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The Xerces Society for Invertebrate Conservation

OREGON TILTH

Conservation Buffers in Organic Systems

Idaho Implementation Guide

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Figure 2. This hedgerow protects the adjacent crop from dust and reduces the risk of dust-induced mite infestations.

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Figure 1. (front cover) Four-year-old demonstration hedgerow with ninebark and checker mallow at the USDA NRCS Plant Materials Center, Corvallis, Oregon. The hedgerow is a collaborative project of the Xerces Society, the Farmscaping for Beneficials Program at Oregon State University and the NRCS Plant Materials Center.
Photo: Gwendolyn Ellen, Oregon State University, 2011.

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Purpose

The purpose of this document is to provide guidance in installing practices for use as buffers in organic production systems in order to meet the National Organic Program (NOP) regulations. Conservation buffers are generally strips of vegetation placed in the landscape to influence ecological processes and provide a variety of services. They are called by many names including wildlife corridors, greenways, windbreaks, and filter strips. (Bentrup, G. 2008)

In the context of organically managed systems, buffer zones are required under NOP rules if there is a risk of contamination, via drift or flow, of substances not allowed under organic regulations. Situations in which buffers will likely be required by the certifier, according to NOP rules, include:

- An organic field bordering a conventional field on which prohibited substances are being used.
- An organic field bordering a roadway to which prohibited substances are applied (usually to control weeds).
- An organic field bordering residential housing in which prohibited substances are being applied.
- An organic field that has, or is immediately adjacent to, fencing made of lumber treated with prohibited substances.

When buffers are required in organic production systems, they represent an opportunity to implement conservation practices that benefit the operation by creating habitat for beneficial organisms (birds, pollinators, or parasites and predators of crop pests), as well as providing a barrier against weed seed migration, preventing wind damage to crops and protecting water quality. In doing so, buffers may simultaneously meet other NOP regulations which require that organic operations "maintain or improve the natural resources of the operation" (NOP Sec 205.200) and, in perennial systems, can be used to introduce biological diversity in lieu of crop rotation.

According to the NOP, buffer zones between organic crops and non-organic crops must be of sufficient size and structure to prevent drift or runoff of non-approved substances. Although there are no specific size requirements, typically a buffer zone is 25- to 30-feet wide. The organic producer can grow non-organic crops in the buffer zone, leave it fallow, or plant this area to hedgerows, windbreaks, meadows, or beetle banks, as appropriate. If a crop is taken from the buffer zone it will need to be harvested separately from the organic crop and the producer must document that it was harvested, stored, and sold as non-organic.

If the organic certifying agency has determined that a buffer is needed, they must also approve the design of the buffer. NRCS staff can work with the landowner to identify additional conservation objectives for the buffer (see Table 1), which may include habitat for parasitoids and predators of crop pests, reducing soil erosion, protecting water quality, wind or dust breaks, habitat and cover for other wildlife including pollinators, and aesthetic considerations.

Hedgerow Planting (422) is a focus of this document as this practice can readily address NOP requirements. However, buffers may be created on organic operations using other NRCS conservation practices, such as Field Borders (386), Herbaceous Wind Barriers (603), Windbreak/Shelterbelt Establishment (380), Riparian Forest Buffer (391), Filter Strip (393) or Conservation Cover (327). All of these practices can be designed to have multiple benefits for the operation.

Relevant National Organic Program (NOP) Regulations

Section 205.202 Land Requirements

Any field or farm parcel from which harvested crops are intended to be sold, labeled, or represented as "organic," must:

(c) Have distinct, defined boundaries and buffer zones such as runoff diversions to prevent the unintended application of a prohibited substance to the crop or contact with a prohibited substance applied to adjoining land that is not under organic management.

Section 205.2 Definition of Buffer Zone

An area located between a certified production operation or portion of a production operation and an adjacent land area that is not maintained under organic management. A buffer zone must be sufficient in size or other features (e.g., windbreaks or a diversion ditch) to prevent the possibility of unintended contact by prohibited substances applied to adjacent land areas with an area that is part of a certified operation.

