

Pennsylvania Bureau of Forestry Planting and Seeding Guidelines



Photo: Michael Wright



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1. Key Principles

Supplemental planting on State Forest lands is a common practice for activities such as re-vegetating a log landing after harvest, erosion and sedimentation control, forage and cover habitat in wildlife openings, and reclamation and restoration in gas development areas. The Bureau of Forestry utilizes native species in supplemental plantings whenever possible; however, there are occasions when native species do not fully support the purpose of the planting and non-native species may be justified. This document provides guidance on how best to plant native grasses, forbs, shrubs and trees on state forest lands, as well as information regarding non-native species that can be planted with caution on state forest lands. This document also provides information on general seed mixes recommended by the Ecological Services Section and alterations for specific need. Any non-native species planted on state forest lands are to be monitored following planting and is subject to review as per the “Assessment and Justification for the Use of Non-Native Plantings” process.

The Bureau of Forestry has researched many species being considered for planting on state forest lands and have determined that the species fit into three categories:

1. **Invasive:** Deemed invasive. Do not plant.
2. **Potentially Invasive:** Avoid planting, except in special situations (after Ecological Services consultation).
3. **Non-invasive:** Native species deemed non-aggressive and non-native species found not to be invasive.

These categories are discussed in greater detail in Sections 2 (herbaceous species) and Section 3 (tree and shrubs), including recommended species and seed mixes.

1. Invasive: Deemed Invasive: Do Not Plant

Any plant classified as a [noxious weed](#) by the PA of Agriculture is barred for use on State Forest lands. It is illegal to cultivate, sell, transport, or plant any species classified as a noxious weed in PA.

Plants on [DCNR Invasive Plant List](#) are prohibited from use on State Forest lands, according to principles set forth in the [State Forest Resource Management Plan](#) and the Bureau of Forestry’s Invasive Plant Strategy. Some of these species may have been planted on State Forest lands in the past. However, current standards do not allow the use of these plants on State Forest lands. This includes species on DCNR’s ‘Invasive Plant Watch List.’

2. Potentially Invasive: Avoid planting except in special circumstances or situations

Some species may have invasive potential, depending on conditions, or as noted by other states. In addition, some non-native species do not provide quality wildlife habitat/forage and may not be compatible with planted tree seedlings during reforestation activities. There may be special circumstances or situations that require the use of these species, such as unique erosion control needs or limited availability of native seed. The species mentioned in this category **should be avoided** whenever possible in favor of more acceptable native alternatives. Consultation with Ecological Services is required prior to the use of these species, and monitoring may be required following planting. New Bureau of Forestry policies also require research into the ecological benefits or impacts of the use of non-native species. Please reference the “Assessment and Justification for the Use of Non-Native Plantings” document for further information.

3. Non-invasive: Native and non-native species recommended for use on State Forest lands.

There are many species to choose for seed mixes and planting on State Forest lands, both native and not native to Pennsylvania. For the species listed in this document, there is little to no evidence to suggest that any of these non-native species will have invasive tendencies, or the listed native species will have aggressive tendencies. These are the species recommended for use on State Forest lands. Other species native to Pennsylvania may be used at the District's discretion; however, other non-native species should be discussed with Ecological Services prior to their use.

Non-native Plantings Monitoring

Non-native plant species listed under category 2 (potentially invasive) WILL require monitoring. Category 3 (non-invasive) species may require monitoring after consultation with Ecological Services. This monitoring should take place once within 5 years of planting and should be completed by district staff, with help from Ecological Services. If requested, Ecological Services will be available to assist with plant identification. Species in Category 1 (invasive) should not be planted. If they have been planted in the past, treatment and/or removal is recommended.

2. Planting Guidance for Native Grasses and Herbaceous Plants

The sowing of grass seed mixes is a long-standing practice used on state forest lands to stabilize soils following disturbance. While the Bureau has traditionally used grass seed mixes to retire log landings and timber sale haul roads, there has been an increased use of native grasses for permanent herbaceous openings for wildlife and for reclamation practices in areas surrounding energy and right-of-way development. Combining native wildflowers and forbs to native warm season grass seed mixes increase the ecological value of restoration practices, attracting pollinators and other insects which then builds a more diverse food web and provides additional food sources for wildlife. Plantings of native warm season grasses allow for natural succession, which over time will limit the establishment of invasive plant species.

