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PLANT MATERIALS TECHNICAL NOTE

Restoration and Diversification of Plant Communities with Woody Plants

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Introduction: The restoration of plant communities may include the use of woody plant materials (shrubs and trees) as part of the revegetation effort. The inclusion of woody species poses some unique selection, establishment, and maintenance challenges when planning and implementing these plantings.

Planting Design: The purpose of planting shrubs is to re-establish native plant communities and/or provide habitat diversity. Woody planting designs should result in curvilinear, clumped mosaic, patchy designs, or combinations thereof, thus providing niche communities of habitat and complementing adjacent vegetation.

Species Selection: Program goals and requirements determine which species can be used and dictate the use of native or introduced species. Plant community restoration projects that mandates the use of indigenous, native species entirely, reference the Field Office Technical Guide (FOTG), Ecological Sites, Section II-E-8, and Section IV - Practice Standards for guidance.

Site Selection: Site selection is critical to the successful establishment of a shrub component. Utilize the previously mentioned guides and soil surveys to identify favorable planting sites (deep soils, overflow areas, coulees, gullies, and swales, lower terrace landscapes). The high cost of woody seed and plants dictates that planting occurs in environments providing the greatest probability of success. One strategy is to establish plants as seed orchards on the upwind side of a planting site, to provide a seed source, for eventual occupation in adjacent plant communities (when applicable, assure that both female and male plants are present). On CRP lands, woody plants must be interspersed throughout a percentage of the herbaceous stands. In this case, transplants can be established in single rows to accommodate establishment and maintenance. Since these orchards should be maintained in the same manner as a windbreak planting, the site should be accessible and accommodate weed control management activities.

Germplasm Origin and Source: The *origin* and *source* of the woody species (seed or plant) is often critical to their successful establishment and long-term survival. “Origin” refers to the original collection site of the plant material and may provide insight into the site and environmental conditions to which the collection is adapted. In most cases, local ecotypes will outperform non-local sources in terms of long-term survival and health. Cultivars or accessions that have been through a testing and/or selection program and are recommended for the location and use are preferred. Cultivated but non-tested local ecotypes are less desirable than tested material. The use of local, wildland-collected material may be tempting, but usually little is known about its potential performance. “Source” refers to the supplier of the seed or plants, i.e., nursery, seed supplier, etc. Given the appropriate origin of the material, plants should be procured from local nurseries when possible. Plants of appropriate origin but produced in distant, milder environments should be adapted, but seedlings may not be properly conditioned to local climates. The preferred sources of plant materials are state nurseries, local commercial nurseries and seed companies.

Site Preparation: Site preparation for seeding should follow standard guidelines for establishing a firm, weed-free bed for good soil to seed contact–refer to FOTG, Section IV, Practice Standards, Practice Standard 327-Conservation Cover; 512–Pasture and Hayland Planting; and 550-Range Planting. Site preparation for planting bareroot or containerized plants will involve mechanical cultivation or chemical fallow at least one year prior to planting. The application of weed barrier materials at planting time should also be considered. In established grasslands, this will require preparing a strip, circle, or square area around each plant. Minimum grass-free area should be a 3-feet wide row or 3 feet in diameter around each plant. Like windbreak plantings, the cultivation of the area is dictated by equipment size and must be planned *accordingly (see Idaho Tree Planting Handbook, North Dakota Tree Handbook, Plant Materials Technical Note No. 43 Tree Planting, Care and Management, and Standard 380 Windbreak and Shelterbelt Establishment)*.

Recommendations for establishment of desirable plant communities based on planting evaluations in Idaho and Montana 1999 - 2001:

