

**INTRODUCTION**

The objective of this technical note is to provide tree planting guidance on sites with flooding limitations. This technical note assumes that the goal is to establish tree species e.g. Oaks that normally do not regenerate well under natural conditions.

Tree plantings within flood plains in Indiana have been variable in terms of success, especially on sites adjacent to the Ohio, Wabash, and White Rivers where long duration flooding occurs.

Most of the documented tree planting failures have occurred below the 7 and/or 15 day flood elevation, and have been attributed to improper species adaptation, planting methods, and planting stock that did not adequately account for the natural flooding events during tree establishment. In addition, because site access may be delayed until flood waters recede, available planting dates may be sub-optimum and access for necessary maintenance may be limited.

Following the recommendations in this document may not necessarily guarantee successful tree establishment, but they will increase the likelihood of success. Success is usually dependent on the absence of inundation during the growing season for a long enough period of time for tree establishment.

**SITE INVENTORY DATA**

Understanding the site location in flood plains (see Figure 1 and Table 1) and obtaining accurate flooding data and soils information is critical for planning tree plantings.

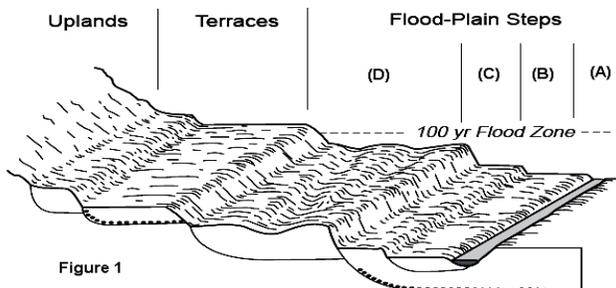


Figure 1

(adapted from Wysocki; et al., 2000)

**Flood-Plain Steps**

*The following are flood plain descriptions for the purpose of this document:*

Step (A) is frequently flooded for long to very long duration and is considered below the 15 day flood profile elevation.

Step (B) is frequently flooded for long to very long duration and is considered below the 7 day flood profile elevation.

Step (C) is considered above the 7 and 15 day flood profile and is occasionally flooded.

Step (D) is considered above the 7 and 15 day flood profile and is occasionally to rarely flooded. Flood durations for Step (C) and (D) are considered brief.

Terraces rarely flood and then only during rainfall events greater than a 100 year flood.

**Flooding Data**

Flood elevation for a site should be obtained in the planning process. Flooding information can be obtained from the NRCS or the US Geological Survey (USGS). NRCS has 7 and 15 day elevation profiles for segments of the Ohio, Patoka, Wabash and White Rivers. These profiles depict a 7 and 15 day flood event that has a 50% chance of occurrence in any year during the growing season as defined in the 1987 Corps of Engineers Wetlands Delineation Manual

(<http://www.in.nrcs.usda.gov/technical/Wetland%20Science/wetland%20science.html>). Flooding information may also be available for other areas if USGS has stream gage data for the planned site.

If flood data are not available, a topographic survey with 1 foot intervals should be obtained unless it is certain that the site is above the 7 day flood elevation using USGS topographic maps.

## Soil Survey Data

Table 1 Flooding Parameter<sup>1</sup>

<b>Flooding Frequency</b>	<b>Chance of Flooding Each Year</b>
Frequent	>50%
Occasional	>5 to 50%
Rare	0 to 5%
<b>Flooding Duration</b>	<b>Days of Flooding</b>
Very long	≥30
Long	7 to <30
Brief	2 to 7
Very Brief	<2

<sup>1</sup>National Soil Survey Handbook Part 618.26

NRCS soil survey information is useful to evaluate soil properties to select adapted species for planting. NRCS soil survey map unit descriptions may describe flooding parameters to determine flood frequency and duration. Data can be obtained from the NRCS Soil Data Mart, Water Features Table (<http://soildatamart.nrcs.usda.gov>) or the NRCS Web Soil Survey: <http://websoilsurvey.nrcs.usda.gov/app/>. An on-site investigation is recommended to verify flooding parameters.

Additional information on flooding frequency and duration can also be obtained from interviewing local people familiar with the site.

## SPECIES SELECTION

Select tree/shrub species that are adapted to the flood-plain step location, soil and site conditions and the planned purpose. See Table 2 for suggested species to plant.

An onsite soils investigation should be completed to evaluate local soil properties and the most adapted species for the site.

## SITE PREPARATION AND WEED CONTROL

To insure successful establishment of trees it is important to have a weed free planting site. Before implementing specific weed control measures, consult a professional forester to develop a site specific weed control plan. Site preparation may be needed to eliminate and control weeds using tillage, herbicides or cover crops.

Contact a professional forester, Purdue University Extension Service or a licensed pesticide applicator for specific herbicide and weed control recommendations. All herbicides shall be applied

according to labeled directions. Research has shown that at least three years (growing seasons) free from excessive competitors are necessary to establish tree seedlings. Weed control is difficult in flood plains because flooding may prevent site access. In addition, annual weed pressure makes it difficult to apply herbicides in bands because tree rows can be difficult to locate.