Table 1. Primary and Secondary Benefits of Buffer-Related Practices

NRCS Practice and Definition	Primary Benefits/Functions of Practice	Secondary Benefits / Functions of Practice
Field Borders (386) Strips of permanent vegetation established at the edge or around the perimeter of a field.	➢ Reduce erosion from wind and water. ➢ Protect soil and water quality.	➢ Manage pest populations. ➢ Provide wildlife food and cover. ➢ Provide food, shelter and overwintering sites for beneficial invertebrates as a component of integrated pest management.
Hedgerow Planting (422) Establishment of dense vegetation in a linear design to achieve a natural resource conservation purpose.	➢ Habitat, including food, cover, and corridors for terrestrial wildlife. ➢ Enhance pollen, nectar, and nesting habitat for pollinators. ➢ Provide food, shelter and overwintering sites for predaceous and beneficial invertebrates as a component of integrated pest management. ➢ Intercept airborne particulate matter. ➢ Reduce chemical drift and odor movement. ➢ Create screens and barriers to noise and dust.	➢ Create food, cover, and shade for aquatic organisms that live in adjacent streams or watercourses. ➢ Increase carbon storage in biomass and soils. ➢ Create living fences. ➢ Delineate boundaries & contour guidelines. ➢ Prevent weed seed migration into the field.
Herbaceous Wind Barriers (603) Herbaceous vegetation established in rows or narrow strips in the field across the prevailing wind direction.	➢ Reduce soil erosion from wind. ➢ Reduce soil particulate emissions to the air. ➢ Protect growing crops from damage by wind or wind-borne soil particles.	➢ Enhance snow deposition to increase plant-available moisture.
Windbreak/Shelterbelt Establishment (380) Linear plantings of single or multiple rows of trees or shrubs or sets of linear plantings.	➢ Reduce wind erosion. ➢ Protect growing plants. ➢ Provide shelter for structures and livestock. ➢ Provide wildlife habitat. ➢ Improve irrigation efficiency.	➢ Manage snow. ➢ Provide a tree or shrub product. ➢ Provide noise and visual screens. ➢ Enhance aesthetics. ➢ Increase carbon storage. ➢ Delineate property and field boundaries. ➢ Prevent weed seed migration into the field. ➢ Provide food, shelter and overwintering sites for beneficial invertebrates such as insect predators, parasitoids and native pollinators for IPM and crop pollination.
Riparian Forest Buffer (391) An area of predominantly trees and shrubs located adjacent to and up-gradient from watercourses or water bodies.	➢ Create shade to lower water temperatures to improve habitat for fish and other aquatic organisms. ➢ Create wildlife habitat and establish wildlife corridors. ➢ Reduce excess amounts of sediment, organic material, nutrients, pesticides and other pollutants in surface runoff and reduce excess nutrients and other chemicals in shallow ground water flow. ➢ Provide protection against scour erosion within the floodplain. ➢ Restore natural riparian plant communities.	➢ Provide a source of detritus and large woody debris for fish and other aquatic organisms and riparian habitat and corridors for wildlife. ➢ Moderate winter temperatures to reduce freezing of aquatic over-wintering habitats. ➢ Increase carbon storage in plant biomass and soils. ➢ Provide a harvestable crop of timber, fiber, forage, fruit, or other crops consistent with other intended purposes.
Conservation Cover (327) Establishing and maintaining permanent vegetative cover. This land is removed from production permanently for the life of the contract.	➢ Reduce soil erosion and sedimentation. ➢ Improve water quality. ➢ Enhance habitat for wildlife, predacious insect invertebrates, and pollinators. ➢ Improve soil quality. ➢ Stabilize slopes.	➢ Improve air quality. ➢ Manage crop pests. ➢ Provide better access to agricultural equipment when soils are moist.

***Note**: All primary benefits and the majority of secondary benefits are taken directly from NRCS practice standards. A few secondary benefits were added by reviewers of this document.*

Buffer Site Design

Site Selection

➢ **Location**: The overall design of a buffer site must meet NRCS practice criteria as well as the standards of the producer's certifying agency and the National Organic Program. To address NOP buffer requirements, the site selected should be adjacent to an area from which there is a risk of contamination from pesticides or chemical fertilizers not allowed in organic systems. This is commonly along property lines, but in situations where the producer has both organic and conventional operations, the buffer could be in the middle of an operation at the boundary between the two types of production.

