

PLANT MATERIALS TECHNICAL NOTE

Seeding Rates for Conservation Species for Montana

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Figure 1. Precision seeding a conservation planting

Introduction

Many conservation practices rely on a seeding as part of the conservation remedy. There are several factors to consider when developing a seeding mix that influence the success of the planting. One factor is seeding rate, based on the desired number of live seeds per linear distance (foot) or per unit area (square foot) and expressed as Pure Live Seed (PLS) pounds per acre. This technical note provides the number of seeds per pound of many conservation plant species, the target number of seeds per square foot or linear foot needed for a full stand or seeding, the resultant number of PLS pounds per acre recommended for a full stand of that species, and other useful information. It should be used in conjunction with other technical notes and references as noted herein.

A. How were the plant species in Table 2 chosen?

The plant species, both native and introduced, in Table 2 (attached at the end of this document) were chosen for their proven ability to work well in various conservation practices in Montana and Wyoming. These species tend to be commercially available, cost-effective, and lend themselves to direct seeding. Other species, selections, and seed sources may also work well. The plants are organized by Grasses-Native; Grasses-Introduced; Legumes-Introduced; Native Forbs and

Legumes; Shrubs/Sub-Shrubs; and Trees. It is important to note that although some sub-shrubs can be successfully planted as seed, most woody plants establish best as seedlings. Most large stature shrubs and trees listed in Table 2 should be planted as seedlings.

B. How were the seeds per pound of each plant calculated?

The number of seeds per pound of each plant species in Table 2 is an approximation calculated from the average of numerous seed lots of the species and its selections. Other references may provide slightly different values. It is important to note that two values are provided in the case of sainfoin (*Onobrychis viciifolia*), moundscale (*Atriplex aptera*), fourwing saltbush (*Atriplex canescens*), and winterfat (*Krascheninnikovia lanata*). The first value is for processed seed and the second for non-processed seed, since both forms are commercially available. The degree of processing has a large effect on the number of seeds per pound and, therefore, on the number of PLS pounds of seed needed for a full stand seeding. It is critical that planners note this difference when developing seed mixes and to inform producers to buy processed or not processed seed accordingly. Additionally, a range of seeds per pound is provided for members of willow (*Salix*), since many species are represented in that Genus.

C. How was the number of pure live seed pounds per acre needed for a full seeding calculated?

The numbers of pure live seed (PLS) pound of seed per acre recommended for each species in Table 2 are calculated from the target number of seeds desired per linear foot or square foot, depending on whether the seed is drilled in rows (linear) or broadcast (area). The standard rule of thumb is to use 20 to 25 seeds per linear or square foot for most plantings, although target number varies with seed size (number of seeds per pound), seedling vigor, type of seeding equipment, and conservation practice (**note:** woody plant seeding rates vary widely reflecting the mature size of species, as well as other factors). It is important to note that the PLS pounds per acre needed for a full drill seeding are based on 12-inch between row spacing, and must be adjusted when the between-row spacing is greater than 12 inches. The target seeding rate per linear foot (based primarily on seed size) is listed in Table 1. Small seeds are seeded at higher rates because they

Table 1. Target number of seeds per foot based on seed size

Seed Size Class	Number of PLS Seeds Per Pound	Target Number of PLS Seeds Per Foot
small	>800,000	30 to 50
medium	80,000 to 800,000	20 to 25
large	<80,000	15 to 20

generally have less carbohydrate reserves, and perish more easily than large seeds, and have a greater potential to be planted too deep. Large-seeded plants often produce larger, more competitive seedlings that tend to survive well, larger stature plants requiring more growing space, and their seeds become logistically difficult to sow in high numbers because of their large size. As noted earlier, the recommended seeding rate also varies with how the seeding is planted. The seeding rate for broadcasting (as opposed to drilling) is **twice** the seeding rate listed in Table 2. Additionally, the seeding rate can vary with the type of conservation practice. For Critical Area Plantings, the seeding rate is also up to **twice** the recommended rate in Table 2. If a Critical Area Planting is broadcast or hydro-seeded, the seeding rate could be up to **four times** the recommended rate in Table 2 (see Field Office Technical Guide (eFOTG), Section IV, Practice Specification, Critical Area Planting, Code 342). Good seedbed preparation, harrowing, application

of chopped mulches, hydro-mulching or other practices that promote better seed to soil contact should be considered to ensure adequate stands.