When herbicides are used they should be applied using a 3 foot circle around each tree or a 2 foot band along each side of each row. Some herbicides can kill or damage seedlings and a directed spray and/or spray shield is recommended to avoid herbicide contact on seedlings.

For best results plant trees in fields that have been previously row cropped using agricultural herbicides to control weeds. This usually permits tree planting in crop stubble without established competing weeds.

### Management and Weed Control Options

#### *No Crops Previous Year*

August-September, Mow the site, disc to leave smooth, (do not plow or chisel this will leave the site rough and the ground soft to plant in the spring).

#### *Corn, Soybeans or Wheat the Previous Year*

No mowing or tillage is usually necessary.

#### *Late Fall to Early Winter Weed Control*

Broadcast spray labeled pre-emergent herbicide for residual weed control. This could be done in the spring, but site conditions (flooding or wetness) or availability of an applicator could prevent timely application.

#### *Spring*

If spring herbicide application is done after weeds start to grow, spray labeled non-selective herbicide with pre-emergent herbicide. Herbicide can be applied before or with tree planting. If applying herbicides with tree planting, apply only in the rows of the trees using a directed band spray.

#### *Summer, Late June and early July*

The pre-emergent herbicide will start to dissipate. Broadcast spray selective labeled herbicide over the top of the tree planting to kill weeds.

#### *Evaluate the Planting*

Evaluate the tree height to determine if additional herbicides or mowing will be necessary.

### *Cover Crops*

A cover crop of cereal rye (1 bushel per acre), or Wild Rye (*Elymus spp.*) (3 PLS pounds per acre) can be seeded to help control weeds on the site. Seed the cover crop from August 1 - September 30 or a dormant seeding December 12 - March 1.

### *Mowing*

Mowing by itself is the poorest form of weed control. Mowing stimulates increased root growth of grasses and does not control the roots of competing vegetation. Close mowing around trees often results in basal damage or main stem wounding. Mowing should only be implemented when recommended by a professional forester to control specific weed species.

For additional site preparation information consult NRCS Indiana FOTG Standard (612) *Tree/Shrub Establishment*, Table 1 Site Preparation Alternatives.

## **PLANTING**

Planting bare root seedling stock is recommended for tree establishment. Container stock is more expensive and has not been proven to increase tree survival rates. Direct seeding of Oak acorns has resulted in limited success and does not allow control of plant spacing and density.

Timing of tree plantings is difficult because flooding can prevent access to sites for normal spring planting. This delays planting until the summer months after the flood water recedes.

All seedlings should be planted in accordance with Planting and Storage Guidelines for Wood Stock as detailed in IN-NRCS FOTG, *Tree/Shrub Establishment* (612) and as follows:

### Planting Dates and Timing

#### **1. Spring Planting**

Tree seedlings should be planted in the spring as early as local weather and soil conditions allow but before June 1. If the site is inundated with flood waters, then consideration should be given to fall planting. Seedling planting after June 1 should only be considered if the soil at the site contains adequate moisture and the seedlings have been properly stored following approved recommendations.

#### **2. Fall Planting**

Dormant seedlings can be planted in the fall (usually after Nov. 1<sup>st</sup>) on sites not susceptible to frost heave.

If fall planting is going to be used seedling availability may be limited and special arrangements with the nursery may be required.

Because flood-plain Steps (A) and (B) sites may be inundated during the spring, fall planting should be considered, if:

- a) planting stock is available
- b) the site is not inundated, and
- c) the soil contains adequate moisture

### Planting Rates

Step (A) sites typically have low survival rates from long duration flooding so replanting in later years may be required. Plant a minimum of 544 trees per acre (8 x 10 foot spacing).

Step (B) and (C) sites flood less frequently than Step (A) sites and can be planted using rates for the applicable purpose using NRCS Indiana FOTG Standard (612) *Tree/Shrub Establishment*

On sites where the landowner is interested in potential future timber crop, trees should be planted using a minimum of 681 trees per acre (8 X 8 foot spacing).

### Considerations

Consider planting a portion of the site in successive years to reduce the risk of seedling mortality from flooding. For example, a 300 acre site could be planted over a three year period planting 100 acres per year.

Consider utilizing topographic surveys to designate historic flood elevations. Plant trees on higher locations of the site and utilize natural regeneration on lower elevations where seedling success is less likely.

Consider controlling weeds using labeled herbicides for two additional years after tree planting by using a 3 foot circle around each tree or a 2 foot band along each side of each row.

Consider planting as many seedlings as practical to increase tree survival numbers. For example if 1210 seedlings per acre are planted, and flooding limits survival to 25%, 302 trees per acre remain to occupy the site.

