UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
BRIDGER, MONTANA

and

MONTANA AGRICULTURAL EXPERIMENT STATIONS
MONTANA STATE UNIVERSITY
BOZEMAN, MONTANA

and

WYOMING AGRICULTURAL EXPERIMENT STATIONS
UNIVERSITY OF WYOMING
LARAMIE, WYOMING

in cooperation with the

DEER LODGE VALLEY CONSERVATION DISTRICT
MONTANA ASSOCIATION OF CONSERVATION DISTRICTS
DEER LODGE, MONTANA

NOTICE OF RELEASE OF NAME GERMPLASM SILVERLEAF PHACELIA, *PHACELIA HASTATA* SELECTED CLASS OF NATURAL GERMPLASM

The U.S. Department of Agriculture, Natural Resources Conservation Service-Bridger Plant Materials Center, Montana Agricultural Experiment Stations-Montana State University, and Wyoming Agricultural Experiment Stations-University of Wyoming in cooperation with the Deer Lodge Valley Conservation District, announce the Selected Class pre-varietal release of Name Germplasm silverleaf phacelia, *Phacelia hastata,* for use in the intermountain foothills and mountains of central Montana and Wyoming, with particular emphasis on areas characterized by soils with low pH and contamination by heavy metals. This release was evaluated and jointly selected by staff from the Deer Lodge Valley Conservation District and USDA/NRCS Plant Materials Center, Bridger, Montana.

As a pre-varietal release, this selection will be referred to as Name Germplasm silverleaf phacelia NRCS accession number 9081632, and PI number XXXXXX.

The alternative release is justified based on a critical need for well-adapted plant materials for non-amended, as well as lime-amended, acidic and heavy-metal contaminated sites in low- to

mid-mountain elevations in the foothills of central Montana and Wyoming. This selection of silverleaf phacelia originates from the contaminated site in which it is intended to be used. There is no other release of silverleaf phacelia adapted to the severe conditions characteristic of the critical area to be reclaimed. It is also anticipated this release will perform well on non-contaminated sites given similar environmental and climatic conditions. Name Germplasm silverleaf phacelia was selected for superior seedling survival, vigor rating, and mean height growth relative to the other silverleaf phacelia accession tested, and its superior performance compared to other forbs tested at the site. Name Germplasm silverleaf phacelia can also be used in other conservation applications such as providing pollinator habitat, wildlife habitat enhancement, and mine land reclamation.

Site Information: The original silverleaf phacelia (accession number 9081632) seed collection was made on July 29, 1998, and on August 6, 1998 by Leslie Marty, then Development of Acid-Tolerant Cultivars (DATC) Project Leader. The collection site is located in Deer Lodge County within the Anaconda Smelter Superfund Site, north of Montana Highway 569 junction with Montana Highway 1 near Anaconda, Montana, at an elevation of 5,081 feet (1.5 kilometers). The approximate latitude/longitude is North 46º07'23" West 112º52'28". The original donor plants were found growing in association with slender wheatgrass *Elymus trachycaulus,* redtop *Agrostis gigantea,* scarlet globemallow *Sphaeralcea coccinea*, and western wheatgrass *Pascopyrum smithii*. The mean annual precipitation at the site ranges from 10 to 13 inches (25.4 to 33.0 centimeters) with most of the precipitation occurring in late spring to early summer. The mean frost free period is 90 to 105 days. The parent material is alluvium. The soil has a gravelly loam texture and is well drained. The slope at the plot site averages 5 to 10 percent. Aerial emissions from past copper smelting operations have resulted in elevated levels of heavy metal and sulfur compounds in the soil at the collection site. Laboratory analyses of a soil sample taken at the collection site are presented in Table 1.

Table 1. Laboratory analysis of a soil sample from the Name Germplasm collection site.

Sample No.	pH	As	Cd	Cu	Pb	Zn	Conductivity	Texture
	S.U.	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mmhos/cm*	
Collection site	5.7	246	9	724	175	477	0.23	Sandy loam
Phytotoxic Criteria†	<5.0	136-315	5.1-20	236-750	94-250	196-240	>4.0	

† Phytotoxic levels accepted by EPA (CDM Federal 1997).

Figure 1. Silverleaf phacelia NRCS photo

Description: Silverleaf phacelia (Figure 1) is a perennial taprooted forb with one to several prostrate to nearly erect stems that are 20 to 40 inches (50 to 100 centimeters) long. The stems and leaves are covered with fine, short, silvery hairs. Leaves are simple with prominent pinnate venation and margins are usually entire, although some leaves may have a pair of small lateral lobes at the base of the blade. Basal leaves are numerous and tufted and narrowly to broadly elliptic in shape tapering to long petioles. Stem leaves are reduced in size and become sessile on the upper stems. Flowers are an inflorescence of short compact coiled clusters. The corolla is lavender, 5-lobed, 0.2 to 0.3 inches (4 to 7 millimeters) long and broad. The fruit is a capsule, 2-chambered, with several seeds per chamber. Name Germplasm silverleaf phacelia has approximately 153,000 seeds per pound (69,400 seeds per kilogram).