- Cheatgrass, medusahead rye, wild oats, and annual rye infestations generally resulted in poor stands of desired plants that were seeded. These weeds must be controlled during site preparation and may require more than one year for control. The seed mixture should normally be planted in the spring following a non-selective herbicide application or early spring tillage.
- Plantings should be delayed one growing season following a small grain crop. The fallow period objective is to maximize soil moisture storage. Fallowed soils also facilitate additional weed control to ensure better stand establishment.
- Cereal grain chaff windrows should be spread out to eliminate toxicity, reduce concentrated volunteer grain competition, and provide for the best seed-to-soil contact possible for desired seeded species.
- Broadleaf summer annual weeds in new cool season species seedings have little impact on stand establishment if managed properly. Weeds should be clipped or shredded prior to seed formation to prevent seed development and to reduce the potential to spread.
- By law, noxious weeds must be controlled at all times including prior to planting, during establishment, as well as in established stands.
- Winterfat, sagebrush, and fourwing saltbush can be successfully established from seed when planted as part of a mixture including grasses and forbs. Winterfat and sagebrush seed must be planted on or very near the soil surface for best establishment. **All woody species benefit when allowed to establish in a separate row free of interspace competition.**
- Enhancement within existing perennial grass stands requires burning, grazing or haying, multiple non-selective herbicide applications and tillage, to germinate and destroy accumulated seed banks for grass control, provide for residue reduction for good seed/soil contact and maximize soil moisture storage.
- Interseeding shrub species into existing stands of grass and forbs has generally been unsuccessful due to competition from other species.
- Areas where interseeding has been successful has required average or above spring (April - May) precipitation and major reduction in competition from existing vegetation.
- The use of seedling shrub transplants and weed barrier material on small acreages is encouraged to promote better seedling survival and establishment.
- Woody seedling transplant locations should be documented on plan map for future reference and evaluation.

I. SEED

Seed Dormancy: In contrast to many grass species, most woody plants have one or more dormancy mechanisms that prevent germination until conditions are favorable for long-term survival. Commercial seed is usually not artificially pretreated, and cooperator pretreatment is generally not reliable. Germination recommendations for many woody species require direct field sowing at a particular time of the year, depending on the species, to overcome dormancy. The result is that the interval from sowing to germination may be lengthy, possibly up to several years, for species such as snowberry and black hawthorn. For best results, multiple year sowing or alternate shrub-grass strip planting operations may be needed in order to limit competition from aggressive cool-season grasses. Woody species requiring little or no pretreatment, such as fourwing saltbush, sagebrush, and winterfat, may be simultaneously sown with herbaceous plants, depending on the physical characteristics of the woody seed and the species mix. Note that sagebrush and winterfat should be placed on the soil surface. **In most cases, however, grass competition and long-term costs favor the use of bareroot or containerized woody material over seed.**

Seed Viability: Only high quality seed with a current (within 6 months of planting) germination and analysis should be used. Seed must be stored in a dry, cool environment to maintain viability. Shelf life varies by species and may be as short as six months for sagebrush species and up to two years for winterfat.

Direct Seeding: Seeding rates for shrubs should be relatively high when mixed with competitive grasses and forbs (Table 1). Depending on the species, large seed can be drilled to a 1-inch depth, whereas small seed should be planted 1/2-inch or less in depth. Sagebrush and winterfat should be planted on or near the soil surface. Planting depth will also vary as a function of the moisture-holding capacity of the soil (soil texture, exposure, aspect, etc). Compromises may be needed when multiple species of one or more life forms are sown in a single operation. One option is to partition the drill box into multiple compartments so that separate rows of shrubs, grasses, legumes, and forbs are seeded. Shrub rows should be at least 3 feet from the nearest grass row. Carriers may be needed to calibrate the drill settings for the various species as well as facilitate uniform and accurate seed distribution across the site. On adequately prepared sites, broadcast seeding with a fertilizer spreader or Brillion broadcast seeder is possible. This technique may be most favored for small-seeded species. Prepare a firm seedbed and harrow to provide rills and ridges for seed placement. Increase the drilled seeding rate up to two times when broadcasting. **Inter-seeding is not recommended when competition is not controlled by either cultivation or herbicides.**

II. PLANTS

Plant Codes: The nursery industry employs a numeric coding system to identify how the stock was grown and for how long. The first number indicates the number of years a seedling was grown in a seedbed, the second number indicates the number of years grown in a transplant bed (e.g. a 2-0 plant was grown for two years as a seedling in a seedbed, a 2-1 plant was grown for two years in a seedbed and one year in a transplant bed and is therefore 3 years old).

Plant Condition: All plants should be healthy, vigorous, and free from any signs of insect, disease, mechanical injury, or signs of environmental or other stress. When plant material is transplanted outside of the frost-free period established for the planting site, it should be maintained and planted in a fully dormant state. For dormant fall transplanting, which should be discouraged in most cases, all leaves should have naturally dehisced by the time of planting. For dormant spring transplanting, buds should not be swollen, nor should there be any other signs of active growth. Actively growing plants may only be installed within the frost-free period established for the planting site. The bark cambium should be smooth

and tight (not wrinkled and/or water-soaked in appearance) and free from mechanical injury. Roots should be healthy and prolific, with light-colored root tips and free of signs of insects, disease, mechanical damage, or environmental stress. Bareroot and container plant root systems should not have any girdling,

twisted, or circling roots. Container plants should be properly hardened-off (acclimated to outdoor conditions) prior to delivery.

