TECHNICAL NOTE

USDA-Natural Resources Conservation Service
Boise, Idaho; Bozeman, Montana

TN PLANT MATERIALS NO. 7 (revised) October 2012

MIXING SEED WITH RICE HULLS

Loren St. John, PMC Team Leader, Aberdeen, Idaho
Derek Tilley, PMC Agronomist, Aberdeen, Idaho
Joe Scianna, PMC Manager, Bridger, MT
Jim Jacobs, Plant Materials Specialist, Bozeman, MT
Dan Ogle, Plant Materials Specialist, Boise, Idaho (retired)
Mark Majerus, PMC Manager, Bridger, Montana (retired)
Larry Holzworth, Plant Materials Specialist, Bozeman, Montana (retired)

Mixing Seed and Rice Hulls Using a Cement Mixer

Introduction

Many conservation practices include a vegetative component requiring establishment of permanent vegetative cover. Permanent vegetative cover is usually established by direct seeding. Occasionally there are situations where a single species may be seeded, but to obtain better ground cover more rapidly and to obtain a more diverse plant community, seed mixtures including grasses, forbs, legumes and even woody species are preferred.

Grass, forb, legume, and shrub seeds generally feed through a seed drill at variable rates because of differences in seed size and weight. Because of this weight difference, seed mixtures also tend to separate with heavy seed migrating to the bottom and light seed migrating toward the top of the mixture as the drill bounces across the field during the seeding operation.

When planting a mixture of different-sized seeds, it is recommended that a carrier such as rice hulls be used to facilitate the drilling operation. This technical note provides details on how to determine seed and rice hull mixtures.

Cracked grain, vermiculite, and granular clay products (kitty litter, "Shop Dry") are other additives that can improve seed flow. Cracked grain is usually more expensive than rice hulls and can vary in size which complicates drill calibration. Vermiculite is inexpensive but not very good for improving seed flow and the dust can be hazardous to inhale. Granular clay products have proven useful for improving seed flow and virtually eliminate seed bridging, but not all seed vendors carry these products. Often times, seed mixes can be purchased already mixed with rice hulls. If that is the case, then all that is needed to calibrate a drill is the total bulk seed and rice hull (or other carrier) mixture per acre.

Rice hulls are excellent as a carrier because they facilitate the uniform distribution of different-sized seeds at accurate seeding rates and are inexpensive and easy to use. Rice hulls also keep mixtures in constant proportion by reducing seed separation during the drilling process. Rice hulls feed through a grain drill at roughly the same rate as barley, making it relatively easy to calibrate. Rice hulls also prevent bridging of light, fluffy seed in the drill.

Rice hulls are cup-shaped and hold the seed in proportion as the mixture feeds through the drill. Rice hulls must be clean and unbroken. It is highly recommended that U. S. #1 Grade rice hulls be used, as poorer quality rice hulls are often broken which reduces the cupping action to hold small sized seeds.

Accompanying this Technical Note is an Excel® spreadsheet that will calculate seed and rice hull mixtures based on any desired seed mixture. Instructions for using the spreadsheet are included. The spreadsheet uses the same calculations as outlined in this Technical Note. To access the spreadsheet, visit:

http://www.id.nrcs.usda.gov/programs/tech_ref.html#TechNotes

Seed and rice hull mixtures

Preliminary Steps

Why use rice hulls?

- keeps grass-legume-forb-shrub seed mixtures in constant proportion by preventing separation during drilling
- prevents bridging of light, fluffy seed
- allows use of a regular grain drill because the mixture feeds at the same rate as barley
- simplifies drill calibration

Rice hulls must be clean and unbroken. Recommend #1 Grade

- rice hulls work like a cup to hold small seeds and carry them as they feed evenly through the drill
- broken rice hulls significantly reduce this cupping action