Method of Breeding and Selection: Name Germplasm silverleaf phacelia is being released as a Selected Class Germplasm, i.e., it has been selected and increased without purposeful manipulation. Three studies investigated the establishment, reproduction, and growth of this phacelia species. In the first study, this selection was compared to a nonlocal source of silverleaf phacelia in the Stucky Ridge Comparative Evaluation Planting (CEP) which was installed near Anaconda, Montana in spring 2003. The second study investigated seed pretreatment strategies to help reduce seed dormancy of this selection and maximize germination success. The third study was a greenhouse study testing the performance of this selection in amended and non-amended soils from the Anaconda area. Summaries of the three studies are below. Please note, when Name Germplasm silverleaf phacelia is referenced in this

document prior to final testing and selection, it is identified by its accession number (9081632).

Study I - Stucky Ridge Comparative Evaluation Planting (CEP)

The Stucky Ridge CEP assessed the performance of local, indigenous seed sources of forbs to nonlocal sources of the same species. The study built on earlier research to identify superior accessions within a species capable of tolerating the edaphic and climatic conditions at the impacted site while providing erosion control and wildlife habitat benefits. This study was part of a more comprehensive effort within the Development of Acid/Heavy-Metal Tolerant Cultivars (DATC) project. It was a collaborative effort between the Deer Lodge Valley Conservation District and the USDA-NRCS Plant Materials Center in Bridger, Montana, initiated in 1995 and supported over various grant cycles by the Environmental Protection Agency and Montana Natural Resource Damage Program (Deer Lodge Valley Conservation District 2008).

A local source of silverleaf phacelia (9081632) was compared with a nonlocal seed source (9082275) originating from California. The nonlocal source was the only available seed source of this species at the time. Both collections were field planted in 2003 on Stucky Ridge near Anaconda, Montana, then tested and evaluated annually for 6 years from 2003 through 2008 (Table 6). The 9081632 accession of silverleaf phacelia exhibited good seedling survival, vigor rating, and mean plant height on an amended acidic/heavy-metal impacted site under the ambient climatic conditions of the Upper Clark Fork Watershed (Deer Lodge County, Montana). The silverleaf phacelia accession from California died within three years of planting. Plant Materials Technical Note No. MT-111, *Stucky Ridge Comparative Evaluation Planting*, describes in detail the Stucky Ridge CEP study in which silverleaf phacelia 9081632 was tested. A synopsis of the Stucky Ridge CEP is provided below.

Stucky Ridge Comparative Evaluation Planting

Fourteen forb accessions representing 5 forb genera, and 2 subshrub accessions representing 1 subshrub species were tested in the Stucky Ridge CEP (Table 4). Two accessions of silverleaf phacelia were among the 14 forbs tested.

Methods and Materials:

On August 27, 2001, prior to plowing, four soil samples were collected by bulking 0- to 6-inch (0- to 15.2-centimeter) composite subsamples taken from separate quadrants of the plot. Soil contaminants in this area are concentrated in the upper 2 inches (5.1 centimeters) of the soil

profile. The soil samples were analyzed for pH, oxidation/reduction potential (Eh), total arsenic (As), cadmium (Cd), copper (Cu), lead (Pb), and zinc (Zn) concentrations. A randomly chosen sample was analyzed for electrical conductivity and soil texture.

Laboratory analysis of the four soil samples indicated that the average 0- to 6-inch (0- to 15.2-centimeter) composite pH was 5.7 (Table 1). Arsenic and metal levels were generally moderate with the exception of copper. Copper concentrations ranged from 485 to 706 milligrams per kilogram and averaged 560 milligrams per kilogram. The copper concentration in the soil exceeded the Maximum Tolerable Levels for wildlife (55 milligrams per kilogram), Maximum Tolerable Levels for domestic livestock (100 milligrams per kilogram), and the 'Excessive or Toxic' metal level for plants (20 to 100 milligrams per kilogram) (Table 2 & Table 3).

Table 2. Maximum Tolerable Levels of Five Metals for Domestic Livestock, and Wildlife.

Maximum Tolerable Levels for	**As**	**Cd**	**Cu**	**Pb**	**Zn**
	mg/kg	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*
Domestic livestock [1]	50	0.5	100	30	500
Wildlife [2]	50	2	55	40	300
1. NRC 1980, 2. Ford, 1996.					

Table 3. Metal Levels in Plants.

Metal levels in Plants [1]	**As**	**Cd**	**Cu**	**Pb**	**Zn**
	mg/kg	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*
Deficient			2 to 5		
Sufficient or Normal	1 to1.7	0.05 to 0.2	5 to 30	5 to 10	27 to 150
Excessive or Toxic	5 to 20	5 to 30	20 to 100	30 to 300	100 to 400
1. Kabata-Pendias and Pendias 1992.					