Plant Transport and Storage: The proper transport and storage of plants are critical factors influencing plant condition and planting success. Dormant plants should be shipped and stored under refrigerated (34°-37°F) and high humidity (90-95+%) conditions. All plant material transported to the planting site under non-refrigerated conditions should be transported in packages that prevent heat buildup and the loss of relative humidity and should be installed within 72 hours of leaving cold storage at the nursery. All plant material transported to the planting site in refrigerated storage and placed directly in on-site refrigerated storage may be held on-site for up to 14 days prior to transplanting. For longer storage periods, stock should be heeled into a high-density planted furrow and irrigated. Plant material that is transported in cold storage but not subsequently maintained in on-site refrigerated storage should be transplanted within 72 hours of removal from refrigerated transport. All bareroot material should have their roots kept in moist packing material wrapped in polyethylene sheeting during transport. A plant grown in containers should have moist media (but not dripping wet) at all times. If actively growing, container plants should be transported and stored under conditions that favor active growth (45°-75°F, light sun and adequate moisture). All plants should be fully protected from wind and sun desiccation during transport (tarps, protective boxes, caps, etc.). On arrival at the planting site and prior to transplanting, plants should be temporarily stored in a cool, shaded (dark), wind-protected area such as on the leeward-shaded side of a building, under a tent, or under trees. The roots should be kept cool and moist to prevent desiccation and maintain good plant health until they are installed. Plants should be protected from heat buildup; sun, air, and wind desiccation; freezing; and animal predation at all times. Minimize the interval between removal of dormant plant material from cold storage and transplanting. All plants should be handled to eliminate potential stress or injury.

Maintenance: Weed control prior to planting and until the woody plants can successfully compete with grasses is mandatory. Weed barrier material, chemical fallow, or mechanical cultivation will be needed around each plant to optimize moisture availability and minimize competition. Weekly irrigation during the first growing season is advised in annual precipitation zones of 14 inches or less or a minimum of one-year clean fallow to store adequate soil moisture is recommended.

A. Bareroot

Bareroot Stock: Bareroot plants are shipped and planted in a dormant state without growing media protecting their roots. This stock is less expensive than containerized material and is acceptable for many species. Shipping, storage, handling, and transplanting of bareroot stock are more timing-critical than container plants because this stock is handled dormant and desiccation of the roots is more likely.

Bareroot plants need to be shipped and transplanted in the early spring before bud break. If bareroot plants do break dormancy, they should only be transplanted within the frost-free period established for the planting site.

Bareroot Plant Material Specifications: Optimal sizes for bareroot material includes a shoot to root ratio of 1:1 to 1:2. Shoots should not be less than 8 inches tall with a basal diameter of not less than 3/8-inch. Each bareroot plant should have at least four, 8-inch long, fibrous roots originating from the stem. All plant material should have a well-branched root system characteristic of the species and adequately sized to support vigorous plant growth under prevailing site conditions. A minimum of one- year-old deciduous stock (1-0) and two-year-old conifer stock (2-0) is recommended. Beware of plant materials labeled "conservation grade". In many cases, conservation grade is the poorest material available. **Evergreens generally establish most successfully as containerized transplants.**

Bareroot Planting: Bareroot plants should be planted in accordance within accepted horticultural practices. Untangle and prune (if necessary) long roots when removing from shipping package. The planting hole should accommodate the entire length and width of roots without bending or squeezing the roots. If necessary, prune roots to prevent "J-rooting". Bareroot plants should be planted so that all root surfaces make contact with soil with no exposure to air. No soil should cover or be mounded around any

stem tissue above the root collar. The hole should be backfilled with friable soil and all large air spaces eliminated by saturation with water or complete soil firming around transplants. Extreme care not to damage the root system should be exercised when backfilling and packing soil around the transplant. Excessive downward force on the roots may cause tearing from the stem. All plants should be transplanted so that the main stem(s) are vertical.

