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Evaluation of Spring Seeded Cover Crops in Colorado, Montana and North Dakota



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Preface

The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Plant Materials Program has been involved in the evaluation of conservation plants and planting technology for more than 80 years.

Plant Materials Centers in Bridger, MT, Bismarck, ND and the Upper Colorado Environmental Plant Center, Meeker, CO conducted a 2-year evaluation of over 50 commercially available varieties of black oats, black seeded oats, cereal rye, crimson clover, daikon radish, hairy vetch, red clover, and winter/field pea to assess their adaptation and performance as spring seeded cover crops. Information from the study will assist conservation planners and farmers in selecting varieties to meet the cover crop objectives of their production systems.

For additional information on specific species of plants mentioned in this publication, please see the USDA PLANTS database at: (<http://plants.usda.gov/java/>) or contact the nearest Plant Materials Center or plant materials specialist (<http://plant-materials.nrcs.usda.gov/contact/>) and/or the Land Grant Universities that serve the State. For specific information on soils and soil health, please see USDA NRCS soils website at: (<http://www.nrcs.usda.gov/wps/portal/nrcs/site/soils/home/>). Also, see technical resources on the National Plant Materials Program Web site at: (<http://www.plant-materials.nrcs.usda.gov/>).

Evaluation Locations



INTRODUCTION

Producers rely on the latest crop variety trials to make informed decisions on planting the best adapted crop variety to maximize yield given their soils and production practices. With the ever-growing interest in planting cover crops, the USDA-Natural Resources Conservation Service (NRCS) Plant Materials Program initiated a nationwide study to identify adapted varieties of cool season annual species for cover cropping. With input from State Agronomists and State Soil Health Specialists, seven cool season annual cover crop species were identified for comparative evaluations using the network of NRCS Plant Materials Centers (PMCs) and the Upper Colorado Environmental Plant Center (UCEPC). Commercially available varieties of black oats, black seeded oats, cereal rye, crimson clover, daikon radish, hairy vetch, red clover, and winter/field pea were evaluated for their performance and adaptation to different soils and geographical regions in the U.S. This technical note represents two years of data collected from PMCs in Bridger, MT and Bismarck, ND, and the UCEPC, Meeker, CO. Performance may vary in other locations and years. Information from this study along with local research from university extension and other research entities can assist farmers and conservation planners in selecting adapted cool season annual varieties for their crop production systems. Additional information for each PMC location, including plant height and biomass (where collected), can be found in their final study reports hyperlinked at the end of this document.

CHOOSING VARIETIES FOR CONSERVATION PLANTINGS

Commodity crops are chosen to fit local climate and soil conditions, and producers select varieties of commodity crops carefully to maximize performance and returns. For the producer, variety selection is a dynamic process that takes advantage of the many options available when deciding which varietal attributes best meet their needs. When choosing cover crop varieties, the producer may also take advantage of differences among varieties to best meet the goals of their production system.



When a cover crop species is chosen to meet a resource concern, a variety from that species may be selected to meet needs such as: 1) production of early or late cover, 2) early or late maturity, or 3) winter survival. By choosing varieties based on the production system, cover crop plans and systems can be developed to:

- time planting and termination dates to fit within the cropping system,
- manage soil moisture, nutrient capture and competition of aggressive species,
- develop mixes with species that mature at similar times to facilitate mechanical termination, and
- use maturity dates to regulate the amount of cover crop residue.

Through selection of varieties that fit production systems, producers may overcome obstacles that discourage the use of cover crops.