Plant Materials Technical Note No. MT-117, *Heavy Metal Analysis of Plants Tested in the Stucky Ridge Comparative Evaluation Planting*, describes the analysis of plant tissues from Stucky Ridge for heavy metal concentration.

Soil Treatment

Prior to planting, 22 tons per acre (49.3 metric tons per hectare) of lime kiln dust was disked to a 6-inch (15.2-centimeter) depth in November 2002. In spring 2003, commercial fertilizer (12% N, 16% P_2O_5, 30% K_2O) was applied at a rate of 500 bulk pounds per acre (560.4 kilograms per hectare) and incorporated to 6 inches (15.2 centimeters) using a chisel plow.

Figure 2. Drill seeding plots in the Uplands Study near Stucky Ridge, October 24, 2001. Photograph by NRCS.

On May 13, 2003, each seed lot was planted with a 4-row Kincaid™ cone drill with 14-inch (35.6-centimeter) between-row spacing and a 0.5-inch (1.3-centimeter) planting depth, in the same manner as the Uplands seeding pictured (Figure 2). The seeding rate for the grass and forb/subshrub trials was 50 Pure Live Seeds (PLS) per linear foot (30.5 centimeters) of row.

Sampling Methods

Seedling density was the growth response variable used to assess performance during the first growing season (2003). Measurements were taken using a 11.8-inch (30-centimeter) x 19.7-inch (50-centimeter) quadrat frame that was randomly placed at five sample locations within each 8-foot (2.4-meter) x 25-foot (7.6-meter) treatment block. The quadrat was situated with its long axis perpendicular to the seeded rows so each sampling measurement included two rows. Seedlings rooted within the quadrat frame were counted. Seeded seedlings, as well as non-seeded seedlings, were counted and recorded separately. Seedling density data was collected on June 24, 2003 to assess emergence and initial establishment, and on August 25, 2003 to assess subsequent establishment and/or mortality (Table 5).

Stucky Ridge Comparative Evaluation Planting (NRCS photo)

Data Analysis

By the second growing season (2004), only plants of Open Range winterfat *Krascheninnikovia lanata* and 9081632 silverleaf phacelia remained alive in the woody plant and forb portion of the study. There were no signs of new emergence of any accessions/species in spring 2004. After the third growing season (2005), plants of Open Range winterfat; 9081632-silverleaf phacelia; Old Works Germplasm fuzzytongue penstemon *Penstemon eriantherus;* Richfield firecracker penstemon *Penstemon eatonii;* and Northern Cold Desert winterfat *Krascheninnikovia lanata,* were found surviving. The surviving 9081632 silverleaf phacelia exhibited good vigor, cover, and seed production (Table 6).

Conclusions/Discussion

Initial forb establishment at Stucky Ridge was less than the grasses in the other part of the study. The initial lack of forb emergence may be due in part to the May 13 planting date. Some forb species in the study, including silverleaf phacelia, have a physiological (after ripening) or physical (hard seed coat) seed dormancy that require a dormancy breaking treatment, such as cold, moist chilling. To overcome seed dormancy, several of the tested forbs require several weeks (8 to 14 weeks) of cold: moist chilling, a condition that would not have been met until the following spring. By 2005, Old Works fuzzytongue penstemon was the forb with the highest seedling density, followed by 9081632 silverleaf phacelia.

Table 4. Forb and subshrub treatments included in the forb/subshrub trial near Anaconda, Montana, at the Stucky Ridge Comparative Evaluation Planting.

Genus & Species	Accession/Variety	Origin
Eriogonum ovalifolium	9082098	Deer Lodge County, MT
Eriogonum umbellatum	9082271	Utah
Eriogonum umbellatum	9082273	Idaho
Krascheninnikovia lantana	Northern Cold Desert	Composite from UT & ID
Krascheninnikovia lantana	Open Range	Composite from MT & WY
Penstemon eriantherus	Old Works Germplasm	Deer Lodge County, MT
Penstemon eatonii	Richfield Selected	Sevier County, UT
Penstemon strictus	'Bandera' 477980	Torrance County, NM
Penstemon venustus	Clearwater Selected	Clearwater River area, ID
Phacelia hastata	9081632	Deer Lodge County, MT
Phacelia hastata	9082275	California
Potentilla gracilis	9081679	California
Potentilla hippiana	9076274	Deer Lodge County, MT
Symphyotrichum chilense	9078675	Deer Lodge County, MT
Symphyotrichum chilense	9081678	Colorado
Symphyotrichum chilense	9082274	Unknown

Table 5. Mean seedling density (2003), percentage stand (2004), and total plant density (2005) of forb and subshrub accessions. (Evaluated 6/24/03, 8/25/03, 6/30/04, 9/22/04, and 8/30/05).