B. Container

Container Stock: Woody plants grown in containers offer the best survival and growth. Although initially more expensive than bareroot material, container plants are often more cost efficient in the long-term. Containerized stock offers more flexibility in the timing of planting and the method of storage prior to planting. Conifer species, with roots especially sensitive to desiccation, lend themselves best to container production (Table 1). Replanting costs are often lower as a result of superior seedling survival and growth rates, reduced transplanting shock, and hence, better competition with grasses. Container plants are transplanted with rooting media surrounding the roots, providing an establishment advantage on marginal sites. Container plants, with their superior growth rates, often reach a functional size more quickly than bareroot plants and thus provide conservation benefits sooner. **Actively growing plants should only be planted within the frost-free period established for the intended planting site.**

Container Plant Specifications: Containerized plants should have a container (media and root) volume of not less than 7 cubic inches. Volumes of 10 to 40 cubic inches are preferred. Properly aged and sized container plants should have enough fibrous root mass to retain the shape of the media when removed from the container. Container plants should be at least 2 years old. If plants are root-bound or roots are spiraled around the container, they should be sliced with a sharp knife to initiate new growth. If root-bound plants are transplanted without treating the roots, the plant will grow extremely slow or not at all and is likely to die.

Container Planting: All containers should be removed at the time of planting. The width of the planting hole should be 1.5 times the diameter of the container and the depth of the hole 1.5 times the depth of the container. The hole should be backfilled with friable soil so that the depth of the hole prior to planting is the same as the depth of the container. Each plant should be transplanted so that the surface of the root ball is level with the grade of the soil at each respective hole. No more than 1/2 inch of soil should cover the upper surface of the root ball and should not be planted more than one inch below grade. All container plants should be transplanted so that the main stem(s) are vertical.

C. Other

Using Wildland Plants: The collection of wildland seedlings is not recommended. Wildland seedlings are easily damaged, difficult to transplant, and the site from which they are collected may be adversely impacted.

Using Vegetative Cuttings: Although vegetative cuttings can be used to establish new plants in a cultivated (greenhouse or nursery) setting, direct field planting of cuttings is not generally practical nor recommended. Vegetative cuttings of select species can be successfully used in irrigated or riparian settings given adequate and consistent soil moisture (refer to FOTG, Section IV, Practice Standards and Specifications, Practice Standard 391–Riparian Forest Buffer, Idaho Plant Materials Technical Note No. 23 - How to Plant Willows and Cottonwoods for Riparian Rehabilitation, and *The Practical Streambank Bioengineering Guide* for further information).

Using Table 1: Seeding and planting information is provided in Table 1. Approximate number of seeds/pound is provided for calculating seeds/square foot and for determining seeding methodologies. It may be difficult or impossible to plant very small or large seed with mechanical planters at the recommended rates. In addition, carriers may be needed. **Seeding rates are based on reclamation estimates for establishing a 100 percent stand and need to be adjusted accordingly for mixtures**. As a result of variability in seeds/pound, germination rates, site conditions, and environmental factors, these rates represent approximate estimates and accuracy may be improved by adjustment based on

known or estimated project-, site-, and seed lot-specific conditions. It should again be noted that transplants are preferred to seed.

Example: A 20 percent stand, consisting of equal parts of big sagebrush, Gardner's saltbush, and silverberry is desired. The seeding rate for each species is calculated as follows:

1) big sagebrush (1.0 PLS pounds/acre) x (0.066 percent[†]) = 0.066 PLS pounds/acre (30 grams)
2) Gardner's saltbush (0.5 PLS pounds/acre) x (0.066 percent) = 0.033 PLS pounds/acre (15 grams)
3) silverberry (1.0 PLS pounds/acre) x (0.066 percent) = 0.066 PLS pounds/acre (30 grams)

Mix Totals:0.165 PLS pounds/acre (75 grams)

[†] Calculated by dividing 20 percent by three species.

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Table 1. Restoration of Plant Communities with Native Woody Plants - Seeding and Planting Information.