D. What other information is provided in Table 2?

Table 2 also provides information on whether the species is a warm-season or cool-season plant, if it is best grown under irrigated or dryland conditions, and if the preferred planting season is spring or fall. It also lists appropriate and preferred (in red) selections and seed sources. For more information on appropriate selections and seed sources, see Plant Materials Technical Note, MT-67, *Seed Source Selection, Use of Certified Seed, and Appropriate Seed Release Class Improve Conservation Planting Success*, and Plant Materials Technical Note, MT-69, *Standard and Preferred Forage and Reclamation Plants for Use in Montana and Wyoming*.

E. What are the row spacing conversions listed in Table 3 and when are they used?

The seeding rates in Table 2 of this document are based on a set number of seed per linear foot within the row, and 12 inches between the rows (with the exception of Russian wildrye). When the between-row spacing decreases below 12 inches, the number of seeds per square foot remains the same but the number of seeds per linear foot decreases (see Table 3). When between-row spacing increases above 12 inches, the number of rows per acre decreases, and therefore, to prevent overcrowding within rows, less seed is needed per acre. In these cases, the number of seeds per linear foot remains constant and we decrease the amount of seed planted per acre using the appropriate conversion factor.

Example 1. A full seeding of slender wheatgrass is desired but the producer has a drill with a fixed spacing (row width) of 14 inches. Since Table 2 lists seeding rates based on 12-inch between row spacing, how do I calculate the amount of seed I now need per acre?

Answer. Divide the recommended seeding rate for slender wheatgrass of 7 PLS pounds per acre by the conversion factor listed in Table 3 of 1.17. In this case, the amount of seed needed per acre is 6 (5.98) PLS pounds per acre. Since the row spacing is 1.17 times wider than a 12-inch row, you now need only 83% of the seed. This is because the number of seeds planted per linear foot of row remains the same, but the number of rows per acre decreases with increasing between-row spacing. In other words, with increasing row space, you actually have less total row length per acre, and therefore, require less seed per acre.

You can calculate the conversion factor yourself by visualizing a perfectly square acre, which measures ~208.7 feet by ~208.7 feet ($\sqrt{43,560}$). For 12-inch (1 foot) row spacing, this basically describes a field with 208.7 rows that are each 208.7 feet long which equals 43,560 row feet. When row spacing is increased to 14 inches (1.17 feet), you can now only fit 178.4 rows across the field. Multiply 178.4 rows times 208.7 feet which equals 37,227 total feet of row. At 22 seeds per foot times 37,227 feet, this equals 818,996 seeds needed. Divide 818,996 seeds by 140,000 seeds per pound for slender wheatgrass, and you arrive at 5.85 (6) PLS pounds, approximately the same as calculated above using the conversion factor.

Example 2. A full seeding of slender wheatgrass is desired but the producer has a seeder with a fixed drill spacing (row width) of only 9 inches. Since Table 2 lists seeding rates based on 12-inch between row spacing, how do I calculate the amount of seed I now need per acre?

Answer. In this case, the seeding rate of 7.0 PLS pounds per acre remains the same. The number of seeds per square foot remains the same, but the number of seeds per linear foot decreases because there are more linear row feet per acre or square foot on 9-inch row spacing than 12 inch (this is important if calibrating the drill by counting seeds per row foot). In this case, the drill must be calibrated for 16 to 17 PLS per linear row foot. Using the conversion

factor in Table 3 for 9-inch row spacing, we multiply 22 seeds per linear foot times 75% (0.75) or 16.5 PLS seeds per foot of row. When calibrating the drill of course, this value will need to be converted to bulk seeds per foot based on the PLS value of the seed lot being used. No changes are needed when calibrating the drill using the weight method.