Genus & Species	Variety/Accession	2003 Seedling Density		2004 Percentage Stand		2005 Plant Density
		6/24	8/25	6/30	9/22	8/30
		per ft²‡	*per ft²*	*%*	*%*	*no./plot*
Eriogonum ovalifolium	9082098	0	0	0	0	0
Eriogonum umbellatum	9082271	0.1	0	0	0	0
Eriogonum umbellatum	9082273	0	0	0	0	0
Krascheninnikovia lanata	Open Range Germplasm	9.5	6.8	5.5	4.5	20.0
Krascheninnikovia lanata	Northern Cold Desert Germplasm	0.2	0.2	0	0	0.3
Penstemon eatonii	Richfield Select	0	0	0	0	0.8
Penstemon eriantherus	Old Works Germplasm	0	0	0	0	15.0
Penstemon strictus	'Bandera'	0.2	0	0	0	0
Penstemon venustus	Clearwater Selected	0	0	0	0	0
Phacelia hastata	9081632	0.3	0.2	0.5	0.5	6.0
Phacelia hastata	9082275	0	0	0	0	0
Potentilla gracilis	9081679	0	0	0	0	0
Potentilla hippiana	9076274	0	0	0	0	0
Symphyotrichum chilense	9078675	0	0	0	0	0
Symphyotrichum chilense	9081678	0	0	0	0	0
Symphyotrichum chilense	9082274	0	0	0	0	0

‡ - To convert to square meters multiply the value by 0.1

Table 6. Mean percentage cover/stand, vigor rating, height, and biomass of *Phacelia hastata* accessions tested at Stucky Ridge, Anaconda, MT, from 2004 through 2008.

Year	Accession	Mean % Cover/ Stand	Mean Vigor Rating	Mean Height	Mean Biomass
		%	*(1-9)**	*cm*	*kg/ha*
2004	PHHA 9081632	3.94	2.44	3.94	no data
2005	PHHA 9081632	6.00	2.75	16.67	no data
2006	PHHA 9081632	0	0	0	no data
2007	PHHA 9081632	0.50	5.00	no data	22.22
2008	PHHA 9081632	no data	no data	no data	no data
2004	PHHA 9082275	0	0	0	no data
2005	PHHA 9082275	0.50	3.00	25.00	no data
2006	PHHA 9082275	0	0	0	no data
2007	PHHA 9082275	0	0	0	no data
2008	PHHA 9082275	0	0	0	no data

*Vigor rating: 1 = best vigor: 4 = average vigor; 9 = dead

Study II - Silverleaf Phacelia (9081632) Germination Study

There is evidence that silverleaf phacelia seeds require a period of cold: moist stratification to overcome dormancy and germinate. Other sources indicated that seed coat scarification may also improve germination (Dougher, 2012). A replicated study was initiated in 2016 to investigate potential dormancy breaking pretreatments for silverleaf phacelia accession (9081632). A randomized complete block design with four replicates, each with 100 seeds, was sown in containers comparing two durations of seed coat scarification (none versus 360 seconds) and three intervals of cold: moist chilling (stratification) (none, 30-day, 60-day).

The results of the study suggest that late spring to early summer sowing of silverleaf phacelia seeds without seed coat scarification and/or cold chilling will result in negligible germination (Figure 4).

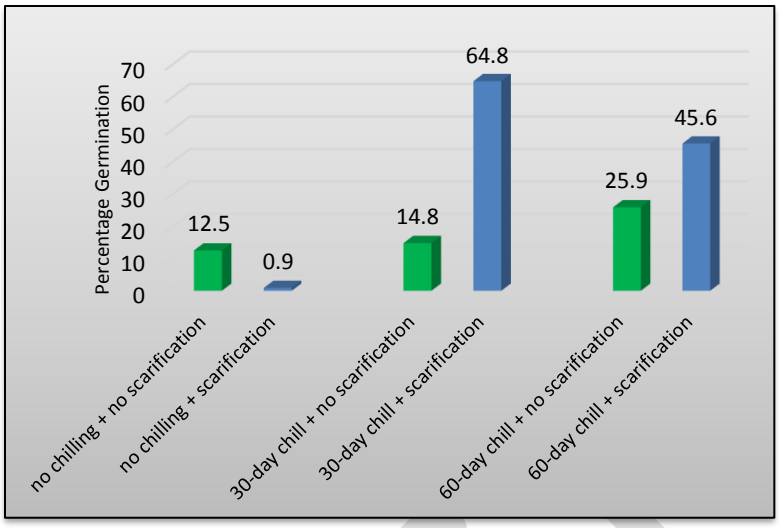


Figure 4. Mean percentage germination of tetrazolium viable seeds

Fall planting of silverleaf phacelia at the Bridger Plant Materials Center (BPMC) in Bridger, Montana resulted in adequate germination the following spring, suggesting the extended winter chilling period is adequate for overcoming seed dormancy. Dormant fall (after approximately November 1) or late winter (February through March) sowing of scarified (90 to 360 seconds with 40 grit sandpaper) seeds of silverleaf phacelia appeared to be the best seed dormancy breaking strategies for field applications. The study is discussed in detail in Plant Materials Technical Note No. MT 110, *Reducing Seed Dormancy in Silverleaf Phacelia*, *Phacelia hastata*.