Common Name	Latin Name	Potential for Direct Seeding (l,m,h)[1]	Approximate Seeds per Pound	Seeding Rate Pounds (PLS/acre)[3]	Method of Seeding (b or d)[5]	Depth of Seeding (inches)	Seeded Alone or in Mixes	Seeding Time of Year (w,sp,s,f)[6]	Bareroot	Container	Planting Time of Year (w,sp,s,f)[6]
serviceberry	*Amelanchier alnifolia*	l	82,000	0.5-1.0	d	<0.5	alone	f	good	excellent	sp
silver sagebrush	*Artemisia cana*	m	850,000	<1.0	b	surface	alone	f	good	good	sp
fringed sagewort	*Artemisia frigida*	m	3.9-4.5 million	ounces	b	surface	mix	f,sp	NI	NI	NI
big sagebrush species	*Artemisia tridentata species*	l	2.4-3.2 million	1.0	b	surface	mix	f	good	excellent	sp
Gardner's saltbush	*Atriplex gardneri*	m	111,500	0.5	b,d	surface-0.5	alone	f	NI	good	sp
fourwing saltbush	*Atriplex canescens*	h	52,000	0.5-1.0	d	0.25-0.75	mix	s,f	good	good	sp
curlleaf mtn. mahogany	*Cercocarpus ledifolius*	l	51,900	1	b,d	surface-0.5	alone	f,w	good	good	sp
rubber rabbitbrush	*Ericameria nauseosus*	m	693,000	<1.0	b	surface	lite mixes[7]	f	good	good	sp
green rabbitbrush	*Ericameria viscidiflorus*	m	782,000	<0.5	b	surface	lite mixes[7]	f	NI	good	sp
redosier dogwood [8]	*Cornus sericea*	l	18,500	1.0 or >	d	0.25-0.50	alone	f	good	good	sp
black hawthorn	*Crataegus douglasii*	l	22,600	0.5-1.0	b,d	surface-<0.25	alone	f	NI	good	sp
silverberry	*Elaeagnus commutata*	m	3,800	1.0-2.0	b,d	surface-1.0	alone	f,w,sp	good	good	f,sp
Rocky Mtn juniper	*Juniperus scopulorum*	l	27,100	<1.0	b,d	surface-0.25	either	s	good	excellent	sp
winterfat	*Krascheninnikovia lanata*	h	111-210,000	b=<1.0;d=<0.5	b;d	surface	use carrier	f to sp	excellent	excellent	sp
bush cinquefoil	*Dasiphora floribunda*	m	>1,000,000	<1.0	b	surface	mix	f,sp	good	good	sp
narrowleaf cottonwood [8]	*Populus angustifolia*	l	NI[2]	NA[4]	NA	NA	NA	NA	good	excellent	sp
black cottonwood [8]	*Populus trichocarpa*	l	NI	NA	NA	NA	NA	NA	good	excellent	sp
American plum	*Prunus americana*	l	870	20.0	d	1.0	alone	f	good	excellent	sp
chokecherry	*Prunus virginiana*	m	4,790	1.0-2.0	d	0.5-1.0	either	f	good	excellent	sp
antelope bitterbrush	*Purshia tridentata*	m	15,400	1.0-2.0	d	1.0	alone	f to sp	good	excellent	late sp
bur oak	*Quercus macrocarpa*	l	75	25.0	hand	1.0	alone	f	fair	excellent	sp
skunkbush sumac	*Rhus trilobata*	l	20,300	1.0-2.0	d	0.5-1.0	either	f,w	good	excellent	sp
golden currant	*Ribes aureum*	m	233,000	<1.0	b,d	0.16-0.25	alone	f,w	good	excellent	sp
wax currant	*Ribes cereum*	m	251,000	<1.0	b,d	0.16-0.25	alone	f,w	good	excellent	sp
Wood's rose	*Rosa woodsii*	l	50,000	0.5-1.0	d	0.5	alone	f	excellent	excellent	sp
Willow [8]	*Salix* species	l	2-3,000,000+	NA	b	surface	alone	sp	excellent	excellent	sp
greasewood	*Sarcobatus vermiculatus*	l	230,000	<0.5	b,d	0.16-0.25	alone	sp	good	excellent	sp
silver buffaloberry	*Shepherdia argentea*	l	40,000	0.5-1.0	d	0.5	alone	f	good	excellent	sp
common snowberry	*Symphoricarpos albus*	l	76,000	1.0-3.0	b,d	surface-0.5	alone	f	good	excellent	sp

[1] l=low; m=medium; h=high.

[2] NI=No Information.

[3] PLS=Pure Live Seed in pounds; Based on reclamation rates designed to establish a 100 percent shrub component of a single species (adjust for multiple species).

[4] NA=Not Applicable.

[5] b=broadcast; d=drilled.

[6] w=winter; sp=spring; s=summer; f=fall.

[7] Use other species at light rates.

[8] Cuttings appropriate