PROCEDURE

Cool season, annual, cover crop varieties were evaluated at NRCS PMCs in Bismarck, ND; Bridger, MT and at the UCEPC, Meeker, CO in 2017 and 2018 (Table 1). Replicated plots were drilled in the spring after the last frost using the pure live seed planting method (Table 2), and seeding rates were determined by averaging the recommended seeding rates from NRCS cover crop standards and specifications for uniform data analysis (Table 3). Legumes were inoculated with appropriate rhizobia prior to planting. Plots were irrigated for establishment in Meeker, CO both years, and in Bismarck, ND in 2017. Plots were not irrigated in Bismarck, ND in 2018 or any year in Bridger, MT. Plots were fertilized in Meeker, CO while plots were not fertilized in Bismarck, ND or Bridger, MT. Cover crop varieties were evaluated for:

- Emergence at 14 days and 28 after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%
- Maturity date—Days after planting to 50% bloom, data was grouped over the region by <65=Early, 66-79=Mid, >80=Late to identify varietal differences, and
- Disease and insect ranking—Damage observed was None, Low, Moderate, or High.

Table 1. Soil type and total rainfall during the evaluation period in 2017-2018 in Bismarck, ND (April-Oct); Bridger, MT (May-Sept) and Meeker, CO (June-Aug).

Plant Materials Center	Soil type	Rainfall (inches) 2017	Rainfall (inches) 2018
Bismarck, ND	Mandan silt loam	11.3	12.5
Bridger, MT	Heldt silty clay loam	5.3	5.1
Meeker, CO	Work loam	3.7	1.8

Table 2. Planting date/year and planting method in Bismarck, ND; Bridger, MT; and Meeker, CO.

Plant Materials Center	Planting Date (Year)		Planting Method
	2017	2018	
Bismarck, ND	June 5	May 16	Drill
Bridger, MT	May 9	May 8	Drill
Meeker, CO	June 21	May 13	Drill

Table 3. Cover Crop planting rates at NRCS Plant Materials Centers in Bismarck, ND; Bridger, MT; and Meeker, CO.

Common Name	Species	PLS lbs./Acre
black oats	<i>Avena strigosa</i>	60
black seeded oats	<i>Avena sativa</i>	60
cereal rye	<i>Secale cereale</i>	100
crimson clover	<i>Trifolium incarnatum</i>	18
daikon radish	<i>Raphanus sativus</i>	9
hairy vetch	<i>Vicia villosa</i>	18
red clover	<i>Trifolium pratense</i>	9
winter/field pea	<i>Pisum sativum</i>	70

COVER CROP PERFORMANCE AND RESULTS

BLACK OATS/BLACK SEEDED OATS

Description: upright, winter annual grass. Height from 2 ½–5 feet. Black oats are not cold hardy and will winterkill at temperatures less than 19°F depending on growth stage. Black seeded oats are more cold tolerant than black oats, but susceptible to winter damage in northern locations. Prefers sandy or loamy soils but can also grow in heavy clay. It is used as a rotational cover crop either seeded alone or in a mixture.

Benefits: N scavenger, improves organic matter and soil structure, erosion control, weed suppressor, livestock forage.



Black oats

Performance of Black Oats/Black Seeded Oats Varieties

Cover Crop	14-day Emergence ^{1/}	28-day Emergence ^{1/}	Maturity Date ^{2/}	Disease Ranking ^{3/}	Insect Ranking ³
Cosaque	Fair/Good ^a	Fair/Excellent ^b	Late	High/Low ^c	Low
Soil Saver	Fair/Good ^a	Fair/Excellent ^b	Mid	Moderate/Low ^c	Low

^{1/}Emergence at 14 and 28 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25; ^{2/}Maturity date—Days after planting to 50% bloom: <65=Early, 66-79=Mid, >80=Late; and ^{3/}Disease and insect ranking—Damage observed was None, Low, Moderate, or High.

^aFair to poor in CO in 2018 and MT in 2017, good to excellent at other locations and years; ^bFair in CO in 2017, good to excellent at other locations and years; ^cHigh to moderate damage in ND both years, low to none at other locations and years.