When undertaking a seeding project please consider the following:

Pre-planning:

- Anticipate ordering seed 6 months in advance to ensure seed availability. The best time to purchase native seed is in fall to be sure the supplier has enough in stock for spring plantings. Be sure to specify **PLS (pure live seed)** when ordering native seed. PLS factors in germination rates to ensure the amount of seed of an individual species is used to achieve adequate cover.
- State-listed or PA Species of Concern may not be planted unless a species recovery plan has been developed and local genetic stock is available. If a district is interested in planting state-listed species, please consult with Ecological Services.
- Seeding rates listed below may be changed when a higher density is desired for erosion control or other purposes.
- When choosing species for a seed mix, attempt to use species representative of the area and consider the management objectives (wildlife opening, road corridor, log landing revegetation, recreational use) for the site. Any mix should have both warm-season and cool-season growing species. Plan ahead for long-term maintenance of the species selected.

Soil and Site Preparation:

- In activities that cause excessive soil compaction, such as log landings or gas development, the **topsoil and subsoil should be segregated and piled** before disturbance and returned to original contour with as little compaction as possible before seeding. Ripping the soil sublayer prior to spreading topsoil is recommended to lessen compaction and increase infiltration.
- **Lime and fertilizer are not generally recommended for native seed mixes.** If lime and fertilizer are used, be sure to **reduce the nitrogen content** (first number in the N-P-K ratio), as this will promote weedy plants or invasives and can potentially kill or inhibit the germination of native seed.
- Seed may be lightly worked into the soil using a rake or bedsprings, but disking will likely bury the seeds too deep and may not be successful. Disking should only be conducted prior to spreading seed.
- If the site to be planted with native warm season grasses is currently occupied by cool season turf grasses, an herbicide application is recommended in the fall prior to spring planting. Disking should follow once the turf grass has been killed to allow the new seed to have contact with mineral soil.

Planting:

- Use straw, **not hay**, to reduce the potential for introduction of weed seed. Hay should only be used if the cost or availability of straw is prohibitive. Invasive seed can also be introduced from contaminated fill material or seeders. Be sure seeding equipment is clean and free of any seed used previously whether on or off State Forest lands.
- Temporary cover crops should be added to all mixes to improve soil stabilization and increase the chance of establishment. Cover crops can be applied before the desired mix if waiting for the optimum time to plant native seed. When using in combination with another mix, they should be applied at a rate of 1 bushel (~30lbs) per acre. If used alone on a site, they should be applied at 2 bushels (~60lbs) per acre.
 - Spring oats (*Avena fatua*) if seeding prior to August 15th
 - Winter rye (*Secale cereale*) if seeding after August 15th
 - **Annual rye (*Lolium multiflorum*) may be used instead of oats or winter rye
- Observations of warm season grass plantings suggest **April through mid-May is the optimum time for planting and establishing native species** in the first growing season. Fall seeding may be successful (late October through late April), but make sure the seed will not lie wet in winter. If initial reseeding must take place in mid-summer, plant a cover crop of Oats for stabilization and plant native grasses the following April.
- For spring plantings, some native warm season grasses and native wildflowers will germinate the first year with most germinating the second year. For late fall/early winter plantings, native warm season grasses and wildflowers could experience dormancy conditions, but many can germinate well the first full growing season after planting.
- Broadcast and hand spreading of native seed equally across the site is acceptable. However, also consider planting single species from the mix in strips across an herbaceous opening to establish varying vertical structure. Another option is to spread some of the warm season grass seed in “patches” to create openings for wildlife between tufts of grass. Some seed, like that of little bluestem, that is “fluffier” can clog a seeder and should be spread separately from the rest of the mix.

Ecological Considerations:

- The use of synthetic matting is prohibited on state forest lands. If matting is to be used for erosion and sedimentation control, it should be made of bio-degradable, Jute material. Synthetic matting is made of a stiff, microfilament netting that may entangle and cause injury or mortality to wildlife.
- When the objective is long-term restoration, rather than temporary cover, it may be important that stock is from local genetic material. Seed companies may provide the genetic origin or offer species collected from different stock. When available, select PA Ecotypes.
- For wildlife habitat, it is important to provide varied structure with good interspersions of bare ground, beneath a shaded canopy which allows small mammals and birds to move freely at ground level, search for seeds, insects and roosting cover. In other cases, on steep slopes or poorer sites, higher rates may be necessary to achieve desired conditions.
- During the first and second year of growth, native warm season grasses typically invest more initial resources in root growth rather than vegetative growth during the first growing season. This enhanced root growth improves soil retention to alleviate erosion and sedimentation issues;

however, this enhanced root growth cannot always be confirmed by the quantity of above-ground, green vegetative growth.