As in Example 1, you can calculate the needed seeds per linear foot yourself by visualizing a ~208.7 feet by ~208.7 feet acre. When row spacing is decreased to 9 inches (0.75 feet), you can now fit 278.3 rows across the field (208.7 divided by 0.75 feet). By multiplying 278.3 rows times 208.7 feet, we determine we have a total of 58,074 feet of row. At 7.0 PLS pounds per acre, we are seeding 980,000 seeds per acre (7 pounds times 140,000 seeds per pound). By dividing 980,000 by 58,074 feet of row, we calculate we need to sow about 16.9 seeds per foot, about the same as calculated using the conversion factor.

Example 3. What would happen if, using a full seeding rate for slender wheatgrass and 12-inch between row spacing, the seeding was a Critical Area and we were broadcasting the seed?

Answer. As mentioned earlier, we double the recommended full seeding rate listed in Table 2 (7 PLS lb./acre) for a Critical Area Planting to 14 PLS lb./acre, and may double this amount again if the seed is broadcast and not drilled, depending on site conditions. This could result in a maximum application of 28 PLS pounds of seed per acre or 88 PLS seeds per square foot.

Table 2. Seeding rates for commonly used conservation plant species.

Common Name	Scientific Name	Approximate Seeds/Pound	PLS pounds/acre for Full Stand ^{1,8}	PLS/ square feet PLS/ linear feet	C versus W ² I versus D S versus F versus NP	Proven Selections
GRASSES-NATIVE						
alkaligrass, Nuttall's	<i>Puccinellia nuttalliana</i>	2,100,000	1	48	C-I-NP	Common
alkali sacaton	<i>Sporobolus airoides</i>	1,750,000	1	40	W-D-NP	Saltalk
bluegrass, big	<i>Poa secunda (P. ampla)</i>	882,000	2	40	C-D-NP	Sherman
bluegrass, Canby	<i>Poa secunda (P. canbyi)</i>	925,000	2	42	C-D-NP	Canbar
bluegrass, Nevada	<i>Poa secunda (P. nevadensis)</i>	1,029,000	2	47	C-D-NP	Opportunity
bluegrass, Sandberg	<i>Poa secunda (P. sandbergii)</i>	900,000	2	41	C-D-NP	High Plains, Reliable
bluestem, big	<i>Andropogon gerardii</i>	130,000	8	24	W-D-S	Sunnyview, Bison, Bonilla, Champ
bluestem, little	<i>Schizachyrium scoparium</i>	260,000	4	24	W-D-S	Badlands , Blaze, Camper
bluestem, sand	<i>Andropogon hallii</i>	113,000	9	23	W-D-S	Garden, Goldstrike
brome, mountain	<i>Bromus marginatus</i>	80,000	10	18	C-D-NP	Bromar, Garnet
buffalograss	<i>Bouteloua dactyloides (Buchloe)</i>	48,000	15	17	W-D-NP	Bison, Plains, Tatanka, Texoka, Cody, Bismarck (vegetative)
cordgrass, prairie	<i>Spartina pectinata</i>	183,000	6	25	W-I-NP	Red River
fescue, Idaho	<i>Festuca idahoensis</i>	450,000	2.5	26	C-D-NP	Joseph, Nezpurs, Winchester
fescue, rough	<i>Festuca campestris</i>	171,000	6	24	C-D-NP	Common
fescue, spike	<i>Leucopoa kingii</i>	144,000	7	23	C-D-NP	Common
grama, blue	<i>Bouteloua gracilis</i>	825,000	2	38	W-D-S	Alma, Bad River, Birdseye, Willis
grama, sideoats	<i>Bouteloua curtipendula</i>	191,000	6	26	W-D-S	Butte, Pierre, Trailways, Killdeer
hairgrass, tufted	<i>Deschampsia cespitosa</i>	2,500,000	0.75	43	C-D-NP	Peru Creek
Indiangrass	<i>Sorghastrum nutans</i>	170,000	6	23	W-D-NP	Tomahawk
Indian ricegrass	<i>Achnatherum hymenoides (Oryzopsis)</i>	235,000	5	27	C-D-NP	Rimrock, Nezpar, Paloma, White River
needle and thread	<i>Hesperostipa comata (Stipa)</i>	115,000	9	24	C-D-NP	AC Sharptail
needlegrass, green	<i>Nassella viridula (Stipa)</i>	186,000	6	26	C-D-F	Lodorm, Cucharas, AC Mallard
prairie Junegrass	<i>Koeleria macrantha (K. cristata)</i>	2,300,000	1	53	C-D-NP	Common
prairie sandreed	<i>Calamovilfa longifolia</i>	273,000	4	25	W-D-S	Goshen, Pronghorn
reed canarygrass	<i>Phalaris australis spp. americanus</i>	602,000	2	28	C-I-NP	Loreed, Vantage, Castor, Palaton