Expected Adaptation: Soil Saver (black oats) and Cosaque (black seeded oat) generally emerged with favorable stands, especially 28 days after planting in Bismarck, ND and Bridger, MT. Emergence in Meeker, CO in 2018 was likely affected by below average precipitation. Days to maturity varied across locations with Soil Saver generally reaching maturity sooner than Cosaque. Foliar disease was an issue for both oat varieties in Bismarck, ND. Insect damage was minimal across locations and years.



Soil Saver at the Bridger, MT PMC

CEREAL RYE

Description: upright, cool season, annual grass. Height from 3 to 6 feet. Grows in a wide variety of climate and soil conditions but performs best in light loams or sandy soils. It also does well in clay soils.

Benefits: N scavenger, improves organic matter and soil structure, erosion control, weed suppressor, livestock forage.



Cereal rye

Performance of Cereal Rye Varieties

Cover Crop	14-day Emergence ^{1/}	28-day Emergence ^{1/}	Maturity Date ^{2/}	Disease Ranking ^{3/}	Insect Ranking ³
Aroostook	Good/Excellent	Good/Excellent	Mid/NB ^a	Low/Moderate ^c	Low
Bates	Good/Excellent	Good/Excellent	Early/NB ^a	Low/Moderate ^c	Low
Brasetto	Good/Excellent	Good/Excellent	Late/NB ^b	Low/Moderate ^c	Low
Elbon	Good/Excellent	Good/Excellent	Mid/NB ^a	Low/Moderate ^c	Low
FL 401	Good/Excellent	Good/Excellent	Early	Low/Moderate ^c	Low
Guardian	Good/Excellent	Good/Excellent	Late/NB ^b	Low/Moderate ^c	Low
Hazlet	Good/Excellent	Good/Excellent	Late/NB ^b	Low/Moderate ^c	Low
Maton	Good/Excellent	Good/Excellent	Mid/NB ^a	Low/Moderate ^c	Low
Maton II	Good/Excellent	Good/Excellent	Early/NB ^a	Low/Moderate ^c	Low
Merced	Good/Excellent	Good/Excellent	Early	Low/Moderate ^c	Low
Oklon	Good/Excellent	Good/Excellent	Mid/NB ^a	Low/Moderate ^c	Low
Rymin	Good/Excellent	Good/Excellent	Late/NB ^b	Low/Moderate ^c	Low
Wheeler	Good/Excellent	Good/Excellent	Mid/NB ^a	Low/Moderate ^c	Low
Wintergrazer 70	Good/Excellent	Good/Excellent	Early/NB ^a	Low/Moderate ^c	Low
Wrens Abruzzi	Good/Excellent	Good/Excellent	Early/NB ^a	Low/Moderate ^c	Low

^{1/}Emergence at 14 and 28 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25; ^{2/}Maturity date—Days after planting to 50% bloom: <65=Early, 66-79=Mid, >80=Late; and ^{3/}Disease and insect ranking—Damage observed was None, Low, Moderate, or High.

^aNB – Never bloomed before first frost in 2017-2018 in ND; ^b Never bloomed in ND in 2017-2018 or before first frost in MT in 2018; ^cLow disease in CO and MT; moderate disease in ND.

Expected Adaptation: Cereal rye varieties emerged with good to excellent stands across locations and years. Days to 50% bloom varied widely among varieties and locations. FL 401 and Merced were the only varieties to reach maturity in Bismarck, ND. Brasetto, Guardian, Hazlet and Rymin also failed to reach 50% bloom in Bridger, MT in 2018. Failure to reach seed maturity before first frost may be a desirable trait because of the low potential for cereal rye to volunteer in subsequent cropping seasons. Foliar disease was observed both years on all varieties in Bismarck, ND but low to no issues in Meeker, CO or Bridger, MT. Insect damage was low to none across locations and years.

CRIMSON CLOVER

Description: cool season annual legume. Plants are generally densely hairy with a rosette of upright, usually unbranched stems, reaching 1 to 3 feet tall supported by a central taproot and many fibrous roots. Flowers produce nectar and pollen that attract European honeybees, as well as a wide variety of native bees.