Maintenance to Sustain Native Herbaceous and Grass Plantings or Permanent Herbaceous Openings:

- Typically, mowing of native grasses should take place for the first time on the 3rd year following initial planting and then on a 3-5 year cycle as needed. In lieu of a rotation for complete mowing, after the 3rd year following planting a 1/3 of the planting could be mowed every year. The ideal time to cut native grasses is very early spring (March or April), after snow melt. Mowing can also take place following the first frosts in November, but native grasses are ideal winter shelter for small mammals so this is only encouraged if Spring mowing is not feasible.
- In the second and subsequent growing seasons, the site should be checked for problematic weeds or invasive plants and spot treated.
- These grasses should be cut back to 8” in height by a brush-hog or similar piece of equipment. **Cutting lower than 4” may harm the development of the native grass seedlings.**
- Prescribed fire provides the best maintenance of warm season grass openings; however, in areas such as rights-of-way, this may not be practical.
- Disking could also be considered to break-up and create more space between grass clumps, break up root mats, and to provide better habitat for wildlife. This treatment should be conducted from November 1st to April 1st. It is likely that disking may only be necessary every 5-10 years.
- For more information on sustaining openings, see the [Permanent Herbaceous Openings](#) and the [Maintaining ROWs for Wildlife](#) documents on Intraforestry.

Grasses and Herbaceous Species Lists:

1. Invasive: Deemed Invasive: Do Not Plant

A number of grasses and forbs are considered invasive by DCNR. Plants on [DCNR Invasive Plant List](#) are prohibited from use on State Forest lands, according to principles set forth in the [State Forest Resource Management Plan](#). Please carefully review this list prior to making seeding or planting selections.

2. Potentially Invasive: Avoid planting except in special circumstances or situations

The use of the species listed below should be limited in most circumstances. This list was created through examining neighboring states’ invasive plant lists, communications with foresters, specialists and resource managers, and research on species behavior. Native and non-native alternatives to these species are provided within Category 3. This list is revised periodically based on field observations and literature review.

Cool Season Grasses

Kentucky bluegrass	<i>Poa pratensis</i>	Creeping red fescue	<i>Festuca rubra</i>
Non-native bluegrasses	<i>Poa species</i>	Redtop grass	<i>Agrostis gicantea</i>
Orchard grass	<i>Dactylis glomerata</i>		

Legumes

Yellow sweet-clover	<i>Melilotus officinalis</i>	White sweet-clover	<i>Melilotus alba</i>
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3. Non-invasive: Recommended native and non-native grasses and herbaceous species.

There are many species to choose for seed mixes and planting on State Forest lands, both native and not native to Pennsylvania. For these species below, there is little to no evidence to suggest any of these non-native species will have invasive tendencies, or that any of these native species will have aggressive tendencies. Other native grasses, legumes, and wildflowers not included on this list may also be used if conditions are appropriate.

Native Warm Season Grasses

Big Bluestem	<i>Andropogon gerardii</i>	Switchgrass	<i>Panicum virgatum</i>
Indiangrass	<i>Sorghastrum nutans</i>	Purpletop	<i>Tridens flavus</i>
Deertongue grass	<i>Dicanthelium clandestinum</i>	Little bluestem	<i>Schizachyrium scoparium</i>

Native Cool Season Grasses

Virginia wildrye*	<i>Elymus virginicus</i>	Autumn bentgrass	<i>Agrostis perennans</i>
Canada wildrye*	<i>Elymus canadensis</i>	Povertygrass	<i>Danthonia compressa</i>
Riverbank wildrye*	<i>Elymus riparius</i>	Povertygrass	<i>Danthonia spicata</i>

Native Legumes

Partridge pea	<i>Chamaechrista fasciculata</i>	Showy tick-trefoil	<i>Desmodium canadense</i>
Senna	<i>Senna herbecarpa</i>		

Native Wildflowers

Black-eyed susan	<i>Rudbeckia hirta</i>	Tall white beardtongue	<i>Penstemon digitalis</i>
Cardinal flower	<i>Lobelia cardinalis</i>	Ox-eye sunflower	<i>Heliopsis helianthoides</i>
Common milkweed	<i>Asclepias syriaca</i>	Goldenrods	<i>Solidago spp.</i>
Butterfly milkweed	<i>Asclepias tuberosa</i>	Asters	<i>Symphotrichum spp.</i>
Evening primrose	<i>Oenothera biennis</i>	Hoary mountain-mint	<i>Pycnathemum incanum</i>
Ironweed	<i>Veronia altissima</i>	Narrowleaf mountain-mint	<i>Pycnathemum tenuifolium</i>
Wild bergamot	<i>Monarda fistulosa</i>		

Native Species for Riparian or Wetland Habitats

Fox sedge	<i>Carex vulpinoidea</i>	Pennsylvania sedge	<i>Carex pensylvanica</i>
Woolgrass	<i>Scirpus cyperinus</i>	Bluejoint grass	<i>Calamagrostis canadensis</i>
Soft rush	<i>Juncus effusus</i>	Blue lobelia	<i>Lobelia siphilitica</i>
Joe-pye weed	<i>Eupatorium purpureum</i>		