➢ **Width and height**: The site selected for the buffer should be wide enough and have space for plants to grow tall enough to intercept any significant pesticide drift from the adjacent conventional operation.

➢ **Irrigation access:** The site should also have access to irrigation water to establish the plants and, in drier areas, address long-term water needs. Drip irrigation works well for plugs or potted plants. For native grasses and wildflower mixes that are broadcast, planting should be done during the rainy season, with back-up sprinkler irrigation.

➢ **Soils:** Soil type will influence the plants that will thrive in an area. Amending planting holes with good quality compost also improves growth rate.

➢ **Sunlight:** Most native perennial shrubs, forbs, and grasses do best in locations with full sunlight. Plants, however, should be selected based on the site conditions and some varieties thrive in shade.

➢ **Accessibility:** The site should be accessible to equipment for site preparation, planting and maintenance.

Plant Selection

The choice of plants for a buffer will vary based on goals and objectives of the producer. Many potential goals are listed as benefits in Table 1 and include habitat creation, erosion reduction and water quality protection.

➢ **Pesticide drift mitigation**: If the objective is pesticide drift mitigation to address NOP requirements, buffer plants should be selected to provide enough height, leaf area, and structural diversity to intercept anticipated contamination, especially pesticide drift, from adjacent conventionally managed land. For buffers with a high risk of frequent exposure to insecticides, the buffer should have approximately 40-50% porosity in multiple rows to allow the wind to go through the trees—not up and over—and ensure droplets are captured by the leaves. The design of a buffer should focus on leafy canopy (e.g., evergreen, conifers, and small needles) rather than nectar and pollen resources of beneficial insects. For design details, see *Windbreaks Designed with Pollinators in Mind,* listed in Appendix C. The method of pesticide application (e.g., aerial application via plane or application by back-pack sprayer) will also be factored in by the certifying agency when determining the size and structure of a buffer zone.

➢ **Pollinators and beneficials**: If the landowner's goal is to provide habitat for beneficials, then the design should focus on providing year-round nectar and pollen resources as well as nesting and overwintering habitat. Native plants often provide the greatest benefit.

➢ **Planting stock:** As crops in the buffer cannot be sold as certified organic, producers are not required to use certified organic seeds and planting stock. Seeds, however, must not be treated with non-approved synthetic substances to prevent contamination of the adjacent organic crops. Producers should always check with their certifier before planting or applying anything new on their operation.

➢ **Runoff filtration:** A mixture of perennial grasses and forbs can be established for this purpose. The more diverse the vegetation, the more effective the buffer will be at slowing down the run-off and allowing the soil and roots to absorb it. For riparian areas, adding trees and shrubs to a buffer may also provide shade to cool the water in support of desirable aquatic organisms, and habitat for birds and other terrestrial organisms.

➢ **Seeding wildflowers**: Wildflowers can be planted from seed within or adjacent to hedgerows to provide plant structure and diversity. Seeding requires excellent site preparation to reduce weed pressure since weed control options are limited when the wildflowers start to germinate. For more information on establishing wildflowers from seed, see *Conservation Cover (327)*

Plant Selection, continued

for Pollinators: Specifications and Implementation Requirements, listed in Appendix C. Transplanting may improve chances of establishment, but will be more expensive than seeds.

➢ **Multiple functions**: Grasses, forbs, shrubs, and trees have different functions and characteristics within the ecosystem and understanding these will allow the landowner to better design a buffer to meet their objectives. In most situations, buffers designed to meet a grower's primary objective(s) can also meet several secondary objectives by including two or more of these groups of plants. For example, the dense root systems of perennial grasses are ideal for filter strips, but adding forbs creates a more diverse filter strip which can provide habitat for beneficial insects and is more resilient to seasonal variations in weather. Adding shrubs and trees further diversifies buffer structure. Use of different plant types should be evaluated based on the landowner's objectives and resource concerns, which might include: aesthetic value; bloom time; flower shape, size, and duration of bloom (in support of predators, parasites and pollinators); nesting and perch habitat for birds and raptors; use as windbreaks and road dust barriers; ditch stabilization or revegetation; or providing shade for stream cooling and fish habitat.