Study III - Performance of *Phacelia hastata* (9081632) on Amended and Non-amended Soils from Stucky Ridge, Anaconda, MT. Study III

This study was designed to test the performance of 9081632 silverleaf phacelia on amended, and non-amended soils from Stucky Ridge within the Anaconda Superfund site under controlled greenhouse conditions. The original seed collection of Name Germplasm silverleaf phacelia came from plants found growing naturally in the contaminated soils of the Anaconda Superfund site.

Silverleaf phacelia seed originating from the Anaconda site was subsequently increased at the BPMC and used in the study. The seed was sown in amended and non-amended soil collected from Stucky Ridge, soil from the seed increase field at the BPMC, and in commercial peat based growing media. The study utilized 7-cubic-inch (114.7 cubic centimeters) Cone-tainers®, arranged in trays containing 200 individual cells. The study utilized a randomized complete block design replicated 4 times (Table 7).

Table 7. Trials

Treatment	Number of Cones per Treatment per Rep	Total Number of Containers per Treatment
Phacelia hastata - amended soil	50 cones	200
Phacelia hastata - non-amended soil	50 cones	200
Phacelia hastata - control soil BPMC	50 cones	200
Phacelia hastata - growth media	50 cones	200
Phacelia hastata - amended soil + organic matter	50 cones	200
Phacelia hastata - non-amended + organic matter	50 cones	200
	Total:	1200

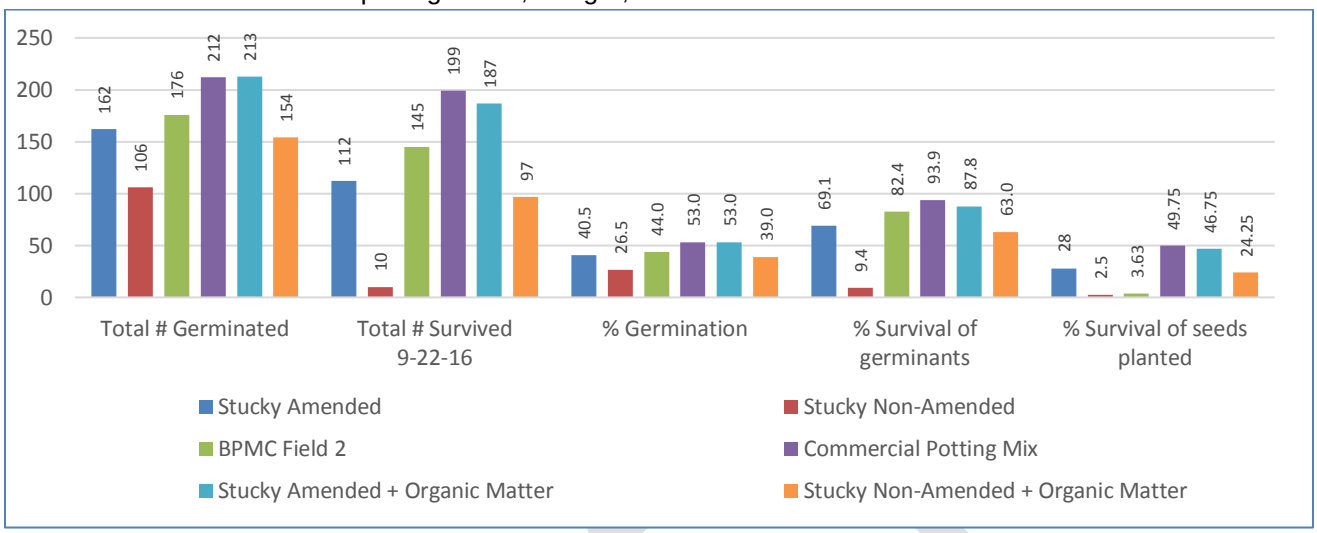
Containers were filled with borrow soil to within 0.5 inch (1.27 centimeters) of the top. On April 18, 2016, silverleaf phacelia seed was planted 1/8-inch (0.3-centimeters) deep with 2 seeds per cone. The cones were randomized in trays and placed in a cooler set at 37.4°F (3°C) for 120 days. The cone trays were monitored bimonthly for signs of germination. Following the 120-day stratification period the cone trays were placed on a greenhouse bench under full sunlight. The greenhouse was maintained at 75.2 to 80.6°F (24 to 27°C) for 16 hours and 64.4 to 69.8 °F (18 to 21°C) nights for 8 hours. In two of the trials (Table 7), Eko Compost® organic matter was mixed at 5% concentration by weight with the borrow soil from Stucky Ridge. The use of organic matter as an amendment to mine impacted soils results in an increase in soil pH and a decreased mobilization of some metals (Munshower, F.F. 2003).