Steps in calculating and mixing rice hulls

1. Become familiar with the drill being used. Consult with cooperator on drill settings for barley (may need to calibrate with barley, see Plant Materials Technical Note No. 19 for details)
2. Determine seed mixture, percent Pure Live Seed (PLS), and bulk seeding rate
3. Obtain pounds per bushel data for each species and for rice hulls (see Table 1)
4. Determine volumes of seed and rice hulls
    - **If seed comprises more than 1/2 of the seed:rice hull volume, add one additional bushel of rice hulls and set the drill as if planting 2 bushels of barley**
5. Mix seed for 1 acre, test drill calibration, and make needed adjustments

Example:

Objective: Seeding Mix:

'Rush' intermediate wheatgrass, 90% of mix, 75% PLS (full seeding rate 10 pounds PLS per acre)

'Appar' blue flax, 10% of mix, 85% PLS (full seeding rate 4 pounds PLS per acre)

Fourwing saltbush, 0.25 pounds PLS/ac, 60% PLS (0.25 pounds PLS per acre will provide approximately 400 plants per acre for wildlife habitat)

Use a grain drill with 7 inch row spacing.

1. Become familiar with drill (see Idaho Plant Materials Technical Note No. 19 Calibrating a Seed Drill for Conservation Plantings)

(Cooperator has calibrated drill for barley in past and knows the settings)

2. Determine amount of bulk seed (mixed) per acre

Rush $\frac{10.0 \text{ pounds PLS/acre x } 0.90 \text{ (mix \%)}}{75.0\% \text{ PLS}} = 12.00$ pounds bulk mixed/acre

Appar $\frac{4.0 \text{ pounds PLS/acre x } 0.10 \text{ (mix \%)}}{85.0\% \text{ PLS}} = 0.47$ pounds bulk mixed/acre

fourwing $\frac{0.25 \text{ pounds PLS/acre}}{60.0\% \text{ PLS}} = 0.42$ pounds bulk mixed/acre

3. Obtain pounds per bushel data: (Table 1)

Rush	18.9 pounds per bushel
Appar	46.1 pounds per bushel
fourwing saltbush	25.4 pounds per bushel
rice hulls	9.0 pounds per bushel

4. Determine volumes of seed and rice hulls

Rush $\frac{12.60 \text{ pounds bulk seed per acre}}{18.9 \text{ pounds per bushel}} = 0.635$ bushel

Appar $\frac{0.47 \text{pounds bulk seed per acre}}{46.1 \text{ pounds per bushel}} = 0.010$ bushel

fourwing $\frac{0.42 \text{ pounds bulk seed per acre}}{25.4 \text{ pounds per bushel}} = 0.016$ bushel

0.635 + 0.010 + 0.016 = 0.661 bushels of seed. Since this is greater than 1/2 of the total volume, we must calculate the amount of rice hulls based upon a drill setting of 2 bushels barley per acre

2.0 bushels - 0.66 bushels seed = 1.34 bushels rice hulls x 9 pounds per bushel* = 12.06 pounds rice hulls per acre.

---

* 1 bushel of rice hulls weighs approximately 9 lbs

Note: Most simple seed mixtures will calculate to less than ½ of a bushel, and rice hulls will only need to be added to make up 1 bushel of seed and rice hulls per acre. The need to double the amount of rice hulls (and calibrate the drill to seed the equivalent of 2 bushels barley per acre) usually occurs when species with light bushel weights or those with low PLS are used in a mix.

Figure 1 (shown at the end of this Technical Note) is the completed worksheet that will perform the calculations for the example above. The only needed information is the acreage of the planting, the components of the mix and their percentages, PLS percent, the pounds per bushel for each component and drill width and number of drill spouts. The worksheet will compute the amount of seed and rice hulls needed per acre and total for the seeding as well as provide calibration rate based on the seed weight-distance method for drill calibration.

5. Mix seed for 1 acre, test drill calibration, and make adjustments

- Blending of seed is very important. A cement mixer works extremely well. Mixing with a loader, shovel, etc over a clean, hard surface will also suffice, but requires more work to properly mix.