Non-native grasses and forbs

Perennial ryegrass	<i>Lolium perenne</i>	Oats	<i>Avena fatua</i>
Timothy	<i>Phleum pratense</i>	Millet	<i>Millium spp.</i>
Winter wheat	<i>Triticum aestivum</i>	Hard fescue	<i>Festuca trachyphylla</i>
Cereal rye	<i>Secale cereale</i>	Alfalfa	<i>Medicago stavia</i>
Buckwheat	<i>Fagopyrum esculentum</i>	Barley	<i>Hordeum vulgare</i>

Non-native legumes

White clover	<i>Trifolium repens</i>	Birds foot trefoil	<i>Lotus corniculatus</i>
Red clover	<i>Trifolium pratense</i>	Flat pea	<i>Lathyrus sylvestris</i>
Alsike white clover	<i>Trifolium hybridum</i>	Crimson clover	<i>Trifolium incarnatum</i>

* The seed awns of the wildryes (*Elymus spp.*) have been shown in certain circumstances to become ingested or attached to a dog's fur or paws, penetrating the skin and leading to the potential for grass awn migration disease. Ecological Services is researching potential native cool season grass alternatives to replace these species. Use these species with caution in areas that may be utilized by hunters.

BOF General Native Seed Mix

Cover Crop: 30 lbs/ac Oats (*Avena fatua*)

3 lb PLS	Big bluestem (<i>Andropogon gerardii</i>)
3 lb PLS	Little bluestem (<i>Schizachyrium scoparium</i>)
2 lb PLS	Indiangrass (<i>Sorghastrum nutans</i>)
2 lb PLS	Switchgrass (<i>Panicum virgatum</i>)
2 lb PLS	Deertongue (<i>Dicanthelium clandestinum</i>)
4 lb PLS	Virginia wildrye (<i>Elymus virginicus</i>)
3 lb	Partridge pea (<i>Chamaecrista fasciculata</i>)
0.5 lb	Showy tick-trefoil (<i>Desmodium canadense</i>)

Total: 19.5 lbs/acre

Listed below are some additions or alterations to the native seed mix for unique situations or management goals.

To attract pollinators, consider adding a combination of these native wildflowers...

0.5-2 lb	Showy tick-trefoil (<i>Desmodium canadense</i>)
0.5-1 lb	Tall white beardtongue (<i>Penstemon digitalis</i>)
0.5-2 lb	Grey goldenrod (<i>Solidago nemoralis</i>)
0.5-2 lb	Common milkweed (<i>Asclepias syriaca</i>)
0.5-2 lb	Wild bergamot (<i>Monarda fistulosa</i>)
0.5-1 lb	Black-eyed susan (<i>Rudbeckia hirta</i>)
0.5-1 lb	Ox-eye sunflower (<i>Heliopsis helianthoides</i>)
0.5-2 lb	Butterfly milkweed (<i>Asclepias tuberosa</i>)
0.5-1 lb	New England aster (<i>Symphiotrichum novae-angliae</i>)
0.5-1 lb	Mountain-mints (<i>Pycnathemum incanum</i> or <i>P. tenuifolium</i>)

Typically 0.5 lbs per acre are sufficient when added to the above Native mix. If the expressed goals of the site is to attract pollinators, consider adding more seed per acre. The best wildflower plantings include enough species to have at least one species blooming during all three growing seasons.

A simplified version of this mix to attract game and wildlife species...

3 lb PLS	Switchgrass (<i>Panicum virgatum</i>)
1 lb PLS	Big bluestem (<i>Andropogon gerardii</i>)
1 lb PLS	Indiangrass (<i>Sorghastrum nutans</i>)
1 lb PLS	Little bluestem (<i>Schizachyrium scoparium</i>)
2 lb PLS	Deer tongue (<i>Dicanthelium clandestinum</i>)
2 lb PLS	Perennial ryegrass (<i>Lolium perenne</i>)
0.5 lb	Canada goldenrod (<i>Solidago canadensis</i>)
4 lb	Partridge pea (<i>Chamaecrista fasciculata</i>)

30 lb Cover Crop Oats (*Avena fatua*)

Total: 12 lbs/acre

BOF General Native/Non-native Seed Mix

Areas with slopes less than 15%

2 lb	Timothy (<i>Phleum pretense</i>)
6 lb	Perennial ryegrass (<i>Lolium perenne</i>)
6 lb PLS	Virginia wildrye (<i>Elymus virginiana</i>)
2 lb PLS	Little bluestem (<i>Schizachyrium scoparius</i>)
2 lb PLS	Big bluestem (<i>Andropogon gerardii</i>)
6 lb	White clover (<i>Trifolium repens</i>)
4 lb	Partridge pea (<i>Chamaecrista fasciculata</i>)
0.5 lb	Black-eyed susan (<i>Rudbeckia hirta</i>)