Table 2. Seeding rates for commonly used conservation plant species (continued).

Common Name	Scientific Name	Approximate Seeds/Pound	PLS pounds/ acre for Full Stand ^{1,8}	PLS/ square feet PLS/ linear feet	C versus W ² I versus D S versus F versus NP	Proven Selections
GRASSES-NATIVE						
wheatgrass, beardless	<i>Pseudoroegneria spicata</i> spp. <i>inermis</i>	145,000	7	23	C-D-NP	Whitmar
wheatgrass, bluebunch	<i>Pseudoroegneria spicata</i>	139,000	7	22	C-D-NP	Goldar, P7
wheatgrass, slender	<i>Elymus trachycaulus</i>	140,000	7	22	C-D-NP	Copperhead , Pryor, Revenue, San Luis, First Strike
wheatgrass, Snake River	<i>Elymus wawawaiensis</i>	135,000	7	22	C-D-NP	Secar
wheatgrass, streambank	<i>Elymus lanceolatus</i> spp. <i>riparium</i>	152,000	7	24	C-D-NP	Sodar
wheatgrass, thickspike	<i>Elymus lanceolatus</i> spp. <i>lanceolatus</i>	152,000	7	24	C-D-NP	Critana, Bannock
wheatgrass, western	<i>Pascopyrum smithii</i>	93,000	10	21	C-I or D-NP	Rosana, Rodan
wildrye, basin	<i>Leymus cinereus</i>	144,000	7	23	C-D-NP	Trailhead, Washoe, Continental, Magnar
wildrye, Canada	<i>Elymus canadensis</i>	115,000	8	21	C-D-NP	Mandan

Common Name	Scientific Name	Approximate Seeds/Pound	PLS pounds/ acre for Full Stand ^{1,8}	PLS/ square feet PLS/ linear feet	C versus W ² I versus D S versus F versus NP	Proven Selections
GRASSES-INTRODUCED						
bluegrass, Canada	<i>Poa compressa</i>	1,600,000	1.5	55	C-I or D-NP	Foothills, Reubens, talon
bluegrass, Kentucky	<i>Poa pratensis</i>	2,150,000	1	49	C-I-NP	Troy, Park, Newport
brome, smooth	<i>Bromus inermis</i>	125,000	8	23	C-I or D-NP	Lincoln, Manchar, Rebound
brome, meadow	<i>Bromus biebersteinii</i>	93,000	10	21	C-I or D-NP	Fleet, MacBeth, Montana, Regar, Paddock
fescue, hard	<i>Festuca brevipila</i>	565,000	2	26	C-D-NP	Durar, Serra
fescue, sheep	<i>Festuca ovina</i>	680,000	2	31	C-D-NP	Covar
fescue, tall	<i>Schedonorus arundinaceus</i>	242,000	4	22	C-I or D-NP	Alta, Kenmont, Fawn
foxtail, creeping	<i>Alopecurus arundinaceus</i>	720,000	2	33	C-I-NP	Garrison, Retain
foxtail, meadow	<i>Alopecurus pratensis</i>	500,000	2.5	29	C-I-NP	Common
orchardgrass	<i>Dactylis glomerata</i>	464,000	2.5	27	C-I-NP	Chinook, Latar, Potomac, Paiute

Table 2. Seeding rates for commonly used conservation plant species (continued).