➢ **Plant growth and development**: The buffer zone's interaction with adjacent crops is dynamic and will change with time. Plants in the buffer zone will increase in size and change the ecology of the area by providing shade, wind protection, new micro-climates, new habitat including overwintering habitat, and new food sources such as nectar, pollen, berries, seeds, fruit, and alternative prey. Deer may browse on buffer zone plants, as well as crops; rabbits, ground squirrels and rodents may take advantage of buffer zone habitat.

Site Preparation

Site preparation is one of the most important components to successfully establishing a buffer. On an organic operation this can present a unique set of challenges since chemical herbicides are generally not allowed. Competition from weeds can envelop a poorly prepped site, killing off many of the buffer plants (see Figure 7). Investing time—in many cases an entire growing season—and effort in creating a well prepared buffer planting site will pay off in lower maintenance and plant replacement costs, and a better growth and establishment rate for the buffer plants. The focus of site preparation in the buffer area should be:

➢ **Reduce** the weed seed bank in the top soil layers

➢ **Eliminate** all perennial weeds

➢ **Avoid** disturbing the soil after the weed seed bank and weed pressure are reduced.

In areas with poor drainage or high rainfall, planting on raised beds or berms could be used to address issues of wet soils in a buffer. Most native perennials will flourish in a well-drained environment.

Site preparation weed management options are provided in Table 2 and largely focus on trees and shrubs used to meet NOP buffer requirements. Pictures of proper site preparation and maintenance are provided on the following pages.

Resources for Buffer Design

Xerces Society for Invertebrate Conservation. Pollinator Habitat Installation Guides
www.xerces.org/pollinator-conservation/agriculture/pollinator-habitat-installation-guides

Conservation Buffers: Design Guidelines for Buffers, Corridors, and Greenways. Bentrup, G. 2008. Gen. Tech. Rep. SRS-109. Asheville, NC. Department of Agriculture, Forest Service, Southern Research Station. 110 p.
http://nac.unl.edu/buffers/docs/conservation_buffers.pdf

Table 2. Weed Management Options

METHOD: Stale Seedbed	
Where to Use: ➢ Where weed pressure is low to moderate ➢ Areas with a low risk of erosion ➢ Areas accessible to equipment	**Timing**: ➢ Total time: Four to six weeks ➢ Begin: Any time ➢ Plant: Fall or early spring

Basic Instructions:

1. This can be done in various combinations: Tillage-Irrigation-Light Tillage-Mulch, or Tillage-Irrigation-Flaming-Mulch, or Tillage-Irrigation-Organic Herbicide-Mulch
2. Where weed pressure is low, till the existing vegetation for the length and width of the hedgerow.
3. Irrigate with sprinklers or natural rainfall.
4. To kill emerging weeds, do very shallow tillage (Lilliston or harrow), or use flame weeders or organic herbicides. It's critical to flame or herbicide the weeds when they're small (2 to 3 inches) to kill them. Use of an organic herbicide might require multiple applications.
5. Mulch with weed barrier cloth, weed-seed-free straw mulch, wood chips, or other materials.

Organic Herbicides*:* Herbicides approved for use in organic systems are generally much less effective than conventional herbicides such as glyphosate. Organic herbicides are most effective when used on small plants (1 to 3 inches). See Appendix B for more information about types of organic herbicides.

Mulches: Weed barrier cloth is very effective in suppressing weeds, but does not allow for ground-nesting native bees or other beneficial invertebrates to tunnel in the soil. When it is used in a cropped area, the NOP stipulates that synthetic mulch must be removed at the end of the season. Buffers are generally considered non-cropped areas, unless crops are produced in the buffer zone. In some cases burlap is used as a long-term substitute for synthetic materials. Care should be taken in the selection of mulches in riparian areas as they can be washed into waterways. Organic mulches of straw, wood chips and other materials can be effective weed barriers, and once these materials degrade, ground-nesting bees are able to access the soil surface. A six-inch layer of straw mulch will generally last only one season.