TOTAL: 28.5 lb/acre

Areas with slopes greater than 15%

6 lb	Timothy (<i>Phleum pretense</i>)
4 lb	Perennial ryegrass (<i>Lolium perenne</i>)
4 lb PLS	Virginia wildrye (<i>Elymus virginiana</i>)
3 lb PLS	Little bluestem (<i>Schizachyrium scoparium</i>)
3 lb PLS	Big bluestem (<i>Andropogon gerardii</i>)
3 lb PLS	Indiangrass (<i>Sorghastrum nutans</i>)
6 lb	White clover (<i>Trifolium repens</i>)
4 lb PLS	Deertongue (<i>Dicanthelium clandestinum</i>)
2 lb	Partridge pea (<i>Chamaecrista fasciculata</i>)
0.5 lb	Black-eyed susan (<i>Rudbeckia hirta</i>)

TOTAL: 35.5 lb/ac

All attempts should be made to use all native seed mixes at sites on State Forest lands. At sites with many acres that need planted, in areas with severely steep slopes, or for projects where funds available for purchasing seed may be limited, this mix of native and non-native species may be more applicable. All additions discussed on the previous page can also be applied to this seed mix.

In shaded sites reduce the mix to...

3 lb PLS	Virginia wildrye (<i>Elymus virginicus</i>)
3 lb PLS	Canada wildrye (<i>Elymus canadensis</i>)
5 lb	Autumn bentgrass (<i>Agrostis perennans</i>)
2 lb PLS	Deer tongue (<i>Dicanthelium clandestinum</i>)
30 lb	Cover Crop

Total: 43 lb/acre

This is a short-lived perennial mix that will allow for natural herbaceous and woody succession following timber sale retirement.

To simply control erosion and sedimentation reduce the mix to...

10 lb PLS	Deertongue (<i>Dicanthelium clandestinum</i>) or Switchgrass (<i>Panicum virgatum</i>)
5 lb PLS	Virginia wildrye (<i>Elymus virginicus</i>)
5 lb	Autumn bentgrass (<i>Agrostis perennans</i>)
2 lb	Partridge pea (<i>Chamaecrista fasciculata</i>)
30 lb	Cover Crop

Total: 52 lb/acre

Comparison Chart: Warm Season vs. Cool Season Grasses (Source: NRCS)

Use this comparison chart when creating a unique seed mix to help decide which grass type best fits the desired goals or outcomes of the planting. Generally, cool season grasses prefer growing when temperatures are between 65 and 80 degrees and warm season grasses prefer temperatures between 80 and 95 degrees. Differences between the two types are described below.

Topic	Warm Season Grasses	Cool Season Grasses
Erosion Control and Water Quality	<p>Provide long-term benefits for erosion control and sediment trapping.</p> <p>Provide nutrient uptake during the summer when cool-season grasses are dormant.</p>	<p>Provide short-term and long-term benefits for erosion control and sediment trapping.</p> <p>Provide nutrient uptake earlier in spring and later in the fall than warm season grasses.</p>
Wildlife Habitat	<p>Excellent nesting and feeding habitat.</p> <p>Bunchgrasses provide openings for feeding, maintaining overhead protection from predators.</p> <p>Remain standing for good winter protection.</p> <p>Diverse - supporting a balanced mix of native plant species and insect populations.</p>	<p>Due to earlier “green-up,” provide a better source of food (green foliage and insects) in early spring than warm season grasses.</p> <p>Mat down more rapidly than warm season grasses as they age, degrading nesting quality, feeding, and overhead protection.</p>
Establishment	<p>Seed may be more expensive and less readily available than cool-season grasses.</p> <p>Usually do not need much lime or fertilizer.</p> <p>Tolerates poor soil conditions (drought, nutrient- poor and/or low pH) better than cool-season grasses.</p> <p>Seeds are slow to germinate and seedlings usually need 2 to 3 years to establish. However, root structures are forming and providing erosion control even when not noticeably green aboveground.</p>	<p>Relatively inexpensive, readily available seeds.</p> <p>Have higher nutrient requirements than warm season grasses. Less tolerant of poor soil conditions. May need fertilizer maintenance.</p> <p>Seedlings are usually well established 1 to 2 years after planting. Rapid seedling growth results in less weed competition during establishment.</p> <p>Can be seeded in spring or late summer. Can also be seeded with cool season legumes.</p> <p>More susceptible to drought.</p>
Maintenance	<p>Maintained by using prescribed burning or, mowing to 6 inches tall.</p> <p>Grasses are long-lived and usually do not need reseeding.</p> <p>Selective herbicides may be used for weed control.</p>	<p>Maintained by mowing on 2- to 3-year rotation, and by overseeding with legumes every 3 to 4 years.</p> <p>As stands mature, grasses may thin out and need to be reseeded.</p> <p>Selective herbicides may be used for weed control.</p>

3. Planting Guidance for Native Shrubs and Trees

Pre-planning Considerations:

There are occasions when planting seedlings is the most efficient method of ensuring that the next forest contains a desired species or to help forests recover after negative forest health impacts. For example, eastern white pine is commonly planted in areas without mature pines to produce seed.