Benefits: N source, improves organic matter and soil structure, erosion control, weed suppressor, livestock forage, pollinator habitat.



Crimson clover

Performance of Crimson Clover Varieties

Cover Crop	14-day Emergence ^{1/}	28-day Emergence ^{1/}	Maturity Date ²	Disease Ranking ^{3/}	Insect Ranking ³
AU Robin	Poor/Excellent ^a	Fair/Excellent ^b	Late	Low	Low
AU Sunrise	Poor/Excellent ^a	Fair/Excellent ^b	Mid	Low	Low
AU Sunup	Poor/Excellent ^a	Fair/Excellent ^b	Mid	Low	Low
Contea	Poor/Excellent ^a	Fair/Excellent ^b	Late	Low	Low
Dixie	Poor/Excellent ^a	Fair/Excellent ^b	Late	Low	Low
Kentucky Pride	Poor/Excellent ^a	Fair/Excellent ^b	Late	Low	Low

^{1/}Emergence at 14 and 28 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25; ^{2/}Maturity date—Days after planting to 50% bloom: <65=Early, 66-79=Mid, >80=Late; and ^{3/}Disease and insect ranking—Damage observed was None, Low, Moderate, or High.

^aMostly poor 14 day emergence in CO and MT both years; excellent in ND both years; ^bMostly fair to poor (AU Sunup and Contea) 28 day emergence in CO in 2017, and poor emergence of all varieties in CO in 2018; Poor 28 day emergence of AU Sun up and Contea in MT in 2017, fair for AU Sunup and Contea in 2018; Good emergence of other varieties in 2018 in MT and excellent both years in ND.

Expected Adaptation: All varieties emerged with exceptional stands both years in Bismarck, ND. AU Robin, AU Sunrise and Kentucky Pride had good emergence in Bridger, MT both years. Other than Kentucky Pride in 2017, all varieties failed to emerge to acceptable stands in Meeker, CO 14 days after planting. Where adapted, AU Sunrise and AU Sunup reached maturity sooner than the other varieties. Disease and insect damage were minimal to none across locations and years.



Early growth of AU Sunrise crimson clover at the Bridger, MTPMC

DAIKON RADISH

Description: winter annual with stiff, straight hairs near the base of the leaves. Seed stalks elongate from the rosette. Flowers in the spring with four pink, white, or lavender petals. Fruit resemble small bean pods. Radish develops a unique taproot which may reach depths of 24 inches or more. The upper 12-20 inches of the taproot thicken and can grow to 2 inches or more in diameter. Concorde, Control and Defender are oilseed radishes while other radishes are daikon/forage varieties.

Benefits: N scavenger, improves organic matter and soil structure, erosion control, weed suppressor, livestock forage.



Daikon radish taproot

Performance of Daikon Radish Varieties

Cover Crop	14-day Emergence ^{1/}	28-day Emergence ^{1/}	Maturity Date ^{2/}	Disease Ranking ^{3/}	Insect Ranking ³
Big Dog™	Excellent/Poor ^a	Excellent/Poor ^c	Mid	None	Low/Moderate ^e
Concorde	Excellent/Fair ^a	Excellent/Poor ^c	Early	None	Low/Moderate ^e
Control	Excellent/Fair ^a	Excellent/Fair ^c	Mid	None	Low/Moderate ^e
Defender	Excellent/Poor ^a	Excellent/Poor ^c	Mid	None	Low/Moderate ^e
Driller	Excellent/Fair ^a	Excellent/Fair ^c	Mid	None	Low/Moderate ^e
Eco-Till™	Excellent/Fair ^a	Excellent/Fair ^c	Mid	None	Low/Moderate ^e
Graza	Poor/Excellent ^b	Poor/Excellent ^d	Late	None	Low/Moderate ^e
Groundhog™	Excellent/Fair ^a	Excellent/Poor ^c	Mid	None	Low/Moderate ^e
Lunch	Excellent/Fair ^a	Excellent/Fair ^c	Mid	None	Low/Moderate ^e
Nitro™	Excellent/Fair ^a	Excellent/Fair ^c	Mid	None	Low/Moderate ^e
Sodbuster	Excellent/Fair ^a	Excellent/Fair ^c	Mid	None	Low/Moderate ^e
Tillage®	Excellent/Fair ^a	Excellent/Fair ^c	Mid	None	Low/Moderate ^e