METHOD: Smother Cropping	
Where to Use: ➢ Where weed pressure is low to moderate ➢ Areas with a low risk of erosion ➢ Areas accessible to equipment	**Timing**: ➢ Total time: One to three months ➢ Begin: Summer ➢ Plant: Generally quick-growing summer cover crops are used and planted once temperatures have warmed enough in the spring or summer. ➢ Smother crop method may be used prior to use of stale seedbed in the spring or summer

Basic Instructions:

1. Select quick-growing crops appropriate for the site. Buckwheat, millets, and sorghum-sudan grasses are usually best. Clovers are too slow to effectively compete with weeds and legumes will fix unnecessary nitrogen.
2. Seed into prepped bed immediately after finished working the soil; use a seeding rate 1.5 to 3 times the normal rate to create an effective smother crop more quickly.
3. Once mature, incorporate the cover crop while minimizing soil disturbance.
4. Ideally follow smother crop with appropriate version of Stale Seedbed technique described above.

METHOD: Solarization	
Where to Use: ➢ Where weed pressure is moderate to high ➢ Areas with a low risk of erosion ➢ Areas accessible to tillage equipment ➢ Locations with full sun, warm weather, and dry summers	**Timing**: ➢ Begin: Works best during mid-summer ➢ Plant: Fall or winter ➢ Timing will vary between 4 and 8 weeks depending on sun intensity and temperature during solarization

Basic Instructions:

1. Mow, rake, harrow, or till and smooth the site in the spring, raking off debris, if necessary.
2. After smoothing the site, irrigate thoroughly and lay clear UV-stabilized plastic, or "regular" clear 1 ml plastic (Molinar, R. 2013, pers. comm.), burying the edges to prevent airflow between the plastic and the ground. Check with your local extension service for which plastic they recommend. Weigh down the center of the plastic if necessary to prevent the wind from lifting it. Use greenhouse repair tape for any rips that occur during the season.
3. Remove the plastic in early fall (remember that non-UV stabilized plastic, although less expensive than UV-stabalized plastic, will disintegrate if left too long in the sun) and immediately install transplants. Refer to the Planting Considerations section of this document for specific bed-preparation recommendations.
4. Once the plastic is removed, avoid disturbing the soil as much as possible because disturbances bring viable weed seed to the surface.

"Regular" Plastic vs. UV-Stabilized (UVS) Plastic: UVS plastic is much more expensive than "regular" clear plastic, and is only needed if the farmer intends to keep the plastic on the ground beyond 5 - 6 weeks. In hotter areas (such as California's Central Valley), 1 ml of clear plastic (non-UV stabilized) can provide excellent results in four weeks if done during midsummer (mid-June to September). High tunnel greenhouse plastic can be used as a source of UVS plastic if other sources are not available.

Site Preparation Examples

Figures 3, 4, 5, and 6 show preparation at a single location.

Figure 3. The producer started in October with a weed-free planting bed created by disking the soil to remove weeds.

Figure 4. The same site after a January rainstorm, a couple of months post planting.

Figure 5. The site in May, six months after planting. Weed management was done with a combination of hand weeding and straw mulch. Note the fruit trees in wire cages for deer protection. This grower includes fruit trees in hedgerows for himself and the workers on the operation.

Figure 6. The site in June, three years later. Bare spots in the buffer are still being mulched with straw.

Figure 7. This hedgerow has become overwhelmed with grass weeds. Many of the plants succumbed to the weedy competition, even though they had the carton protection, which helps mark the plants for agricultural workers, and protects the young plants from wind and sun and, to a lesser extent, from weed competition. The grower might have been better off using a plastic weed barrier, more aggressive site preparation, or thick mulch.