Across all media types, five months after planting, 42.7% of the seed germinated, and 67.6% of emerging seedlings survived to grow into mature plants (Table 8 and Figure 5).

Table 8. Total germination, total survival, mean percentage germination, and mean percentage survival of *Phacelia hastata* in various potting media, Bridger, Montana. 2016.

Media Type	Total Number Germinated	Total Number Survived 9-22-16	Percentage Germination	Percentage Survival of Germinants	Percentage Survival of Seeds Planted
			%	%	%
1 - Stucky Ridge Soil Amended	162.0	112.0	40.5	69.1	28.0
2 - Stucky Ridge Soil Non Amended	106.0	10.0	26.5	9.4	2.5
3 - BPMC Field 2 Soil	176.0	145.0	44.0	82.4	3.6
4 - Commercial peat-based potting media	212.0	199.0	53.0	93.9	49.8
5 - Stucky Amended + Organic Matter	213.0	187.0	53.0	87.8	46.8
6 - Stucky Non Amended + Organic Matter	154.0	97.0	39.0	63.0	24.3
Average:	170.5	125.0	42.7	67.6	31.3

Figure 5. Total germination, total survival, mean percentage germination, and mean percentage survival of *Phacelia hastata* in various potting media, Bridger, Montana. 2016.



Additional Studies: Silverleaf phacelia 9081632 was also tested in other on- and off-Center studies and field plantings, including two Montana State University graduate studies. In the first study, *Increasing Harvestability of Phacelia hastata Seed Using Plant Growth Regulators*, four plant growth regulator formulations were tested for their effect on seed yield, seed quality, and plant growth characteristics. Two foliar applications of paclobutrazol, at a rate of 30 parts per million at the one-month rosette stage and then again three weeks later, increased seed yield of silverleaf phacelia in thinned plots by 337%. In plots treated with ethephon, seed shatter was eliminated but seed yield and germination decreased. Results suggest foliar sprays of the plant growth regulator paclobutrazol regulate the flowering process of, and increase harvestable seed from *P. hastata* (Keating, 2014).

In the second graduate study with silverleaf phacelia 9081632 titled *Establishment and Seed Production of Native Forbs Used in Restoration*, the impact of pre- and post-emergence herbicides alone and in combination with hand weeding was assessed on 5 wildflower species. The objectives of the study were to 1) determine wildflower seedling tolerance to post-emergence herbicides and 2) evaluate the effect of pre-and post-emergence herbicides on native wildflower seedling establishment, weed control, and wildflower seed production. In the greenhouse phase of the study, silverleaf phacelia was susceptible to all tested broadleaf herbicides with only pendimethalin resulting in unacceptable injuries less than 50% of the time. Statistical tests indicated that while plants sprayed with linuron or pendimethalin had similar fresh and dry biomass to the control, imazapic and halosulfuron applications decreased fresh

(*P*<0.001 and *P*=0.009, respectively) and dry biomass (*P*=0.023 and *P*=0.001, respectively) compared with the untreated control. Plants sprayed with halosulfuron also had lower fresh biomass when compared to pendimethalin (*P*=0.024). Plants treated with imazapic had a lower fresh biomass than pendimenthalin (*P*=<0.001) and linuron (*P*=0.013). Furthermore, dry biomass for plants treated with imazapic was lower than for those treated with linuron or pendimethalin (*P*=0.011 and *P*<0.001, respectively) (Wiese, 2009).

In the field phase of the second study, test plots were established at Montana State University in Bozeman, Montana, and at the USDA-NRCS Plant Materials Center in Bridger, Montana. Results indicated site to site variation was important and that wildflower species responded uniquely to weed management. Emergence of silverleaf phacelia and other test species were negatively affected by trifluralin (Wiese, 2009).

Evaluation Planting: As part of a larger Initial Evaluation Planting, 10 accessions of silverleaf phacelia from Montana and Wyoming, including 9081632, were evaluated at the Bridger Plant Materials Center from 2004 through 2008 (Table 9). These were small, non-replicated plots of seeded wildland collections planted in non-contaminated soil in an attempt to assess performance on soils not impacted by acid and heavy metal contamination. Depending on the year, plant height, percentage stand, vigor rating, and percentage flowering were evaluated (Table 10). Silverleaf phacelia 9081632 varied in mean height, percentage stand, and vigor rating over time, as did the other accessions tested. In three of four years of testing, accession

Table 9. Origin of Phacelia hastata accessions in Initial Evaluation Planting, BPMC, 2005-2008.