- Use high quality rice hulls

- Complex mixtures having more than 4-5 components can be difficult to calibrate. It is highly recommended to first mix a small batch (enough for 1/4 acre) and test calibration prior to mixing the entire seed and rice hull mix.

Example: for one acre mix:

Rush	12.00 pounds
Appar	0.47 pounds
Fourwing saltbush	0.42 pounds
Rice hulls	12.05 pounds

Test Drill Calibration

The worksheet (Figure 1) calculates drill calibrations based on the seed weight-distance method. For details of drill calibration and the different methods of calibration, see Plant Materials Technical Note No. 19: Calibrating a Seed Drill for Conservation Plantings.

Calibrating a rangeland drill

Conduct Test Run and Make Drill Adjustments

- Rice hull mixtures work better in drills with metal flutes. Plastic flutes create static electricity and can cause seed/rice hull mixtures to hang-up and plug.

- Do not fill drill box more than ½ full. Filling a drill to the top causes mix separation and bridging of seed.

- Agitators in the seed box aid in maintaining a constant flow. Agitators tend to quit working rather easily without notice so it is important to monitor seed flow and periodically stir the seed mix. A stout stick or hoe can be used to stir the seed mix.

- Awn-tipped seed will cause bridging - increase rice hulls to 65 to 70 percent of mixture

- For seed with no bushel weight listed in Table 1, weigh a bushel equivalent for that seed lot and use that figure to determine rice hull mixture.

Acknowledgements

The authors appreciate the assistance of the following individuals who provided bushel weight data for this publication:

Brent Cornforth (retired) and Boyd Simonson, Aberdeen, ID Plant Materials Center
Michael Bouck, Utah Crop Improvement Association
Mike Knudson, Bismarck, ND Plant Materials Center (retired)
Mark Majerus, Bridger, MT Plant Materials Center (retired)
Manuel Rosales, Tucson, AZ Plant Materials Center
Dave Skinner, Pullman, WA Plant Materials Center (retired)

References

1973 Grass Seed-Rice Hull Mixing Ratio Study for Seeding Recommendations. Carnahan, G.F. USDA-NRCS Aberdeen Plant Materials Center, 1974 Annual Technical Report. pp. 132-140.

The Dilution Method for Plot or Field Seeding of Grasses and legumes Alone or in Mixtures. Lemmon, P. E. and Hafenrichter A.L. 1947. Journal of the American Society of Agronomy. Vol. 39, No. 9. pp. 817-821.

Stabilizing Small Seed Dilution Mixtures. Lavin, F. and Gomm, F.B. 1968. Journal of Range Management. Vol. 21 No. 5. pp. 328-330.

Seed Dilution with Rice Hulls. USDA-NRCS Plant Materials Technical Note No. 16, Lockeford, CA. March, 1966. 2pp.

Use of Rice Hulls to Facilitate the Seeding of Grasses and Legumes. Windle, L. USDA-NRCS Aberdeen Plant Materials Center, 1965 Annual Technical Report. pp. 97-111.

Calibrating a Seed Drill for Conservation Plantings. USDA-NRCS Plant Materials Technical Note No. 19. Boise, ID, Bozeman, MT, Spokane, WA. July, 2004. 15pp.

“The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers. If you believe you experienced discrimination when obtaining services from USDA, participating in a USDA program, or participating in a program that receives financial assistance from USDA, you may file a complaint with USDA. Information about how to file a discrimination complaint is available from the Office of the Assistant Secretary for Civil Rights. USDA prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex (including gender identity and expression), marital status, familial status, parental status, religion, sexual orientation, political beliefs, genetic information, reprisal, or because all or part of an individual’s income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) To file a complaint of discrimination, complete, sign, and mail a program discrimination complaint form, available at any USDA office location or online at www.ascr.usda.gov, or write to: USDA, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, DC 20250-9410.

Or call toll free at (866) 632-9992 (voice) to obtain additional information, the appropriate office or to request documents. Individuals who are deaf, hard of hearing, or have speech disabilities may contact USDA through the Federal Relay service at (800) 877-8339 or (800) 845-6136 (in Spanish). USDA is an equal opportunity provider, employer, and lender. Persons with disabilities who require alternative means for communication of program information (e.g. Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).”