^{1/}Emergence at 14 and 28 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25; ^{2/}Maturity date—Days after planting to 50% bloom: <65=Early, 66-79=Mid, >80=Late; and ^{3/}Disease and insect ranking—Damage observed was None, Low, Moderate, or High.

^aGood to excellent at all locations both years except CO in 2018 where emergence was mostly fair for all varieties and poor for Big Dog and Defender; ^bPoor to fair in CO and MT both years, poor in ND in 2017 and excellent in 2018; ^cGood to excellent 28 day emergence at all locations both years except CO in 2018 where emergence was fair for all varieties and poor for Big Dog, Concorde, Defender and Groundhog; ^dPoor emergence in CO and MT in 2017, fair in CO in 2018 and good to excellent in MT in 2018 and ND both years; ^eLow in MT 2017, moderate damage at all locations and years.

Expected Adaptation: Daikon radish varieties performed consistently well across locations for 14- and 28-day emergence, except Graza, which generally performed poorly except in Bismarck, ND. Graza did not reach maturity either year in Bismarck, ND. Days to maturity were similar among varieties and across locations and years, except Concorde (early) and Graza (late). There was no disease damage on any variety across locations or years. Moderate insect damage was observed on all varieties at all locations and years.



Daikon radish varieties at the Bridger, MT PMC

HAIRY VETCH

Description: trailing or climbing, winter annual, legume with stems 2 to 5 feet. Leaves are terminated by branched tendrils. Stems and leaves are usually covered with soft woolly fuzz. Flowers in clusters of 10 to 40 and usually violet to purple colored. Lana is a variety of woollypod vetch (*Vicia villosa* ssp. *dasycarpa*) included in this study because of its similarity in usage to hairy vetch.

Benefits: N source, weed suppressor, improves organic matter, soil structure, pollinator habitat.



Hairy vetch flowers

Performance of Hairy Vetch Varieties

Cover Crop	14-day Emergence ^{1/}	28-day Emergence ^{1/}	Maturity Date ^{2/}	Disease Ranking ^{3/}	Insect Ranking ³
CCS Groff	Fair/Good ^a	Fair/Excellent ^c	Mid	None/Low ^e	None/Low ^e
Lana	Fair/Good ^a	Fair/Excellent ^c	Early	None/Low ^e	None/Low ^e
Purple Bounty	Fair/Good ^b	Fair/Excellent ^c	Mid	None/Low ^e	None/Low ^e
Purple Prosperity	Fair/Good ^b	Fair/Excellent ^c	Mid	None/Low ^e	None/Low ^e
TNT	Fair/Good ^a	Fair/Excellent ^c	Late	None/Low ^e	None/Low ^e
Villana	Fair/Good ^a	Good/Excellent ^d	Late	None/Low ^e	None/Low ^e

^{1/}Emergence at 14 and 28 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25; ^{2/}Maturity date—Days after planting to 50% bloom: <65=Early, 66-79=Mid, >80=Late; and ^{3/}Disease and insect ranking—Damage observed was None, Low, Moderate, or High.

^aFair in CO both years and MT in 2017, good to excellent in MT 2018 and ND both years; ^bPoor in CO both years, good in MT in 2017 and ND both years; ^cFair in CO both years, good to excellent both years in MT and ND; ^dGood emergence in CO, excellent in MT and ND; ^eNo disease or insect damage observed in CO and ND both years or in MT in 2017, low disease and insect damage observed in 2018 in MT.