Accession Number	Species	County	State
9078432	*Phacelia hastata*	Deer Lodge	MT
9078436	*P. hastata*	Park	MT
9081632	*P. hastata*	Deer Lodge	MT
9081669	*P. hastata*	Rosebud	MT
9081670	*P. hastata*	Big Horn	MT
9081671	*P. hastata*	Powder River	MT
9081675	*P. hastata*	Sublette	WY
9081829	*P. hastata*	Wheatland	MT
9081830	*P. hastata*	Powder River	MT
9082290	*P. hastata*	Mineral	MT

9081632 had above average height and percentage stand compared to the other accessions. In 2006, mean percentage stand measured 100% (highest in study) and mean vigor rating measured “1” (tied for highest in study). Mean percentage flowering (only assessed in 2007) of 9081632 measured 80%, one of the highest flowering percentages of the accessions tested, and well above the overall mean of 48.5%. Climatic conditions, the amount and timing of annual precipitation, are largely thought to be responsible for annual trends in performance.

Table 10. Mean *Phacelia hastata* evaluation data, Initial Evaluation Planting, BPMC, 2005-2008.

		2005		2006	2006		2007	2007	2007		2008	2008
	2005	Mean	2006	Mean	Mean	2007	Mean	Mean	Mean	2008	Mean	Mean
Accession	Mean	Percentage	Mean	Percentage	Vigor	Mean	Percentage	Vigor	Percentage	Mean	Percentage	Vigor
Number	Height	Stand	Height	Stand	Rating	Height	Stand	Rating	Flowering	Height	Stand	Rating
	cm	*%*	*cm*	*%*	*(1-9)**	*cm*	*%*	*(1-9)**	*%*	*cm*	*%*	*(1-9)**
9078432	10	75	20	90	4	30	75	3	90	23	50	3
9078436	15	50	55	80	1	25	20	5	70	37	25	6
9081632	10	75	35	100	1	26	40	5	80	32	70	4
9081669	15	75	25	40	5	20	70	2	10	30	100	2
9081670	12	60	25	70	5	23	80	2	90	40	100	1
9081671	10	85	20	40	4	30	80	1	60	25	85	2
9081675	10	50	25	90	2	12	40	5	40	20	50	4
9081829	10	50	20	15	7	20	45	4	35	35	90	2
9081830	NA	0	NA	0	NA	15	60	4	5	32	90	2
9082290	9	30	45	55	5	20	40	5	5	31	5	6
Grand Mean	11.2	55	30.0	58.0	3.8	22.1	55.0	3.6	48.5	30.5	66.5	3.2

* "1" indicates best or highest.

In off-Center plantings evaluations of silverleaf phacelia 9081632 on non-contaminated sites by the Idaho PMC, emergence and initial establishment tended to be “fair” to “good”, but stand persistence was “poor” (Tilley, 2017). In a planting at Coffee Point, near Aberdeen, Idaho, establishment was “fair” (0.28 plants per foot), but plants did not survive long enough to flower. Annual precipitation that year measured only 7 inches which may have contributed to its rating and survival. In another planting in Skull Valley near Tooele, Utah, first year precipitation measured approximately 3 inches, and only 0.03 silverleaf phacelia plants per foot established but then died. In a third planting at the Curlew National Grassland in Power County, Utah, early establishment was relatively good (3.3 plants per square meter) but then declined quickly with each subsequent year (Tilley, 2014).

Ecological Considerations and Evaluation: Silverleaf phacelia is a tap-rooted perennial that colonizes sandy or gravelly, dry mineral substrate, or disturbed soil from the foothills to above timberline. It is common in rocky gullies or outcrops within valley grasslands. It blooms from May through September, providing a food source for pollinators. The NRCS Plant Materials Program, Environmental Evaluation of Plant Materials Releases has rated silverleaf phacelia as follows:

- "Low" chance to adversely affect habitats, ecosystems, and agricultural areas;
- "Easy" rating for the degree of management which might be needed to control the species or release if it becomes a problem, or eradicate the species or release if it is no longer desirable;
- "High" rating for the importance of the species or release to meet a conservation needs; and
- "High" chance that silverleaf phacelia will propagate and maintain itself under natural conditions.

Conservation Use: Name Germplasm silverleaf phacelia is intended primarily for use on severely impacted sites with low pH and high concentrations of heavy metals, although it performs well and can be used on non-impacted sites as well. It can be used in the following conservation practices:

*Wildlife**:***

Provides pollen and nectar for native bees and other beneficial insects during an extended blooming period (May through September).

*Mine land Reclamation**:***

Name Germplasm silverleaf phacelia is valuable in the revegetation of disturbed sites. Name Germplasm silverleaf phacelia was originally collected from plants growing near Anaconda, Montana on soils impacted by smelter emissions and is therefore well suited for this purpose. Name Germplasm silverleaf phacelia has exhibited tolerance and adaptation to acid soils (pH range 4-5) and the presence of heavy metals. The species provides excellent soil erosion control.

Insect Control:

Incorporating Name Germplasm silverleaf phacelia into a planting mix increases the nectar and pollen available for beneficial predatory insects. This enhances the biological control of pest species (Hickman 1996).

Landscaping:

The attractive lavender flowers, long blooming period, and drought tolerance make this an excellent species to use in xeriscaping plans.