Common Name	Scientific Name	Approximate Seeds/Pound	PLS pounds/acre for Full Stand ^{1,8}	PLS/ square feet PLS/ linear feet	C versus W ² I versus D S versus F versus NP	Proven Selections
GRASSES-INTRODUCED						
ryegrass, perennial	<i>Lolium perenne</i>	247,000	4	23	C-I or D-NP	Friend, Linn
timothy	<i>Phleum pratense</i>	1,300,000	1.5	45	C-I-NP	Climax, Drummond, Engmo
wheatgrass, crested (fairway)	<i>Agropyron cristatum</i>	200,000	5	23	C-D-NP	Ephraim, Fairway, Parkway, Roadcrest, Ruff
wheatgrass, crested desert	<i>Agropyron desertorum</i>	175,000	6	24	C-D-NP	Douglas, Nordan, Summit
wheatgrass (fairway x standard)	<i>Agropyron x hybrid</i>	175,000	6	24	C-N-NP	Hycrest, CD II, Hycrest II
wheatgrass, hybrid	<i>Elymus hoffmanii</i>	134,000	8	25	C-I or D-NP	Newhy, AC Saltlander
wheatgrass, intermediate	<i>Thinopyrum intermedium</i>	79,000	10	18	C-I or D-NP	Greenar, Manifest, Oahe, Rush, Reliant
wheatgrass, pubescent	<i>Thino. intermedium</i> spp. <i>barbulatum</i>	80,000	10	18	C-I or D-NP	Luna, Manska, Greenleaf
wheatgrass, Siberian	<i>Agropyron fragile</i> (<i>A. sibericum</i>)	170,000	6	23	C-D-NP	P-27, Vavilov
wheatgrass, tall	<i>Thinopyrum ponticum</i>	79,000	10	18	C-I or D-NP	Alkar, Jose, Largo, Orbit
wildrye, Altai	<i>Leymus angustus</i>	80,000	10	18	C-D-NP	Ejay, Pearl, Prairieland
wildrye, manystem	<i>Leymus multicaulis</i>	181,000	6	25	C-I or D-NP	Shoshone
wildrye, Dahurian	<i>Elymus dahuricus</i>	88,000	10	20	C-D-NP	Arthur, James
wildrye, mammoth	<i>Leymus racemosus</i>	47,000	15	16	C-D-NP	Volga
wildrye, Russian ³	<i>Psathyrostachys juncea</i>	170,000	6	23	C-D-NP	Bozoisky-Select, Mankota, Swift, Bozoisky II

Common Name	Scientific Name	Approximate Seeds/Pound	PLS pounds/acre for Full Stand ^{1,8}	PLS/ square feet PLS/ linear feet	C versus W ² I versus D S versus F versus NP	Proven Selections
LEGUMES-INTRODUCED						
alfalfa ⁴	<i>Medicago sativa</i>	225,000	5	26	I or D-NP	See Footnote #4
birdsfoot trefoil	<i>Lotus corniculatus</i>	418,000	3	29	I or D-NP	Empire, Leo
clover, alsike	<i>Trifolium hybridum</i>	700,000	1.5	24	I or D-NP	Common
clover, red	<i>Trifolium pratense</i>	275,000	4	25	I or D-NP	Common

Table 2. Seeding rates for commonly used conservation plant species (continued).

Common Name	Scientific Name	Approximate Seeds/Pound	PLS pounds/acre for Full Stand ^{1,8}	PLS/ square feet PLS/ linear feet	C versus W ² I versus D S versus F versus NP	Proven Selections
LEGUMES-INTRODUCED						
clover, strawberry	<i>Trifolium fragiferum</i>	300,000	4	28	I or D-NP	Common
clover, white (Ladino)	<i>Trifolium repens</i>	262,000	4	24	I or D-NP	Common
milkvetch, cicer	<i>Astragalus cicer</i>	124,000	8	23	I or D-NP	Lutana, Monarch, Windsor
sainfoin ⁵	<i>Onobrychis viciifolia</i>	30,240/18,500	21 or 34	14	I or D-NP	Eski, Melrose, Remont, Shoshone, Delaney
small burnet	<i>Sanguisorba minor</i>	55,000	15	19	D-NP	Delar
sweetclover, yellow	<i>Mellilotus officinalis</i>	262,000	4	24	I or D-NP	Common
sweetclover, white	<i>Mellilotus alba</i>	258,000	4	24	I or D-NP	Common