Figure 8. A two-year-old hedgerow with a plastic weed barrier mulch has been very effective in keeping weeds from growing but prevents perennial forbs, such as yarrow, from expanding beyond the holes in which they were planted. The plastic weed barrier also prevents beneficials such as ground-nesting bees, predacious ground beetles, and spiders from accessing the soil.

Short-Term Maintenance and Planting Considerations

The more densely the buffer area is planted, the more quickly a weed-suppressive cover will be established. This is a cost-benefit decision, as high density plantings also cost more due to the greater number of plants or seeds used. Combinations of perennial trees and shrubs with understories of native grasses and wildflowers can be used in various ways. If seeds are used to plant the buffer (as opposed to plugs or transplants) weed control prior to planting must be very thorough. It is impractical to weed the seeded area once the buffer plants germinate. It may be worthwhile to increase the seeding rate by up to 50% or more in order to achieve a weed-suppressive cover more quickly. Alternatively, a focus on seeding perennial wildflowers will allow for mowing annual weeds. Site-appropriate native plants may also aid in successful buffer establishment because they require less water and nutrients.

Regular shovels are usually adequate for transplanting most woody nursery stock. However, dibble sticks or mechanical transplanters are sometimes helpful for plug-planting. Power augers and mechanical tree spades can be helpful for larger plants. Depending on weed pressure, hedgerow plants can be installed through planting holes cut into landscape fabric, after which the fabric is typically covered with mulch. While this practice may be highly effective for weed control, it likely reduces nesting opportunities for ground-nesting pollinators and other wildlife. Hedgerows should be installed without, or with minimal, landscape fabric when possible.

- **Amendments**: Most native plants are adapted to a variety of soil conditions and do not need any specific amendments. However, in areas where the soil is compacted, degraded, or depleted, compost should be used during planting. Compost should be free from weed seeds, aged properly, and mixed thoroughly with soil in the holes during planting. Where rodent damage may occur, underground wire cages around roots are recommended. Plant guards also may be needed to protect plants from above ground browsing or antler damage by deer. Newly planted areas should be clearly marked to protect them from mowing and herbicides.
- **Plant size**: Consider size at maturity when planting. Most woody shrubs can be spaced on 4- to 10-foot centers and most herbaceous plants spaced closer on 2- to 3-foot centers. It is helpful to measure the planting areas prior to purchasing transplants and to stage the transplants in the planting area prior to installing them in the ground.
- **Transplanting**: Transplanting often occurs in the spring, but can happen anytime the ground can be worked. It should be timed to avoid prolonged periods of hot, dry, or windy weather. In drier regions, it is important to plant early to allow root growth before the summer. Regardless of when planting occurs, however, the transplants should be irrigated thoroughly immediately after planting. Holes for plants can be dug and pre-irrigated prior to planting as well. Some woody native shrub and tree cuttings, commonly called slips, can be planted directly into the ground. Specific species readily root and can be planted in the fall before the rainy season.
- **Irrigation**: In most areas that do not receive abundant fall and winter rains, native and drought-tolerant woody plants should be irrigated with at least one inch of water per week (except during natural rain events), for the first two years after planting. Long, deep watering is best to encourage deep root system development. Shallow irrigation should be avoided. Drip irrigation is useful, although it may be cost-prohibitive in large buffer areas. Other methods that allow for deep watering can also be successful. It is advisable to irrigate at the base of plants and avoid overhead irrigation that would encourage weed growth. Plugs are more amenable to drip irrigation, but drip lines with closely spaced emitter holes can be used for irrigation of native annuals. Once plants are established, irrigation should be removed or greatly decreased. In areas with very little precipitation, irrigation may be needed for the lifespan of the buffer. Non-native plants may require more frequent irrigation, and may still require supplemental irrigation once established.
- **Mulching**: To reduce weed competition and retain moisture during the establishment phase, plantings should be mulched. Recommended materials include wood chips, bark dust, weed-free straw, nut shells, grapeseed pomace, or other regionally appropriate weed-free mulch materials.
- **Mowing**: Mowing is a good method to control weeds during buffer establishment and for long-term maintenance. Mow weeds when they are flowering to prevent weed seed formation. Set mower height above the establishing herbaceous buffer plants (8" or higher) to prevent injury to them. This should be done during a time when birds and other desirable wildlife are not nesting. If the buffer/hedgerow has no understory, mow close to the ground.