Table 1.
Pounds of Seed per Bushel for Recommended Releases [1/]

Bushel weights can be highly variable from seed lot to seed lot and can be even more variable for seed of shrubs and forbs which are typically cleaned to a much lower purity than grasses. The values listed are averages of as many seed lots as possible. If a species is not listed or you want to determine actual bushel weights of seed lots you are working with, the following procedure can be used:

1) Pour seed into a 1 cup measure and level off. Do not pack the seed into the measuring cup.
2) Weigh the measured seed (in grams) and multiply the weight by 0.328

Example: 1 cup of seed weighs 45 grams. 45 grams x 0.328 = 14.76 pounds per bushel

***U.S. #1 Grade Rice Hulls=9.0 lbs/bu**

Common Name	Release Name	Pounds per Bushel
Grasses		
Bentgrass, Redtop	Multiple turfgrasses	14.0
Bluegrass, Big	'Sherman	17.9
Bluegrass, Canada	Foothills Germplasm	20.9
Bluegrass, Canby	'Canbar'	18.8
Bluegrass, Nevada	'Opportunity'	32.5
Bluegrass, Sandberg	High Plains Germplasm	15.7
	Mountain Home Germ.	19.3
	Reliable Germplasm	18.0
Brome, Meadow	'Cache'	26.7
	'Fleet'	N/A
	'Paddock'	N/A
	'Regar'	23.6
Brome, Mountain	'Bromar'	23.1
	Garnet Germplasm	23.0
Brome, Smooth	'Lincoln'	N/A
	'Manchar'	20.6
Canarygrass, Reed	'Ioreed'	34.1
Dropseed, Sand	Common	33.0
Fescue, Arizona	'Redondo'	22.0
Fescue, Hard	'Durar'	25.0
Fescue, Idaho	Common	20.8
	'Joseph'	N/A
	'Nezpurs'	N/A
	Winchester Germplasm	N/A
Fescue, Red	Multiple – turgrasses	N/A
Fescue, Sheep	'Bighorn'	N/A
	'Black Sheep'	??
	'Covar'	24.8
Fescue, Tall	'Alta'	25.4
	'Fawn'	N/A
	'Forager'	N/A
	'Johnstone'	27.4
Foxtail, Creeping meadow	'Garrison'	9.6

