
| | | | | 56 days | | | | | |
| None | Control | 1.03b | .14b | 1.03a | .26a | .17a | 42a | 127b | 183a |
| Dormant | 28 | 1.03b | .17ab | 1.01a | .32a | .17a | 42a | 252a | 199a |
| Bud Break | 0 | 1.69a | .20a | 0.75b | .32a | .17a | 55a | 237a | 189a |
| | | | | 84 days | | | | | |
| None | Control | 1.06a | .18a | 1.10a | .41a | .30a | 61a | 272b | 244a |
| Dormant | 56 | .71b | .14b | 0.87b | .32a | .26ab | 45ab | 297b | 176b |
| Bud Break | 28 | 1.07a | .16ab | 0.91b | .36a | .22bc | 51ab | 525a | 201ab |
| Active Growth | 0 | 1.25a | .15ab | 0.78b | .36a | .16c | 41b | 353ab | 107c |
| | | | | 112 days | | | | | |
| None | Control | .86a | .15bc | 0.97a | .20a | .21bc | 46bc | 347a | 166b |
| Dormant | 84 | .82a | .19a | 1.05a | .30a | .29a | 64a | 473a | 224ab |
| Bud Break | 56 | .95a | .18ab | 1.05a | .31a | .26ab | 57ab | 622a | 268a |
| Active Growth | 28 | .86a | .14c | 0.80b | .21a | .16c | 38c | 407a | 168b |
| | | | | 140 days | | | | | |
| None | Control | .81a | .18a | 0.96a | .37a | .23ab | 45ab | 503a | 183a |
| Dormant | 112 | .99a | .21a | 1.08a | .47a | .27a | 64a | 619a | 231a |
| Bud Break | 84 | .84a | .18a | 0.93a | .43a | .23ab | 46ab | 472a | 214a |
| Active Growth | 56 | .78a | .16a | 0.96a | .34a | .20b | 34b | 434a | 167a |

[z]Mean separation within columns and termination dates by Duncan's multiple range test, 5 percent level.

[y]Days from start of dormant flooding treatment. Trees were flooded 28 days when either dormant, during bud break, or in active growth. Seven trees of each treatment were terminated and averaged at 28 day intervals until 140 days after dormant flooding.

Twenty-eight days of flooding at bud break did not affect Ca, Mg, Zn, and Mn while K was reduced and N, P and Fe were increased compared to the control (Table IV). Flooding during bud break decreased K and Mg while increasing Fe after 28 days from trees being returned to drained conditions compared to the control treatment. Trees evaluated 56 days after being drained from bud break flooding, increased Mn but all other elements were not significantly different from the control. Eight-four days after trees flooded during bud break had been drained, all elemental concentrations were not significantly different than the non-flooded treatment.

Twenty-eight days of flooding during active growth showed that N, P, Ca and Fe concentrations were not affected but K, Mg, Zn and Mn were reduced compared to the control treatment (Table IV). Trees flooded during active growth then drained for 28 days decreased only the concentration of K in the roots compared to the trees that were not flooded. Elemental concentration of trees flooded during active growth and then drained for 56 days did not differ significantly from trees that were not flooded.

# CHAPTER IV

## DISCUSSION

Plants require an adequate supply of oxygen to grow and produce fruit. Flooding as well as drought can cause loss of plant productivity and death. Even though plant responses are similar, different species are affected in many different ways. Many researchers have found that flooding or restricted aeration decreased growth, dry matter production and, yields of plants. Olien (19) demonstrated with apple seedlings that flooding during dormancy did not have an adverse affect on the seedlings ability to continue growth. Actively growing trees were affected by flooding, with tree growth and yield being most affected by spring flooding.

In this study leaf number was not affected, but the leaf area was reduced by flooding during bud break and active growth compared to the non-flooded treatment (Table I). Trunk diameter and tree height of the seedlings was not significantly affected by the dormant treatment, but was reduced by flooding during bud break and active growth. Leaf, trunk, and root dry weights were not significantly affected by flooding the seedlings while dormant. Root flooding during bud break or while trees were in active growth reduced the leaf, trunk, and root dry weights compared to unflooded trees. Flooding during bud break reduced seedling performance in all areas of observations except leaf number compared to control treatment (Table I).

Hypertrophied lenticels were formed below the water level of all flooded tree trunks. The roots of the flooded trees were thin, black and smaller on all sampling dates compared to the control treatments where the roots were thick and yellow with profuse secondary roots. The reduction in root mass can be attributed to both the death and inhibited root growth of the flooded trees.

Flooding during bud break reduced percent nitrogen concentrations in the leaf of the pecan seedlings (Table II). Twenty-eight days after trees were drained from root flooding Mg, Zn, and Mn were reduced significantly. All elements were reduced when the seedlings were flooded during active growth with N, P, Zn, and Mn being reduced 28 days after being drained.

The effects of dormant flooding on trunk elemental concentrations were limited to a reduction in Zn (Table III). Flooding during bud break affected N, P, K, and Mg by reducing them significantly compared to the control. Active growth flooding reduced P, K, Ca, Mg, Zn, Fe, and Mn with Zn being reduced 28 days after being drained.

Root concentration of N, P, K, and Mn were reduced 56 days after being drained from dormant flooding compared to the control treatment (Table IV). Flooding at bud break reduced the concentration of K twenty-eight days after being drained with K and Mg being reduced 56 days after being drained. Concentrations of K, Mg and Zn were reduced by active growth flooding and reduced K significantly 28 days after being drained.

CHAPTER V

# CONCLUSION

Pecans are a horticulturally important crop in Oklahoma and are typically found growing in low lying areas such as stream and river bottoms with deep alluvial soils. These sites are frequently flooded for long periods of time during the spring and fall. Although, pecans are somewhat tolerant to flooding there is a concern as to the effects of root flooding on tree performance. A greenhouse study was established using seedling trees to evaluate the effects of root flooding during dormancy, bud break, and while trees were in active growth.

In this study flooding during dormancy had little or no effect on tree performance. Flooding during bud break and active growth reduced leaf area, and leaf, trunk, and root dry weights compared to the non-flooded trees. Trunk diameter and height of trees flooded at bud break were decreased. Root flooding was most damaging to tree growth when trees were beginning or were in active growth.

Leaf, trunk, and leaf elemental absorption was rarely affected by dormant flooding. Flooding at bud break and during active growth and terminated immediately decreased almost all of the elements tested. After allowing 56 days of recovery, concentrations of most elements in trees flooded at bud break and during active growth were not significantly different from the non-flooded treatment.

Seedling trees are probably more susceptible to flooding damage than mature trees in the field; therefore, these results cannot be extrapolated directly to adult trees. The results suggest that flooding while trees are beginning or are in active growth may decrease yield by reducing root growth, decreasing leaf area, and decreasing elemental absorption. Flooding could cause alternate bearing which would decrease yields over a period of years.

These results are the first in a series of studies that will evaluate the effects of root flooding on tree performance. With reliable information on the long and short term effects of flooding, a producer can evaluate potential sites for pecan production, and will have an economic basis for decisions concerning water management in the orchard.

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