Expected Adaptation: Varieties generally had good to excellent 14 and 28-day emergence in Bridger, MT in 2018 and Bismarck, ND both years. Lana and Villana had fair to good 14 and 28-day emergence in Meeker, CO. Lana reached maturity approximately 2 weeks sooner than TNT and Villana. Disease and insect damage were very low to none across locations and years.



Lana woolly pod vetch blooming at the Bridger, MTPMC

RED CLOVER

Description: biennial or short-lived perennial that grows as one of two types: medium (double-cut) or mammoth (single-cut). Plants grow from crowns with hollow, hairy stems and branches. Stem lengths of medium and mammoth types average 18 inches and 24 to 30 inches, respectively. Each leaf consists of a slender stalk bearing 3 leaflets. Flowers borne in compact clusters or heads and are usually rose-pink in color.

Benefits: N source, improves organic matter and soil structure, erosion control, weed suppressor, livestock forage,



Red clover

Performance of Red Clover Varieties

Cover Crop	14-day Emergence ^{1/}	28-day Emergence ^{1/}	Maturity Date ^{2/}	Disease Ranking ^{3/}	Insect Ranking ³
Cinnamon Plus	Poor/Good ^a	Fair/Excellent ^b	Late	None/Low ^d	None/Low ^d
Cyclone II	Poor/Good ^a	Fair/Excellent ^b	Late	None/Low ^d	None/Low ^d
Dynamite	Poor/Good ^a	Fair/Excellent ^b	Late	None/Low ^d	None/Low ^d
Freedom	Poor/Good ^a	Fair/Excellent ^b	Late	None/Low ^d	None/Low ^d
Kenland	Poor/Good ^a	Fair/Excellent ^b	Late	None/Low ^d	None/Low ^d
Mammoth	Poor/Good ^a	Fair/Excellent ^b	Late	None/Low ^d	None/Low ^d
Starfire II	Poor/Good ^a	Poor/Excellent ^c	Late	None/Low ^d	None/Low ^d
Wildcat	Poor/Good ^a	Fair/Excellent ^b	Late	None/Low ^d	None/Low ^d

^{1/}Emergence at 14 and 28 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25; ^{2/}Maturity date—Days after planting to 50% bloom: <65=Early, 66-79=Mid, >80=Late; and ^{3/}Disease and insect ranking—Damage observed was None, Low, Moderate, or High.

^aMostly poor in CO in 2018 and MT both years, fair in CO in 2017, good to excellent in ND both years; ^bFair in CO in 2017, poor in 2018, fair to good in MT both years, excellent both years in ND; ^cStarfire II rated poor to fair in MT and CO both years; ^dNo disease or insect damage observed in CO and ND both years, low disease damage in MT 2018, low insect damage observed in MT both years at 50% bloom.

Expected Adaptation: Red clover varieties provided good to excellent 14- and 28-day emergence in Bismarck, ND and fair to good 28-day emergence in Bridger, MT except Starfire II, which had poor to fair emergence. None of the varieties were consistent for early or late emergence in Meeker, CO. All varieties were late maturing and overwintered in Bismarck, ND. Disease and insect damage were none to very low among varieties across locations and years.

WINTER/FIELD PEA

Description: winter annual, legume with bluish-green waxy vines. Vines can reach 9 ft long, but modern varieties have shorter vines, about 2 feet long. Stems are hollow and leaves alternate, pinnately compound. Flowers white, purple or pink. Winter pea varieties include Frost Master, Lynx, Survivor 15, Whistler, and Windham. Spring pea varieties include Arvica 4010, Dunn, and Maxum.

Benefits: N source, improves organic matter and soil structure, erosion control, weed suppressor, livestock forage, pollinator habitat.