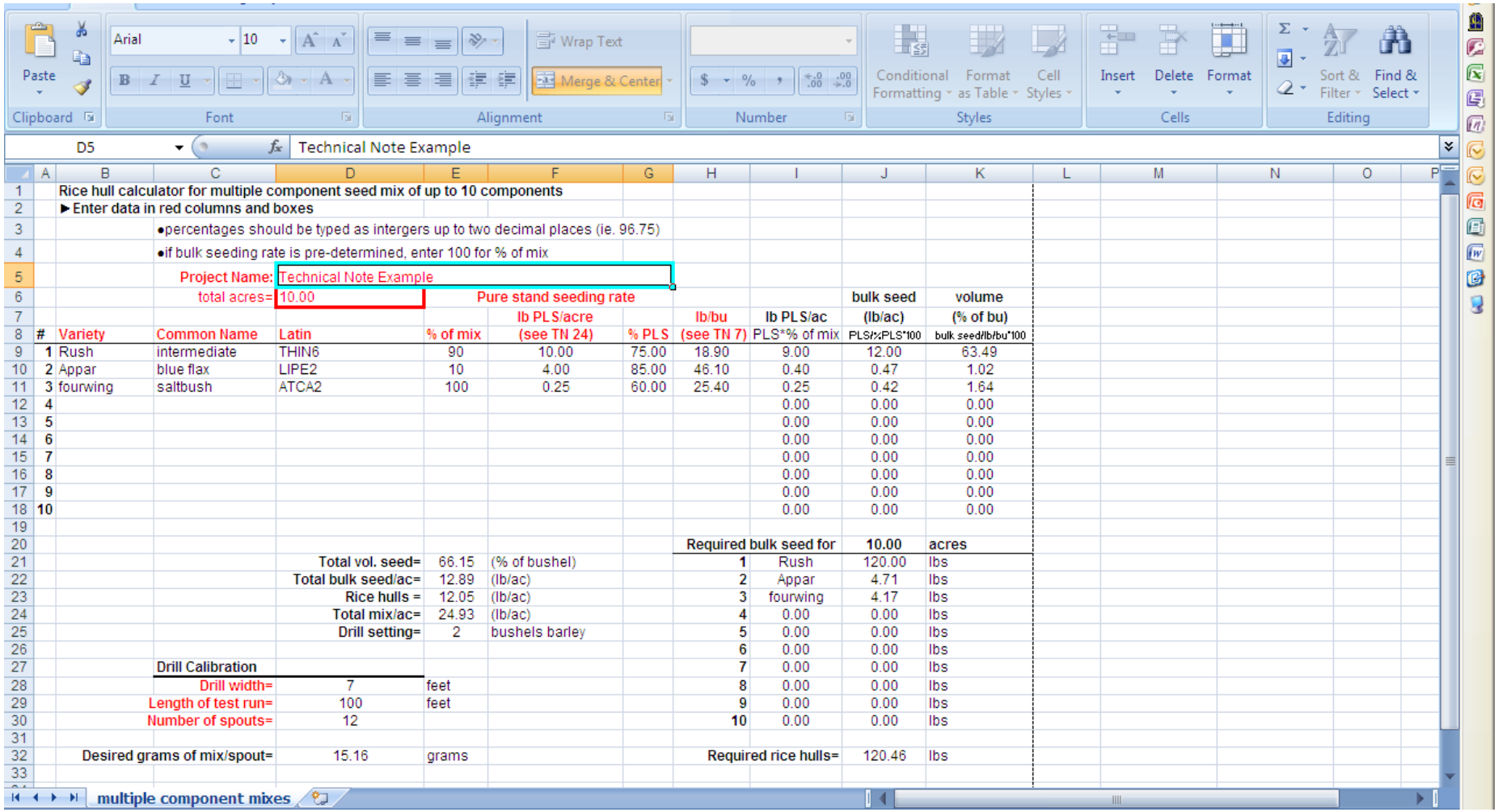
Hairgrass, Tufted	'Norcoast'	N/A
	'Peru Creek'	N/A
	Tillamook	36.0
	Willamette	41.8
Junegrass, Prairie	'Boerkel'	N/A
Needlegrass, Green	Cucharas Germplasm	41.5
	'Lodorm'	48.0
Needlegrass, Thurber's	Wildland collections	25.6
Orchardgrass	'Latar'	18.1
	'Paiute'	18.6
	'Potomac'	N/A
Ricegrass, Indian	'Nezpar'	56.5
	'Paloma'	N/A
	Ribstone Germplasm	N/A
	'Rimrock'	51.4
Ryegrass, Perennial	Common	24.0
Sandreed, Prairie	'Goshen'	43.7
Squirreltail, Bottlebrush	Fish Creek Germplasm	22.1
	Sand Hollow Germplasm	25.2
	Toe Jam Creek Germplasm	21.1
	Wapiti Germplasm	27.6
Switchgrass	'Blackwell'	N/A
	'Dakotah'	59.0
	'Forestburg'	50.0
	'Sunburst'	N/A
Timothy	'Climax'	N/A
	Common	45.0
	'Mohawk'	N/A
Wheatgrass, Beardless	'Whitmar'	19.5
Wheatgrass, Bluebunch	Anatone Germplasm	21.7
	'Goldar'	30.0
	'P7'	20.7
Wheatgrass, Crested AGCR	'Douglas'	25.9
	'Ephraim'	28.8
	'Kirk'	N/A
	'Parkway'	26.6
	'Ruff'	N/A
	'Roadcrest'	28.0
Wheatgrass, Crested AGDE	'Nordan'	26.0
	'Summit'	N/A
Wheatgrass, Crested X	'Hycrest'	25.0
	'CD II'	26.1
Wheatgrass, Intermediate	'Amur'	N/A
	'Oahe'	N/A
	'Reliant'	22.3
	'Rush'	18.9
	'Tegmar'	25.1
Wheatgrass, Pubescent	'Greenleaf'	N/A
	'Luna'	29.0
	'Manska'	21.2
Wheatgrass, RS Hybrid	'Newhy'	24.7