Common Name	Scientific Name	Approximate Seeds/Pound	PLS pounds/acre for Full Stand ^{1,8}	PLS/ square feet PLS/ linear feet	C versus W ² I versus D S versus F versus NP	Proven Selections
NATIVE FORBS & LEGUMES^{6,7}						
blanketflower, Indian	<i>Gaillardia aristata</i>	186,000	6	26	D-NP	Meriwether
dotted gayfeather	<i>Liatris punctata</i>	136,000	7.5	23	D-NP	Common
globemallow, scarlet	<i>Sphaeralcea coccinea</i>	500,000	2	23	D-NP	Common
Lewis flax	<i>Linum lewisii</i>	294,000	3.5	24	D-NP	Appar (I), Maple Grove (N)
Maximilian sunflower	<i>Helianthus maximiliana</i>	250,000	4	23	D-NP	Prairie Gold, Medicine Creek
penstemon, fuzzytongue	<i>Penstemon eriantherus</i>	358,000	3	25	D-NP	Old Works
penstemon, Rocky Mountain	<i>Penstemon strictus</i>	478,000	2	22	D-NP	Bandera
prairie clover, purple	<i>Dalea purpurea</i>	317,000	3.5	25	D-NP	Kaneb, Bismarck
prairie clover, white	<i>Dalea candida</i>	278,000	4	26	D-NP	Antelope
upright prairie coneflower	<i>Ratibida columnifera</i>	600,000	2	28	D-NP	Stillwater
sweetvetch, northern (Utah)	<i>Hedysarum boreale</i>	33,600	25	19	D-NP	Timp
yarrow, western	<i>Achillea millefolium</i> var. <i>occidentalis</i>	2,850,000	0.5	33	D-NP	Great Northern

Table 2. Seeding rates for commonly used conservation plant species (continued).

Common Name	Scientific Name	Approximate Seeds/Pound	PLS pounds/ acre for Full Stand ^{1,8}	PLS/ square feet PLS/ linear feet	C versus W ² I versus D S versus F versus NP	Proven Selections
NATIVE SHRUBS/SUB-SHRUBS^{6,7}	Most commonly established from seed					
kochia, forage	<i>Bassia prostrata</i> spp. <i>vivescens</i>	400,000	2	18	D-NP	Immigrant
kochia, forage	<i>Bassia prostrata</i> spp. <i>grisea</i>	324,000	1.5	11	D-NP	Snowstorm
moundscale ⁵	<i>Atriplex aptera</i>	49,000/24,500	4 or 8	5	D-F	Wytana
rabbitbrush, yellow	<i>Chrysothamnus viscidiflorus</i>	782,000	1	18	D-NP	Common
rabbitbrush, rubber	<i>Ericamera nauseosa</i>	693,000	1	16	D-NP	Common
sagebrush, big	<i>Artemisia tridentata</i>	2,500,000	0.5	29	D-NP	Common
sagewort, cudweed	<i>Artemisia ludoviciana</i>	4,500,000	0.25	26	D-NP	Common
sagewort, fringed	<i>Artemisia frigida</i>	4,500,000	0.25	26	D-NP	Common
sagewort, green	<i>Artemisia dracunculus</i>	4,500,000	0.25	26	D-NP	Common
saltbush, four wing ⁵	<i>Atriplex canescens</i>	44,000/22,000	4 or 8	4	D-F	Common
saltbush, Gardner's	<i>Atriplex gardneri</i>	111,500	1	3	D-F	Common
winterfat ⁵	<i>Krascheninnikovia lanata</i>	93,000/54,000	3 or 6	6	D-F	Open Range
yucca	<i>Yucca glauca</i>	25,000	8	5	D-F	Common
NATIVE SHRUBS/SUB-SHRUBS^{6,7}	Commonly established as seedlings, but may be seeded					
bitterbrush, antelope	<i>Purshia tridentata</i>	15,400	5	2	D-F	Maybell
cinquefoil, shrubby	<i>Dasiphora fruticosa</i>	1,500,000	0.5	17	D-F	Common
chokecherry	<i>Prunus virginiana</i>	4,800	10	1	I or D-F	Common
dogwood, redosier	<i>Cornus sericea</i>	18,500	2	1	I-NP	Common
juniper horizontal	<i>Juniperus horizontalis</i>	29,500	2	1	D-F	Common
mountain mahogany, curl-leaf	<i>Cercocarpus ledifolius</i>	30,000	1.5	1	D-F	Common
rose, Wood's	<i>Rosa woodsii</i>	50,000	4	5	D-F	Common
serviceberry, Saskatoon	<i>Amelanchier alnifolia</i>	82,000	1	2	D-NP	Common
sumac, skunkbush	<i>Rhus trilobata</i>	20,300	2	1	D-F	Bighorn
snowberry, common	<i>Symphoricarpos albus</i>	76,000	3	5	I or D-F	Common
snowberry, western	<i>Symphoricarpos occidentalis</i>	74,400	3	5	I or D-F	Common