Area of Adaptation: Name Germplasm performs well in loamy to sandy soils in the foothills of the Anaconda Smelter Superfund Site on soil impacted by acid and heavy-metal contamination, and in annual precipitation zones of 12 to 14 inches (30.5 to 35.6 centimeters) average. It is expected to perform well on sites with similar soil, climate, and topographical conditions, such as in the foothills and intermountain valleys of the Northern Rocky Mountains. The original seed source was collected in MLRA 44. It may perform well in other regions where silverleaf phacelia is adapted. Silverleaf phacelia is commonly found in dry, open terrain from the prairies into the mountains from approximately 2,000 to 8,000 feet (610 to 2,438 meters). It ranges from eastern Oregon and Washington, southern British Columbia and Alberta to South Dakota, Wyoming, and the mountainous area of northern Colorado (Figure 6).

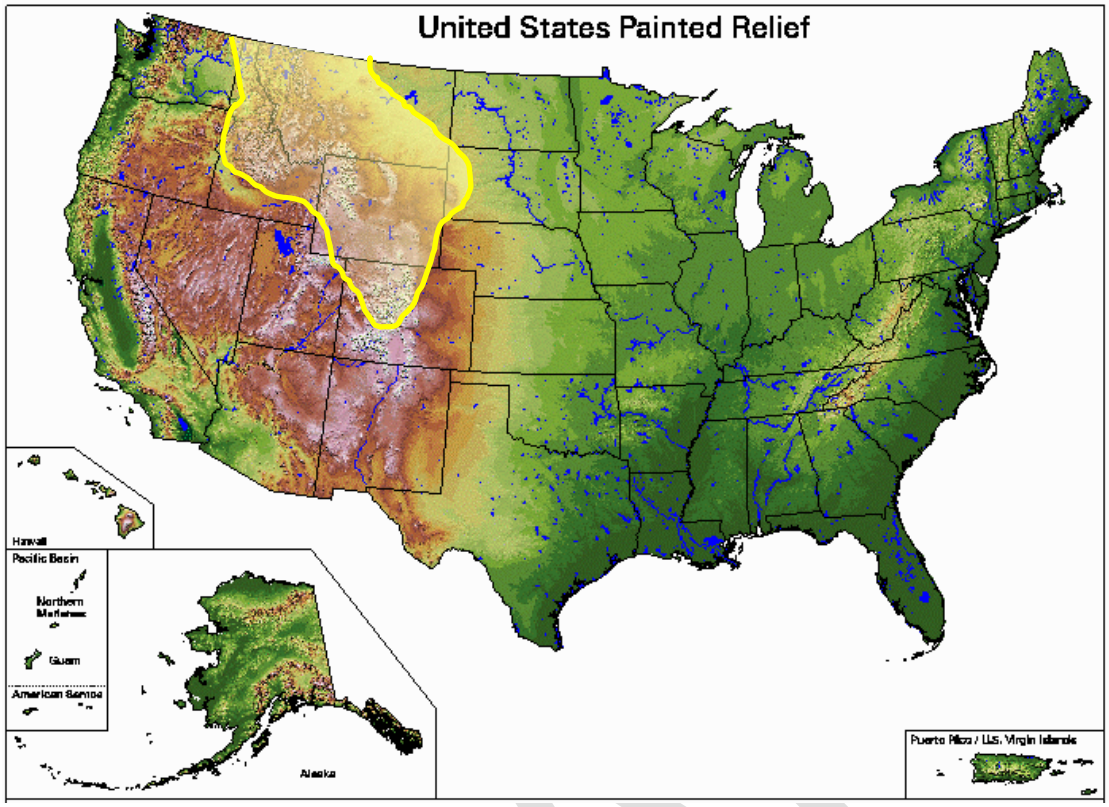


Figure 6. Anticipated range of adaptation of Name Germplasm silverleaf phacelia.

Availability of Plant Materials: Generation G1 (equivalent to Foundation) seed of Name Germplasm silverleaf phacelia is available to commercial growers from the USDA-Natural Resources Conservation Service (NRCS), Plant Materials Center in Bridger, Montana, through the Foundation Seed Stocks Program at Montana State University-Bozeman or the University of Wyoming Foundation Seed Service at Powell, Wyoming. Commercial production of two generations (G2 and G3) beyond G1 is allowed.

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Signatures for release of:

Name Germplasm silverleaf phacelia (*Phacelia hastata*)

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Lisa Coverdale State Conservationist Natural Resources Conservation Service Bozeman, Montana	Date
Astrid Martinez State Conservationist Natural Resources Conservation Service Casper, Wyoming	Date
Dr. Charles Boyer Director Montana Agricultural Experiment Station Montana State University Bozeman, Montana	Date
Bret Hess Director Wyoming Agricultural Experiment Station University of Wyoming Laramie, Wyoming	Date
Terrell Erickson Director, Ecological Sciences Division United States Department of Agriculture Natural Resources Conservation Service Washington, DC	Date