Wheatgrass, Siberian		
	‘Vavilov’	24.4
	‘Vavilov II’	31.0
Wheatgrass, Slender	‘First Strike’	21.0
	‘Pryor’	20.2
	‘Revenue’	N/A
	‘San Luis’	22.7
Wheatgrass, Snake River	‘Discovery’	25.8
	‘Secar’	20.3
Wheatgrass, Streambank	‘Sodar’	21.1
Wheatgrass, Tall	‘Alkar’	17.9
	‘Jose’	18.3
	‘Largo’	N/A
	‘Platte’	N/A
Wheatgrass, Thickspike	‘Bannock’	16.8
	‘Critana’	18.5
	‘Elbee’	N/A
	‘Schwendimar’	15.0
Wheatgrass, Western	‘Arriba’	20.0
	‘Recovery’	17.7
	‘Rodan’	18.7
	‘Rosana’	19.5
Wildrye, Altai	‘Eejay’	N/A
	‘Mustang’	26.0
	‘Pearl’	N/A
	;Prairieland’	19.1
Wildrye, Basin	‘Continental’	16.8
	‘Magnar’	18.5
	‘Trailhead’	17.5
	Washoe Germplasm	18.5
Wildrye, Blue	‘Arlington’	N/A
	Little Naches Germplasm	29.2
	Union Flat Germplasm	27.2
Wildrye, Canada	‘Mandan’	25.3
Wildrye, Mammoth	‘Volga’	16.3
Wildrye, Manystem	‘Shoshone’	36.4
Wildrye, Russian	‘Bozoisky-Select’	23.6
	‘Bozoisky II’	23.8
	‘Crabtree’	N/A
	‘Mankota’	19.0
	‘Swift’	N/A

Forbs and Legumes		
Common Name	**Release Name**	**Pounds per Bushel**
Alfalfa	Multiple varieties	60.0
Aster	Wildland collections	N/A
Balsamroot, Arrowleaf	Wildland collections	N/A
Burnet, Small	'Delar'	23.1
Clover	Common	60.0
Clover, Alsike	'Aurora'	N/A
Clover, Red	'Big Bee'	N/A
	'Dollard'	N/A
	Kenland'	N/A
	'Redman'	N/A
	'Reddy'	N/A
Clover, Strawberry	'Salina'	N/A
Clover, White	'Ladino'	N/A
	'Grassland Huia'	N/A
	'Kent Wild'	N/A
	''New York'	N/A
Coneflower, Prairie	Stillwater Germplasm	33.1
Dustymaiden, Douglas'	Wildland collections	4.0
Flax, Blue	'Appar'	46.1
Flax, Lewis	Maple Grove Germplasm	38.8
Globemallow	Wildland collections	23.5
Milkvetch, Basalt	NBR-1 Germplasm	60.4
Milkvetch, Cicer	'Lutana'	65.3
	'Monarch'	N/A
	'Windsor'	N/A
Penstemon, Firecracker	Richfield Germplasm	34.8
Penstemon, Fuzzytongue	Old Works Germplasm	40.1
Penstemon, Palmer	'Cedar'	53.9
Penstemon, Rocky mountain	'Bandera'	27.5
Penstemon, Venus	Clearwater Germplasm	30.6
Phacelia, Silverleaf	Wildland collections	59.1
Prairie clover, White	Antelope Germplasm	63.8
Sagewort, Louisiana	'Summit'	N/A
Sainfoin	'Eski'	N/A
	'Remont'	28.6
Sweetclover	Common	60.0
	'Madrid'	N/A
Sweetvetch, Utah	'Timp'	50.0
Tansyaster, Hoary	Wildland collections	3.0
Trefoil, Birdsfoot	Common	62.0
	'Empire'	N/A
	'Maitland'	N/A
Yarrow	Eagle Germplasm	37.0
	Great Northern Germplasm	20.6
	Yakima Germplasm	36.0