## REFERENCES

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- Herbicides for Year-of-Planting Weed Control In Hardwood and Conifer Plantations*  
<http://forestry.msu.edu/extension/extdocs/E2752.pdf>
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<http://forestry.msu.edu/extension/extdocs/E2754.pdf>

**Table 2. Species for Flood Plain Planting**

Common Name	Scientific Name	Soil Drainage <sup>1</sup>	Planting Location <sup>2</sup>	Below the 15 Day Line	<sup>3</sup> Flooding Tolerance	Soil pH Range
<b>Tree Species</b>						
American Sycamore	<i>Platanus occidentalis</i>	PD-WD	A-D	Yes	Tolerant	4.5-7.8
Baldcypress	<i>Taxodium distichum</i>	VPD-WD	A-D	Yes	Tolerant	4.5-7
Black Gum	<i>Nysaa sylvatica</i>	PD-WD	B-D	No	Somewhat	4.5-6.5
Black Walnut	<i>Juglans nigra</i>	MWD-WD	D	No	Intolerant	6.6-7.8
Black Willow	<i>Salix nigra</i>	VPD-WD	A-D	Yes	Tolerant	4.5-7
Eastern Cottonwood	<i>Populus deltoides</i>	PD-ED	B-D	No	Somewhat	4.5-7.4
Kentucky Coffeetree	<i>Gymnocladus dioicus</i>	SPD-WD	B-D	No	Somewhat	5.5-6.5
Maple, Red	<i>Acer rubrum</i>	VPD-WD	B -D	No	Somewhat	4.5-6.5
Maple, Silver	<i>Acer saccharinum</i>	VPD-WD	A-D	Yes	Tolerant	4.5-6.5
Oak, Bur	<i>Quercus macrocarpa</i>	PD-ED	B-D	No	Somewhat	4.5-7.8
Oak, Cherrybark	<i>Quercus pagoda</i>	SPD-WD	C-D	No	Somewhat	4.5-6.5
Oak, Overcup	<i>Quercus lyrata</i>	VPD-WD	A-D	Yes	Tolerant	4.5-7
Oak, Pin	<i>Quercus palustris</i>	VPD-WD	B-D	No	Somewhat	4.5-6.1
Oak, Shumard	<i>Quercus shumardii</i>	SPD-WD	C-D	No	Somewhat	6.1-7.4
Oak, Swamp Chestnut	<i>Quercus michauxii</i>	SPD-WD	C-D	No	Somewhat	4.5-6.5
Oak, Swamp White	<i>Quercus bicolor</i>	VPD-WD	C-D	No	Somewhat	4.5-6.1
Pecan	<i>Carya illinoensis</i>	SPD-WD	A-D	Yes	Tolerant	6.1-7.8
Persimmon	<i>Diospyros virginiana</i>	MWD-WD	C-D	No	Somewhat	4.5-6.5
River Birch	<i>Betula nigra</i>	VPD-WD	B-D	No	Somewhat	4.5-6.5
Shellbark Hickory	<i>Carya laciniosa</i>	VPD-WD	C-D	No	Somewhat	6.1-7.4
Sweetgum	<i>Liquidambar styraciflua</i>	PD-WD	A-D	Yes	Tolerant	5.5-6.5
<b>Shrub Species</b>						
America Plum	<i>Prunus americana</i>	MWD-ED	D	No	Intolerant	4.5-6.5
Black Chokeberry	<i>Photinia melanocarpa</i>	PD-WD	B-D	No	Somewhat	4.5-6.5
Buttonbush	<i>Cephalanthus occidentalis</i>	VPD-WD	A-D	Yes	Tolerant	6.1-7.8
American Elder	<i>Sambucus nigra ssp. canadensis</i>	VPD-WD	A-D	Yes	Tolerant	4.5-7.4
Pawpaw	<i>Asimina triloba</i>	SPD-WD	D	No	Intolerant	5.5-7.4
Dogwood, Gray	<i>Cornus racemosa</i>	VPD-WD	A-D	Yes	Tolerant	4.5-7
Dogwood, Silky	<i>Cornus amomum</i>	VPD-WD	A-D	Yes	Tolerant	4.5-7.4
Hazelnut	<i>Corylus americana</i>	MWD-WD	D	No	Intolerant	4.5-7.4
Highbush Cranberry	<i>Viburnum opulus var. americanum</i>	VPD-WD	A-D	Yes	Tolerant	4.5-7
Ninebark	<i>Physocarpus opulifolius</i>	VPD-WD	C-D	No	Somewhat	4.5-7.4
Smooth Sumac	<i>Rhus glabra</i>	MWD-ED	D	No	Intolerant	5.5-7
Washington Hawthorn	<i>Crataegus phaenopyrum</i>	SPD-ED	D	No	Intolerant	4.5-7.4

<sup>1</sup> VPD=very poorly drained, PD=poorly drained, SPD=somewhat poorly drained

MWD=moderately well drained, WD=well drained, ED=excessively drained

<sup>2</sup> See Figure 1 on page 1 for planting locations.

<sup>3</sup> Flooding tolerance during the growing season for established trees: Tolerant (T)-can withstand inundation for more than 30 days, Somewhat Tolerant (ST)-can survive saturated soils and inundation for up to 30 days, Intolerant (I)-able to survive only 1 to 5 days of inundation

Note: Tree species on terraces and/or uplands should be selected based upon soil properties as listed in eFOTG Sect. II or the NRCS Soil Data mart from the soil map unit on the site.