NATURAL RESOURCES CONSERVATION SERVICE

TREE/SHRUB ESTABLISHMENT PLANTING DESIGN PROCEDURES
(612DP)

INTRODUCTION

Tree/shrub establishment refers to establishing woody plants by planting seedlings or cuttings, direct seeding, or natural regeneration. The use of this standard is for non-windbreak tree and shrub plantings. Its purposes are detailed in the standard Tree/Shrub Establishment (612). For specialized tree/shrub establishment situations refer to the specific standards: Riparian Forest Buffer (391) and Design Procedures (391DP); Windbreak/Shelterbelt Establishment (380), Design Procedures (380DP), and Tree Planting Procedures (380TPP); Critical Area Planting (342); and Hedgerow Planting (422).

Contents of Tree/Shrub Establishment Planting Design Procedures include:

Section	Subject Area
1	Adapted Species by Type of Planting
2	Planting Sites
3	Initial Plant Densities (Tree/Shrub Spacing)
4	Care and Maintenance/Protection
5	Management
6	Supporting References

1. ADAPTED SPECIES BY TYPE OF PLANTING

a. All species must be adapted to the site and the intended purpose. For species suitability by soil series see Nebraska Field Office Technical Guide, Section II-Forestland Interpretations, Guide to Suitable Soils for Wood Crops, by Vegetative Zones; or by soils and vegetative zones in NE FOTG, Section II-Windbreak Interpretations, Conservation Tree/Shrub Suitability Groups, Tables 1-10. Refer to Section II, Windbreak Interpretations, Table 11 for detailed information on species attributes, including specific uses.

i) Production of wood crops – the following species are generally favored by woodland managers:

American basswood	Black cherry	Pecan
Bur oak	Black walnut	Hackberry
Green ash [1/]	Silver maple	Northern red oak
Ponderosa pine	Eastern cottonwood	

[1/] Green ash is highly susceptible to emerald ash borer, although the pest has not yet been detected in Nebraska.

ii) Production of Christmas trees – the following species are recommended:

Scots pine [2/]	Austrian pine [2/]
White fir	Eastern white pine
Ponderosa pine	Douglas fir
Blue spruce	

[2/] Scots pine and Austrian pine are extremely susceptible to pine wilt.

iii) Production of fence posts – the following species are recommended:

Osage-orange [3/]	Black locust
Ponderosa pine	Eastern redcedar [3/]
Northern catalpa	Bur oak

[3/] Treatment of posts to prolong utility recommended for all species except Osage-orange and Eastern redcedar.

iv) Production of firewood – the following hardwood species are generally favored for firewood plantations:

Green ash	Siberian elm
Osage-orange	Eastern cottonwood
Silver maple	Hickories
Honeylocust	Black walnut
Oaks	Hackberry

v) Riparian forest buffers – refer to NE FOTG, Riparian Forest Buffer (391) and Riparian Forest Buffer Design Procedures (391DP).

vi) General tree/shrub plantings for beautification, biodiversity, watershed protection, and conservation of soil and moisture - any adapted species that meets intended purposes (NE FOTG, II, Windbreak Interpretations, Conservation Tree/Shrub Groups, Table 11).

vii) **Restoration of declining forest habitat** - refer to NE FOTG, Restoration and Management of Rare or Declining Habitats (643) and Restoration and Management of Rare or Declining Habitats - Woodland/Forest Design Procedures (643DPb).

viii) **Wildlife habitat** - refer to NE FOTG, Wetland Wildlife Habitat Management (644), Upland Wildlife Habitat Management (645), and Nebraska Biology Technical Note 65, Terrestrial Communities of Nebraska, Version IV.

2. PLANTING SITES

a. Refer to Windbreak/Shelterbelt Establishment Tree Planting Procedures (380TPP) for detailed information in addition to details regarding:

i) Cutover Woodland (areas where timber harvesting has occurred)

Planting in cutover woodland is generally for the purpose of supplementing natural reproduction, speeding up the stocking process, or increasing the number of desirable species.

1. If the original woodland contained desired conifers, such as Ponderosa pine, plant only the desired conifer species.
2. Remove or kill undesired shrubs and trees before planting (weeding).
3. Plantings on cutover woodland require ongoing weeding operations on an annual basis.

ii) Cropland and Grassland

1. Refer to Windbreak/Shelterbelt Establishment Tree Planting Procedures (380TPP).

iii) Interplanting on the Woodland

Interplanting is generally for the purpose of introducing desirable species in a stand of inferior species or for filling voids in the stand.

1. Black walnut may be successfully planted in small openings in woodlands on deep, well-drained, moist soils.
2. Use species that are shade tolerant for understory. Refer to NE FOTG II, Windbreak Interpretations, Conservation Tree/Shrub Groups, Table 11.
3. Larger, undesirable trees will need to be cut or killed to provide needed sunlight. Refer to Forest Stand Improvement Design Procedures (666DP).

iv) Agroforestry/Alley Cropping

1. Agroforestry can be interpreted as the multiple uses of trees to benefit agriculture. This would include windbreaks, timber, decorative florals, edible fruits/nuts, fuelwood, Christmas trees, and wildlife habitat plantings.
2. Alley cropping is more specific to growing trees to produce a valuable product on the same acre as traditional agricultural crops, including pasture and hay.
3. Species, such as black walnut or pecan, are grown in rows between crops or pasture and are intensively managed to produce high value timber and/or nuts.