Supplemental planting is the planting of species already present in the stand, but at less than desirable levels. This artificial regeneration supplements the regeneration present, and should target relatively open areas. A wide spacing is normal for supplemental planting (10-15 ft. spacing). Underplanting, a form of supplemental planting, is simply planting shade tolerant seedlings under an existing canopy. This can be done for the same reasons as enrichment planting, or to add understory species to the existing stand.

Enrichment planting is done in stands to establish desirable tree species, often after timber harvests. This can be done to increase diversity and wildlife value to the stand. Planting trees and shrubs along riparian areas can also be considered enrichment planting.

Reforestation planting is done to establish forest cover over an area previously forested, but not currently forested. This is done in areas where natural regeneration is lacking.

One of the keys to successful planting is matching the seedling species with existing site characteristics. A soil test may be appropriate to identify growing conditions. Some species, such as white pine, can grow almost anywhere there is adequate light. Site preparation is another step required for successful regeneration.

Additional Notes

In addition to the above restrictions on specific species/genera, the following planting guidelines are to be followed on State Forest lands:

- **The planting of non-native species in State Forest Wild and Natural Areas may be permitted under limited circumstances after receiving approval via a State Forest Environmental Review (SFER).**
- Native tree species with no special status may be planted. Pennsylvania stock is preferred and cultivars should be avoided. Use Penn Nursery as the primary supplier of seedling stock when possible or a suitable alternative that uses regional genetic stock.
- Former plantations of exotic species (Norway spruce, red pine, etc.) may be replaced to the same species. Conversion of plantations to more natural, native stands is encouraged unless there is special historical significance to the plantation (e.g. CCC plantation of historical significance).

- Newly planted seedlings need protection from deer browse damage in many forest districts. Consider fencing entire planting areas with woven-wire fencing or protecting individual trees with tree tubes.

Tree and Shrub Species Lists:

1. Invasive: Deemed Invasive: Do Not Plant

A number of trees and shrubs are considered invasive by DCNR. Plants on [DCNR Invasive Plant List](#) are prohibited from use on State Forest lands, according to principles set forth in the [State Forest Resource Management Plan](#). Please carefully review this list prior to making seeding or planting selections.

2. Potentially Invasive: Avoid planting except in special circumstances or situations

The use of the species listed below should be limited in most circumstances. This list was created through examining neighboring states’ invasive plant lists, communications with foresters, specialists and resource managers, and research on species behavior. Native and non-native alternatives to these species are provided within Category 3. This list is revised periodically based on field observations and literature review.

Deciduous Trees and Shrubs

Sawtooth oak	<i>Quercus acutissima</i>
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3. Non-invasive: Recommended native and non-native tree and shrub species.

Conifer and shrubs may provide cover, food, or structure for various wildlife species. Soft mast producing trees and shrubs provide food for many birds and small mammals. Hard mast producing trees and shrubs provide food for mammals and some birds. Hard mast can also be stored for consumption later. The following species may be used in openings, ROWs, early successional habitats, where underrepresented in the forest, or other suitable places on State Forest lands. This list is not all inclusive, many other PA native species can be considered.

Conifers

White pine	<i>Pinus strobus</i>	Red spruce	<i>Picea rubens</i>
Virginia pine	<i>Pinus virginiana</i> (south of route I-80)	Red pine	<i>Pinus resinosa</i> (north of route I-80)
White spruce	<i>Picea glauca</i>	Pitch pine	<i>Pinus rigida</i>
Black spruce	<i>Picea mariana</i> (wet areas)		

Non-native Conifers

Norway spruce**	<i>Picea abies</i>
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Soft-mast Producing Trees/Shrubs

Serviceberry	<i>Amelanchier arborea</i>	Washington hawthorn	<i>Crataegus phaenopyrum</i>
Smooth serviceberry	<i>Amelanchier laevis</i>	Sweet crabapple	<i>Malus coronaria</i>
Staghorn sumac	<i>Rhus typhina</i>	Low serviceberry	<i>Amelanchier stolonifera</i>
American mtn-ash	<i>Sorbus americana</i>	Cockspur hawthorn	<i>Crataegus crus-galli</i>
Large-seed hawthorn	<i>Crataegus macrosperma</i>	White hawthorn	<i>Crataegus punctata</i>
Frosted hawthorn	<i>Crataegus pruinosa</i>		