Long-Term Maintenance of Buffers

Buffer zones require maintenance, and the type of maintenance depends on what has been planted and its location. The most important maintenance considerations are irrigation, weeding, and replacing dead plants. An important component of reducing plant mortality in the buffer zone is making sure workers know which plants are "keepers". Flag or stake the plugs and transplants so that workers can differentiate buffer zone plants from weeds and don't destroy them by hoe, weed-wacker, mowing, mulching, or flaming.

- **Irrigation**: Long-term irrigation needs will vary greatly based on geography. In California, for example, native woody plants and perennials generally require two to three years of irrigation to insure their long-term survival. Drip irrigation is usually sufficient, and longer, deeper watering intervals will support deeper root penetration. As stated above, in regions with very little precipitation, irrigation may be needed for the lifespan of the buffer. Use of overhead irrigation will likely encourage weed growth and may interfere with weed management practices.

- **Weed management**: As noted earlier, reducing weeds on a planting bed is very important. Use of plastic collars can protect young trees from grazing, weed competition, and inadvertent mowing. Hand weeding is more commonly used on buffer zones that have used mulch. Use of weed barrier cloth reduces the need for hand weeding in buffer zones. In areas that do not contain flammable mulch, hand-held flamers can provide efficient weed control if used when weeds are young (under three inches). As flaming does not involve disturbing the soil, it does not bring up additional weed seeds into the germination zone. Grasses are more difficult to control with flame weeding, as their growing tips are protected.

- **Grazing**: Grazing can be used to manage buffers, but should be done with a good understanding of the forage preferences of the grazing animal, and a plan for moving the animals before any damage occurs to the buffer. Temporary fencing may be needed to prevent access of grazers to crops or to sensitive riparian areas. Grazing should not take place when the soil is wet, when buffer plants are seedlings or setting seed, when plant cover is sparse, or when plants are stressed from drought.

- **Burning**: Burning can sometimes revitalize grassy buffers by getting rid of old thatch and providing more space for some of the native plants. Mowing is another way that a buffer zone can be revitalized and, as mentioned above, both should be done in blocks to minimize disturbance of wildlife.

- **Replacements**: When planting perennials, it's to be expected that some small percentage of the plants die. These skips should be replanted as soon as possible to prevent weeds from filling the gap.

- **Food Safety**: As mentioned previously, deer, rabbits, ground squirrels and other animals may use the buffer zone for food and habitat. In some cases this may result in food safety concerns as animals may enter crop production areas and leave scat. However, buffer zones can help to address other food safety concerns such as the use of filter strips to prevent irrigation water contamination. As rules under the Food Safety Modernization Act (FSMA) are finalized and implemented, producers will need to be aware of these issues.

Figure 9. This double row of deciduous trees on a small organic farm in Washington provides a buffer from the neighboring farm, acts as a windbreak, and provides shade for workers and nesting habitat for birds.

Appendix A.
Seed Suppliers and Plant Lists

General and Multi-State

NRCS Electronic Field Office Technical Guide locator (eFOTG).
http://efotg.sc.egov.usda.gov/efotg_locator.aspx?map=

Native Plants Database (Lady Bird Johnson Wildflower Center). The Xerces Society has collaborated with the Lady Bird Johnson Wildflower Center to create lists of plants that are attractive to native bees, bumble bees, honey bees, and other beneficial insects, as well as plant lists with value as nesting materials for native bees. These lists can be narrowed down with additional criteria such as state, soil moisture, bloom time, and sunlight requirements.
www.wildflower.org/collections

Native Seed Network. Resource to link buyers and sellers of native seed by geography. The site includes information about the use of native plants, seed selection and other resources.
www.nativeseednetwork.org

Pollinator Conservation Resource Center website provides information on pollinator plant lists, conservation guides, pesticide protection, seed venders, nurseries, and more. Xerces Society.
www.xerces.org/pollinator-resource-center