3. INITIAL PLANT DENSITIES (TREE/SHRUB SPACING)

a. In plantations, tree/shrub spacing is related to the purpose of the planting, the site, and the size of maintenance equipment. Suggested spacings are:

i) **Christmas trees** - 5 feet by 5 feet minimum. Spacing between rows can be varied to accommodate equipment and other items identified in the management plan.

ii) **Wood products** (walnut, other sawlogs, firewood) - 8 feet by 8 feet or wider. Refer to Table 1 for minimum and maximum initial planting density.

iii) **Riparian forest buffers** - refer to NE FOTG, Riparian Forest Buffer Design Procedures (391DP).

iv) **Alley cropping** – distance between rows will vary depending on landowner objectives, site conditions, cultural practices, etc. Within tree rows are usually 8 feet by 8 feet or wider, but can be closer if Christmas trees or shrubs are grown.

v) **General tree/shrub plantings** for beautification and other purposes will have varied spacings. Refer to Table 1 for minimum and maximum initial planting densities.

vi) **Landscape plantings** shall be according to an approved landscape plan.

vii) **Wildlife habitat plantings** - Refer to NE FOTG, Wetland Wildlife Habitat Planting (644) and Upland Wildlife Habitat Planting (645) for specifics regarding tree/shrub plantings for wildlife habitat.

viii) **Restoration of declining habitats** - Refer to NE FOTG, Restoration and Management of Rare or Declining Habitats (643) and Restoration and Management of Rare or Declining Habitats - Woodland/Forest Design Procedures (643DPb). The minimum and maximum initial planting densities for this purpose are presented in Table 1.

ix) **All other purposes** - Tree and shrub plantings for all other purposes shall be planted according to the appropriate NE FOTG standard. Refer to Table 1 for initial planting densities.

Table 1 – Initial Tree/Shrub Planting Density (Saplings/Plants/Stems per Acre) [3/]

Plant Types/Heights: (20-year tree/shrub height in feet)	Minimum & Maximum Plant-to-Plant Spacing[2/] (feet)		Minimum & Maximum Number of Tree/Shrub Saplings/Plants/Stems Per Acre	
	Min.	Max.	Min.	Max.
Small shrubs [1/] **(< 10')**	**3**	**6**	**1210**	**4840**
Large shrubs and small trees, including columnar trees (10' to 20')	**6**	**10**	**440**	**1210**
Large trees (> 20')	**10**	**15**	**200**	**440**

[1/] Small shrubs planted as understory for large trees do not need to meet minimum planting density requirements.

[2/] It is preferable that plant-to-plant spacing is equal between and within rows when possible. If necessary for maintenance, a wider between row spacing is allowed as long as the minimum number of saplings, plants, or stems per acre will be planted.

[3/] To calculate initial planting density, determine the square feet per tree and divide it by the square feet in one acre. For example, an initial planting density of 10 ft by 10 ft equals 100 square feet per tree/shrub seedling. Divide 43,560 sq. ft/acre by 100 sq. ft/seedling for an initial planting density of 436 seedlings per acre. Refer to Table 2 for various densities that have already been calculated.

Table 2 – Various Spacings and Initial Planting Densities for Tree/Shrub Seedlings

Spacing (feet)	Square Feet per	Number of Tree/Shrub Seedlings per Acre
2 x 2	4	10,890
3 x 3	9	4,840
4 x 4	16	2,723
5 x 5	25	1,742
6 x 6	36	1,210
6 x 8	48	907
8 x 8	64	680
10 x 10	100	436
10 x 14	140	311
12 x 12	144	302
12 x 16	192	227
14 x 14	196	222
10 x 20	200	218

b. Initial planting densities for trees and shrubs will depend on their average height at 20 years of age. Estimate average 20 year height using either method listed below.

i) Estimate average 20 year height based on performance of the individual species (or comparable species) in nearby areas on similar sites.

ii) Estimate average 20 year height from references containing predetermined and documented heights found in Conservation Tree/Shrub Suitability Groups, NE FOTG, Section II, Windbreak Interpretations and Section II, Forestland Interpretations.

c. Space shall be provided as necessary for access roads, harvesting, firebreaks, and management purposes.

4. CARE AND MAINTENANCE/PROTECTION

a. Refer to Windbreak/Shelterbelt Establishment Tree Planting Procedures (380TPP) for detailed guidelines.

5. MANAGEMENT

a. Refer to Tree/Shrub Pruning (660) and Design Procedures (660DP), NE Forestry Technical Note 71, and Forest Stand Improvement (666) and Design Procedures (666DP) for long-term guidance on thinning, pruning, and other forest management guidelines.

b. Refer to NE Forestry Technical Note 63 for guidance for the evaluation of survival for conservation tree and shrub plantings.

c. Contact your local forester for assistance in developing a long-range forestry management plan.

6. SUPPORT REFERENCES

Conservation Tree and Shrub Groups, NE FOTG, Section II, Windbreak Interpretations

Forest Stand Improvement Design Procedures (666DP)

Guide for Evaluation of Survival for Conservation Tree and Shrub Plantings, NE Forestry Tech Note 63

Guide to Suitable Soils for Wood Crops, by Vegetative Zones, NE FOTG, Section II, Forest Land Interpretations (not available electronically)

How to Prune Trees, NE Forestry Tech Note 71

Restoration and Management of Declining Habitats (643)

Restoration and Management of Rare Declining Habitats, Woodland and Forest (643DPb)

Riparian Forest Buffer (391)

Riparian Forest Buffer Design Procedures (391DP)

Tree and Shrub Pruning (660)

Tree/Shrub Establishment (612)

Upland Wildlife Habitat Management (645)

Wetland Wildlife Habitat Management (644)

Windbreak/Shelterbelt Establishment Tree Planting Procedures (380TPP)