Field pea

Performance of Winter/Field Peas Varieties

Cover Crop	14-day Emergence ^{1/}	28-day Emergence ^{1/}	Maturity Date ^{2/}	Disease Ranking ^{3/}	Insect Ranking ^{3/}
Arvica 4010	Poor/Good ^a	Fair/Excellent ^b	Mid	Low/High ^c	Low ^c
Dunn	Poor/Good ^a	Fair/Excellent ^b	Mid	Low/High ^c	Low ^c
Frost Master	Poor/Good ^a	Fair/Excellent ^b	Mid	Low/High ^c	Low ^c
Lynx	Poor/Good ^a	Fair/Excellent ^b	Mid	Low/High ^c	Low ^c
Maxum	Poor/Good ^a	Fair/Excellent ^b	Mid	Low/High ^c	Low ^c
Survivor 15 ^{4/}	Poor/Good ^a	Fair/Excellent ^b	NB ^d	Low/High ^c	Low ^c
Whistler	Poor/Good ^a	Fair/Excellent ^b	Mid	Low/High ^c	Low ^c
Windham	Poor/Good ^a	Fair/Excellent ^b	Early	Low/High ^c	Low ^c

^{1/}Emergence at 14 and 28 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25; ^{2/}Maturity date—Days after planting to 50% bloom: <65=Early, 66-79=Mid, >80=Late; and ^{3/}Disease and insect ranking—Damage observed was None, Low, Moderate, or High; ^{4/}Not planted in CO.

^a Mostly poor in CO both years, poor in MT in 2017, fair to good emergence in ND in 2017, good to excellent in MT and ND in 2018; ^b Mostly fair to poor in CO both years, good to excellent in MT and ND both years; ^d NB-Never bloomed in MT or ND; ^c Very low to no disease and insect damage in CO and MT both years, high disease damage in ND both years but no insect damage.

Expected Adaptation: Winter and field pea varieties varied in early and late emergence across locations and years but overall, they emerged to acceptable stands in Bridger, MT and Bismarck, ND, with the exception of Survivor 15 in Bridger. In Meeker, CO, Arvica 4010 and Dunn were the only varieties with good 28-day emergence in 2017, none of the other varieties emerged to acceptable stands. Most varieties had similar maturity dates with Windham and Maxum slightly earlier than the other varieties. Insect and disease damage were minimal but foliar disease was severe in Bismarck, ND both years.