Technical References: Plant Fact Sheets, Plant Guides and Technical Notes (USDA-NRCS)
www.id.nrcs.usda.gov/programs/tech_ref.html

USDA Plants Database
http://plants.usda.gov

Idaho

NRCS Plant Materials Center
P.O. Box 296
1691 A South 2700 West
Aberdeen, ID 83210-0296
208-397-4133
Loren.Stjohn@id.usda.gov

Appendix B.
Classes of Organic Herbicides
(Webber et al. 2008)

The **Organic Materials Review Institute (OMRI)** maintains lists of generic materials and trade names of materials, including herbicides, registered for use on organic operations. For more information, see: www.omri.org

Corn Gluten Meal (CGM), a byproduct of the wet-milling process of corn, and **Mustard Meal** (MM) are phytotoxic. The non-selective preemergence, or preplant-incorporated, herbicides CGM and MM inhibit root development, decrease shoot length, and reduce plant survival of weed and crop seedlings. Research has demonstrated that CGM can be effectively used for weed control with established turf, transplanted vegetables, and, if precisely applied to provide a CGM-free planting strip, for direct-seeded vegetables. It is essential to understand that as non-selective herbicides, CGM and MM can injure or kill germinating and emerging crop seedlings. Crop safety is greater when these substances are applied to established perennial plants. Initial research with MM has shown similar application and weed control potential as CGM. Although CGM and MM can provide effective early preemergence weed control of germinating weed seeds, supplemental weed control measures will be required to control escaped weeds, established perennial weeds, or weeds emerging in the mid-to late-growing season. CGM and MM must not be derived from genetically modified organisms (GMO) to be cleared as potential organic materials. MM can cause extreme dermal reaction in humans and should be used with suitable protective equipment.

Vinegar. There are a number of organically approved products that contain vinegar (i.e., 5%, 10%, and 20% acetic acid). Vinegar (acetic acid) is a non-selective contact herbicide. In general, weed control increases as acetic acid content and application volume increase (i.e., 20, 40, 80, and 100 gpa). Typically, vinegar is less effective in controlling grasses than broad leaf weeds and more effective on annual species than perennials. In addition to application volumes and concentration, weed control is also dependent on the weed size and the species. Carpetweed *(Mollugo verticilata l.)* is very sensitive to acetic acid at very low concentrations and application volumes, while yellow nutsedge *(Cyperus esculentus l.)* is able to tolerate high acetic acid concentrations and application volumes. Repeated applications of acetic acid may be necessary for satisfactory weed control depending on weed size, weed species, and whether it is an annual or perennial plant. There is also a difference between nonsynthetic and synthetic acetic acid and approval for use in organic production. If the material is intended for use on certified organic land, check for approval of your specific product with your organic certifying agency. Also keep in mind that clearance for organic use does not mean a product cannot cause personal injury, if handled in an unsafe manner. Vinegar with greater than 10% acetic acid can cause severe eye damage or even blindness.

Clove Oil. Clove oil is the active ingredient in a number of organically approved postemergent non-selective herbicides. Clove oil weed control efficacy can be as good, or better than acetic acid herbicides, and can be applied at lower application volumes and remain effective. As with acetic acid and other contact herbicides, broad-leaf weed control, in general, is greater than grass weed control. There is evidence that adding certain organically approved adjuvants (i.e., garlic and yucca extracts) will increase weed control with clove oil.

D-Limonene, Orange Oil and Lemongrass Oil. These are all contact, post-emergent herbicides. As with acetic acid and other contact herbicides, control of broadleaf weeds is greater than grass weed control. Adding an organically acceptable adjuvant may result in improved control.

Ammonium Nonanoate or Ammonium Pelargonate. This is another non-selective contact post emergent herbicide that has shown excellent weed control activity and has just recently received clearance as an organic herbicide. Ammonium nonanoate occurs in nature and is formed from the biodegradation of higher fatty acids. Ammonium nonanoate is more effective on broad leaf weeds than grasses and smaller or younger weeds than larger or more mature weeds. Ammonium nonanoate can be effective at more application volumes than acetic acid products.

Appendix C. References

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