Hard-mast Producing Trees

Dwarf chinquapin oak	<i>Quercus prinoides</i>	Red oak	<i>Quercus rubra</i>
Scrub oak	<i>Quercus ilicifolia</i>	Allegheny chinquapin	<i>Castanea pumila</i>
Black locust	<i>Robinia psuedoacacia</i> (south of route I-80)		

Non-native Hard-mast Producing Trees

Chinese chestnut	<i>Castanea mollissima</i>	American chestnut hybrids	<i>Castanea dentata x mollissima</i>
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Blackberry / Raspberry Species

Common blackberry	<i>Rubus allegheniensis</i>	Black raspberry	<i>Rubus occidentalis</i>
Smooth blackberry	<i>Rubus canadensis</i>	Red raspberry	<i>Rubus idaeus</i>

Shrubs

Arrow wood viburnum	<i>Viburnum dentatum</i>	Graystem dogwood	<i>Cornus racemosa</i>
Nannyberry viburnum	<i>Viburnum lentago</i>	Silky dogwood	<i>Cornus amomum</i>
Buttonbush	<i>Cephalanthus occidentalis</i>	Elderberry	<i>Sambucus canadensis</i>
Alder	<i>Alnus spp.</i>	Native chokeberries	<i>Aronia spp.</i>
American hazelnut	<i>Corylus americana</i>	Ninebark	<i>Physocarpus opulifolius</i>

***If Norway spruce is used to replace eastern hemlock, plant another native conifer (for example, white pine, red spruce, or white spruce) to increase opportunities for wildlife. A mixture of species will be required to compensate for the loss of eastern hemlock.*

Riparian Areas

Streams impacted by management activities and the riparian areas may be planted for canopy coverage or habitat enhancement. Forested riparian areas provide filter capabilities, stream bank stabilization, stream shading, additions of organic material to the stream, and shelter and food for wildlife.

Please consult the riparian trees and shrub list below. When planning riparian habitat planting projects, please partner with Ecological Services biologists to develop structure and composition specifications to meet habitat goals. Different riparian species may require different habitat and proper planning will help ensure suitable habitat is created.

Species recommended for stream crossing can include the following list, but be sure to use species native to the geographic region of interest.

Trees

Bigtooth aspen	<i>Populus grandidentata</i>	Black gum	<i>Nyssa sylvatica</i>
Quaking aspen	<i>Populus tremuloides</i>	Eastern hemlock	<i>Tsuga canadensis</i>
Pin oak	<i>Quercus palustris</i>	Red maple	<i>Acer rubrum</i>
Black willow	<i>Salix nigra</i>	Yellow birch	<i>Betula alleghaniensis</i>
Black cherry	<i>Prunus serotina</i>	American sycamore	<i>Platanus occidentalis</i>
Tulip poplar	<i>Liriodendron tulipifera</i>	Black spruce	<i>Picea mariana</i>
Eastern white pine	<i>Pinus strobus</i>	Silver maple	<i>Acer saccharinum</i>
Red spruce	<i>Picea rubens</i>		

Small Trees

Flowering dogwood	<i>Cornus florida</i>	Serviceberry	<i>Amelanchier arborea</i>
Staghorn sumac	<i>Rhus typhina</i>	Smooth serviceberry	<i>Amelanchier laevis</i>
Smooth sumac	<i>Rhus glabra</i>	Low serviceberry	<i>Amelanchier stolonifera</i>
Winged sumac	<i>Rhus aromatica</i>	Redbud	<i>Cercis canadensis</i>

Shrubs

Alder	<i>Alnus spp.</i>	Winterberry holly	<i>Ilex verticillata</i>
Chokeberry	<i>Aronia melanocarpa</i>	Silky dogwood	<i>Cornus amomum</i>
Buttonbush	<i>Cephalanthus occidentalis</i>	Elderberry	<i>Sambucus canadensis</i>
Choke cherry	<i>Prunus virginiana</i>	Highbush blueberry	<i>Vaccinium corymbosum</i>
Gray dogwood	<i>Cornus racemosa</i>	Arrow-wood viburnum	<i>Viburnum dentatum</i>
Blackhaw	<i>Viburnum prunifolium</i>	Inkberry	<i>Ilex glabra</i>
Witch hazel	<i>Hamamelis virginiana</i>	Red-osier dogwood	<i>Cornus sericea</i>
Ninebark	<i>Physocarpus opulifolius</i>		