Table 2. Seeding rates for commonly used conservation plant species (continued).

Common Name	Scientific Name	Approximate Seeds/Pound	PLS pounds/ acre for Full Stand ^{1,8}	PLS/ square feet PLS/ linear feet	C versus W ² I versus D S versus F versus NP	Proven Selections
NATIVE TREES^{6,7}	Establish by transplants or cuttings					
American plum	<i>Prunus americana</i>	870	N/A	N/A	I-S	Common
cottonwood, black	<i>Populus balsamifera</i> ssp. <i>trichocarpa</i>	no inform.	N/A	N/A	I-S	Common
cottonwood, narrowleaf	<i>Populus angustifolia</i>	1,000,000	N/A	N/A	I-S	Common
cottonwood, plains	<i>Populus deltoides</i> ssp. <i>monilifera</i>	364,500	N/A	N/A	I-S	Common
black hawthorn	<i>Crataegus douglasii</i>	22,600	N/A	N/A	I-S	Common
boxelder	<i>Acer negundo</i>	13,400	N/A	N/A	I-F	Common
buffaloberry, silver	<i>Shepherdia argentea</i>	4,000	N/A	N/A	D-S or F	Sakakawea, Mill Creek
bur oak	<i>Quercus macrocarpa</i>	75	N/A	N/A	D-F	Ekalaka
juniper, common	<i>Juniperus communis</i>	36,500	N/A	N/A	D-F	Common
juniper, Rocky Mountain	<i>Juniperus scopulorum</i>	27,100	N/A	N/A	D-S	Bridger-Select
green ash	<i>Fraxinus pennsylvanica</i>	19,000	N/A	N/A	D-F	Cardan
pine, ponderosa	<i>Pinus ponderosa</i>	12,600	N/A	N/A	D-F	Hunter
silverberry	<i>Elaeagnus commutata</i>	3,800	N/A	N/A	I-F	Dupuyer Streambank, Pondera Floodplain, common
willow	<i>Salix</i> spp.	2-3,000,000	N/A	NA	I-NP	Common

NOTE:

Seeds per square foot or linear foot of row (grasses, forbs, legumes)

Small seed size (800,000 seeds/lb or greater) because of the small seed size and corresponding small amount of carbohydrate reserves the recommended rates are 30-50 PLS/square foot or linear foot.

Medium seed size (80,000 to 800,000) recommended rates of 20-25 PLS/square foot or linear foot.

Large seed size (80,000 seeds/lb or less) because of large seed size and resulting large stature plants the recommended rates are 15-20 PLS/square foot or linear foot.

¹ Calculations and formulas for Pure Live Seed (PLS), pounds per acre, and respective seeds per row foot in 12-inch or less row spacing, are described below.