Shrubs and sub-shrubs.		
Common Name	**Release Name**	**Pounds per Bushel**
Bitterbrush, Antelope	‘Fountain Green’	N/A
	‘Lassen’	N/A
	Maybell Source	32.5
Buckwheat, Whorled	Wildland collections	45.6
Buckwheat, Snow	‘Umatilla’	43.9
Buckwheat, Sulphur	Wildland collections	42.8
Cinquefoil, Shrubby	Wildland collections	N/A
Sagebrush, Basin Big	Wildland collections	N/A
Sagebrush, Mountain Big	‘Hobble Creek’	N/A
Sagebrush, Wyoming Big	‘Gordon Creek’	N/A
	Wildland collections	10.4
Saltbush, Fourwing	‘Rincon’	16.5
	‘Wytana’	22.7
Shadscale	Wildland collections	20.9
Saltbush, Gardner	Common	20.3
Kochia, Forage	‘Immigrant’	13.6
	‘Snowstorm’	N/A
Rabbitbrush, Yellow	Wildland collections	N/A
Rabbitbrush, Rubber	Wildland collections	1.7
Winterfat	‘Hatch’	N/A
	Open Range Germplasm	33.1
Rose, Woods’	Wildland collections	N/A

Figure 1. Interactive rice hull calculator. Available at http://www.id.nrcs.usda.gov/programs/tech_ref.html#TechNotes



Rice hull calculator for multiple component seed mix of up to 10 components

► Enter data in red columns and boxes

•percentages should be typed as intergers up to two decimal places (ie. 96.75)

•if bulk seeding rate is pre-determined, enter 100 for % of mix

Project Name: Technical Note Example

total acres= 10.00

Pure stand seeding rate

#	Variety	Common Name	Latin	% of mix	lb PLS/acre (see TN 24)	% PLS	lb/bu (see TN 7)	lb PLS/ac PLS*% of mix	bulk seed (lb/ac) PLS/%PLS*100	volume (% of bu) bulk seed/lb/bu*100
1	Rush	intermediate	THIN6	90	10.00	75.00	18.90	9.00	12.00	63.49
2	Appar	blue flax	LIPE2	10	4.00	85.00	46.10	0.40	0.47	1.02
3	fourwing	saltbush	ATCA2	100	0.25	60.00	25.40	0.25	0.42	1.64
4								0.00	0.00	0.00
5								0.00	0.00	0.00
6								0.00	0.00	0.00
7								0.00	0.00	0.00
8								0.00	0.00	0.00
9								0.00	0.00	0.00
10								0.00	0.00	0.00

Total vol. seed=	66.15	(% of bushel)	
Total bulk seed/ac=	12.89	(lb/ac)	
Rice hulls =	12.05	(lb/ac)	
Total mix/ac=	24.93	(lb/ac)	
Drill setting=	2	bushels barley	

Drill Calibration

Drill width=	7	feet
Length of test run=	100	feet
Number of spouts=	12	
Desired grams of mix/spout=	15.16	grams

Required bulk seed for 10.00 acres

1	Rush	120.00	lbs
2	Appar	4.71	lbs
3	fourwing	4.17	lbs
4	0.00	0.00	lbs
5	0.00	0.00	lbs
6	0.00	0.00	lbs
7	0.00	0.00	lbs
8	0.00	0.00	lbs
9	0.00	0.00	lbs
10	0.00	0.00	lbs

Required rice hulls= 120.46 lbs

multiple component mixes