Wildlife Use of Native Shrub and Tree Species

Species	Wildlife Species
Shrubs	
Arrowwood viburnum (<i>Viburnum dentatum</i>)	Fruit eaten by songbirds
Northern bayberry (<i>Myrica pensylvanica</i>)	Fruit and seeds eaten by songbirds. Provides habitat for ground-dwelling wildlife.
Sweet crabapple (<i>Malus coronaria</i>)	Fruit eaten by birds, deer, small mammals.
Dogwoods	Bluebird, Cardinal, Cedar waxwing, rabbit, ruffed grouse, wild turkey, wood thrush.
Gray dogwood (<i>Cornus racemosa</i>)	Fruit eaten by pheasant, turkey, grouse.
Red osier dogwood (<i>Cornus sericea</i>)	Fruit eaten by songbirds, grouse, quail, turkey. Twigs browsed by deer and turkey.
Silky dogwood (<i>Cornus amomum</i>)	Sometimes browsed by rabbits and deer.
Elderberry (<i>Sambucus americana</i>)	Fruit eaten by many birds including bluebird, brown thrasher, cardinal, indigo bunting, rose-breasted grosbeak, pheasant and dove. Recommended for rabbit, quail and turkey.
American hazelnut (<i>Corylus americana</i>)	Nuts eaten by squirrel, deer, jays, grouse, and pheasant. Recommended by quail and turkey.
Nannyberry (<i>Viburnum lentago</i>)	Fruit eaten by songbirds. Recommended for turkey.
Hawthorn (<i>Crataegus spp.</i>)	Fox sparrow, gray fox, raccoon, ruffed grouse.
Alder (<i>Alnus spp.</i>)	Beaver, goldfinch, ruffed grouse
Pines/Softwoods	
Eastern white pine (<i>Pinus strobus</i>)	Roosting trees for birds. Seeds eaten by a wide variety of birds, squirrels, and mice. Recommended for turkey.
Pine (<i>Pinus spp.</i>)	Beaver, black-capped chickadee, brown creeper, gray squirrel, mourning dove, porcupine, and nuthatches.
Non-mast producing Species	
Bigtooth aspen (<i>Populus grandidentata</i>)	Twigs and barks eaten by deer and beavers. Buds and catkins eaten by ruffed grouse. Recommended for porcupine.
Soft Mast Producing Species	
Serviceberry (<i>Amelanchier arborea</i>)	Fruits eaten by bluebird, cardinal, cedar waxwing, grey catbird, scarlet tanager, and veery. Recommended for turkey, beaver, and deer.
Hard Mast Producing Species	
Oaks (<i>Quercus spp.</i>)	Black bear, blue jay, raccoon, ruffed grouse, white-tailed deer, turkey, wood duck

Adapted from :

MacGowan, B.J. "Designing hardwood tree plantings for wildlife." USFS FNR-213. North Central Research Station, USDA Forest Service & Department of Forestry and Natural Resources, Purdue University.

Forest Stewardship #5: Wildlife. Penn State Extension publication.

Species Considerations for Conifer Planting

Species	Wildlife Habitat Characteristics	Present Distribution	Site Requirements	Shade Tolerance/Growth
Red Spruce (<i>Picea rubens</i>)	Lacking lower limb structure & thermal characteristics of hemlock. Northern flying squirrel feeds on the fruiting body of the mycorrhizae.	Northern PA, and higher elevations in northern Appalachian mountains.	Higher elevation, good moisture regime. Grows well on poor sites, acidic and shallow soils.	Tolerant- Very Tolerant. Long-lived (350-400 years), slow growing.
Norway Spruce (<i>Picea abies</i>) **Non-native**	Retains lower limbs.	Throughout PA.	Tolerant of wide range of moisture regime and pH.	Very shade tolerant.
White Spruce (<i>Picea glauca</i>)	Retains lower limbs.	Northern PA	Tolerant of wide range of moisture regime and pH.	Intermediate shade tolerance. Long lived (250-300 years)
Black Spruce (<i>Picea mariana</i>)	Small dbh at maturity, retains lower limbs, shallow rooting.	Northern PA	Moisture regime important, prefers peat, and wet organic soils. Common in swamps or bogs.	Tolerant. 200 year lifespan typical.
White Pine (<i>Pinus strobus</i>)	Gets large, provides thermal cover, retains more lower limbs than red pine	Throughout PA	Tolerant of wide range of moisture regime and pH in northern North America.	Intermediate shade tolerance. Long lived.
Red Pine (<i>Pinus resinosa</i>)	Medium to large tree. Does not retain lower limbs	Northern PA	Tolerant of xeric sites, does well on sandy soils	Very intolerant, fast growth
Pitch Pine (<i>Pinus rigida</i>)	Medium sized tree	Mainly southern and eastern PA	Acidic soil, tolerant of fire	Intolerant
Virginia Pine (<i>Pinus virginiana</i>)	Relatively short	Southern PA	Grows well on xeric, nutrient poor sites	Intolerant