The bulk seed value is used for drill calibration, and is either expressed or calculated as seeds per linear foot of row, seeds per square foot, or weight per unit area. Bulk seed required for applying the proper PLS rate is calculated as follows:

- Percent PLS = (Percent Germination X Percent Purity) ÷ 100
- PLS lb./acre seeding rate ÷ (Percent PLS ÷ 100) = bulk seed (lb./acre)
- PLS seeds/linear or ft² ÷ (Percent PLS ÷ 100) = bulk seed/linear or ft²

Pounds per acre and seeds per foot within a row for various row spacing can be calculated as follows:

All seeding rates shown in Table 2 are expressed as PLS lb./acre based on 12-inch between-row spacing. When row spacing is less than 12 inches, the PLS lb./acre remains constant and the seeds per linear foot is decreased using the listed conversion factor. To calculate the needed seeds per linear or square foot, using the following formula:

Seeds/lb. X PLS seeding rate (lbs./acre) ÷ 43,560 ft²/acre X desired between-row spacing (inches) ÷ 12 inches/foot = PLS seeds/linear row foot or ft²

When between-row spacing is wider than 12 inches, the PLS lb./acre is reduced by the listed conversion factor, and the seeds per linear foot remains constant. To calculate the needed PLS pounds of seed per acre, use the following formula:

Pounds PLS/acre rate in a 12-inch between-row spacing (recommended seeding rate) X [12 inches ÷ actual between-row spacing (inches)] = PLS lbs/acre.

Reference: Montana Plant Materials Technical Note MT-30, Drill Calibration.

Note: Bulk or PLS seeds/linear row foot will be less in a 12-inch or less between-row spacing while bulk or PLS lb/acre remains constant. Bulk or PLS seeds/linear row foot (~20) will remain constant in 12-inch or greater row spacing, but bulk or PLS lb./acre will decrease.

The constant within row seed density provides an initial population to obtain a site occupancy balance with the existing environmental conditions, protection against wind and water erosion, and competition against weeds. Decreasing the PLS seeds per linear foot in less than one foot row spacing, i.e., 10 seeds per linear foot in 6-inch rows, still provides ~20 seeds per square foot.

²C = Cool Season, W = Warm Season, I = Irrigated, D = Dryland, S = Spring Seeding Preferred, F = Fall Seeding Preferred, NP = No Seasonal Seeding Preference.

³Minimum between-row spacing of 18 inches.

⁴Alfalfa should have a fall dormancy rating of three (3) or less. See the latest Certified Alfalfa Seed Council Fall Dormancy and Pest Resistance Ratings.

⁵Sainfoin without pod/with pod; Moundscale and fourwing saltbush seed de-winged/winged; Winterfat seed naked/fluffy.

⁶Shrubs, forbs, and trees will not be planted at a full seeding rate. The purpose of including tree and shrub species is to add species diversity and mimic a native plant community.

⁷Maximum mixture rates determined for percent (%) species composition averaged from Montana Ecological Site Descriptions.

⁸Standard drilled seeding rate will be doubled for broadcast and critical area seeding.

Table 3. Pounds per acre and seeds per foot for various row spacing can be calculated as follows:

ROW SPACING (INCHES)	PLS POUNDS PER ACRE	SEEDS / ROW FOOT
6	Same as 12-inch row spacing	Multiply 12-inch row spacing seeds/foot by 0.50
7	Same as 12-inch row spacing	Multiply 12-inch row spacing seeds/foot by 0.58
9	Same as 12-inch row spacing	Multiply 12-inch row spacing seeds/foot by 0.75
10	Same as 12-inch row spacing	Multiply 12-inch row spacing seeds/foot by 0.83
14	Divide lbs./acre at 12-inch row spacing by 1.17	Same as 12-inch row spacing
18	Divide lbs./acre at 12-inch row spacing by 1.50	Same as 12-inch row spacing
20	Divide lbs./acre at 12-inch row spacing by 1.67	Same as 12-inch row spacing
21	Divide lbs./acre at 12-inch row spacing by 1.75	Same as 12-inch row spacing
28	Divide lbs./acre at 12-inch row spacing by 2.33	Same as 12-inch row spacing
30	Divide lbs./acre at 12-inch row spacing by 2.50	Same as 12-inch row spacing
35	Divide lbs./acre at 12-inch row spacing by 2.91	Same as 12-inch row spacing
40	Divide lbs./acre at 12-inch row spacing by 3.33	Same as 12-inch row spacing
42	Divide lbs./acre at 12-inch row spacing by 3.50	Same as 12-inch row spacing