Dunn field pea blooming at the Bridger, MTPMC

Comparison of Spring Seed Cover Crop Varieties in CO, MT, and ND

Cover Crop	14-Day Emergence ^{1/}	28-Day Emergence ^{1/}	Maturity Date ^{3/}	Disease Ranking ^{5/}	Insect Ranking ^{5/}
BLACK OATS					
Cosaque	Fair/Good ^a	Fair/Excellent ^b	Late	High/Low ^c	Low
BLACK SEEDED OATS					
Soil Saver	Fair/Good ^a	Fair/Excellent ^b	Mid	Moderate/Low ^c	Low
^a Fair to poor in CO in 2018 and MT in 2017, good to excellent at other locations and years; ^b Fair in CO in 2017, good to excellent at other locations and years; ^c High to moderate damage in ND both years, low to none at other locations and years.					
CEREAL RYE					
Aroostook	Good/Excellent	Good/Excellent	Mid/NB ^a	Low/Moderate ^c	Low
Bates	Good/Excellent	Good/Excellent	Early/NB ^a	Low/Moderate ^c	Low
Brassetto	Good/Excellent	Good/Excellent	Late/NB ^b	Low/Moderate ^c	Low
Elbon	Good/Excellent	Good/Excellent	Mid/NB ^a	Low/Moderate ^c	Low
FL 401	Good/Excellent	Good/Excellent	Early	Low/Moderate ^c	Low
Guardian	Good/Excellent	Good/Excellent	Late/NB ^b	Low/Moderate ^c	Low
Hazlet	Good/Excellent	Good/Excellent	Late/NB ^b	Low/Moderate ^c	Low
Maton	Good/Excellent	Good/Excellent	Mid/NB ^a	Low/Moderate ^c	Low
Maton II	Good/Excellent	Good/Excellent	Early/NB ^a	Low/Moderate ^c	Low
Merced	Good/Excellent	Good/Excellent	Early	Low/Moderate ^c	Low
Oklon	Good/Excellent	Good/Excellent	Mid/NB ^a	Low/Moderate ^c	Low
Rymin	Good/Excellent	Good/Excellent	Late/NB ^b	Low/Moderate ^c	Low
Wheeler	Good/Excellent	Good/Excellent	Mid/NB ^a	Low/Moderate ^c	Low
Wintergrazer 70	Good/Excellent	Good/Excellent	Early/NB ^a	Low/Moderate ^c	Low
Wrens Abruzzi	Good/Excellent	Good/Excellent	Early/NB ^a	Low/Moderate ^c	Low
^a NB – Never bloomed before first frost in 2017-2018 in ND; ^b Never bloomed in ND in 2017-2018 or before first frost in MT in 2018; ^c Low disease in CO and MT; moderate disease in ND.					
CRIMSON CLOVER					
AU Robin	Poor/Excellent ^a	Fair/Excellent ^b	Late	Low	Low
AU Sunrise	Poor/Excellent ^a	Fair/Excellent ^b	Mid	Low	Low
AU Sunup	Poor/Excellent ^a	Fair/Excellent ^b	Mid	Low	Low
Contea	Poor/Excellent ^a	Fair/Excellent ^b	Late	Low	Low
Dixie	Poor/Excellent ^a	Fair/Excellent ^b	Late	Low	Low
Kentucky Pride	Poor/Excellent ^a	Fair/Excellent ^b	Late	Low	Low
^a Mostly poor 14 day emergence in CO and MT both years; excellent in ND both years; ^b Mostly fair to poor (AU Sunup and Contea) 28 day emergence in CO in 2017, and poor emergence of all varieties in CO in 2018; Poor 28 day emergence of AU Sunup and Contea in MT in 2017, fair for AU Sunup and Contea in 2018; Good emergence of other varieties in 2018 in MT and excellent both years in ND.					
^{1/} Emergence at 14 and 28 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25; ^{2/} Maturity date—Days after planting to 50% bloom: <65=Early, 66-79=Mid, >80=Late; and ^{3/} Disease and insect ranking—Damage observed was None, Low, Moderate, or High.					

Comparison of Spring Seed Cover Crop Varieties in CO, MT, and ND (cont.)

Cover Crop	14-Day Emergence ^{1/}	28-Day Emergence ^{1/}	Maturity Date ^{3/}	Disease Ranking ^{5/}	Insect Ranking ^{5/}
DAIKON RADISH					
Big Dog™	Excellent/Poor ^a	Excellent/Poor ^c	Mid	None	Low/Moderate ^e
Concorde	Excellent/Fair ^a	Excellent/Poor ^c	Early	None	Low/Moderate ^e
Control	Excellent/Fair ^a	Excellent/Fair ^c	Mid	None	Low/Moderate ^e
Defender	Excellent/Poor ^a	Excellent/Poor ^c	Mid	None	Low/Moderate ^e
Driller	Excellent/Fair ^a	Excellent/Fair ^c	Mid	None	Low/Moderate ^e
Eco-Till™	Excellent/Fair ^a	Excellent/Fair ^c	Mid	None	Low/Moderate ^e
Graza	Poor/Excellent ^b	Poor/Excellent ^d	Late	None	Low/Moderate ^e
Groundhog™	Excellent/Fair ^a	Excellent/Poor ^c	Mid	None	Low/Moderate ^e
Lunch	Excellent/Fair ^a	Excellent/Fair ^c	Mid	None	Low/Moderate ^e
Nitro™	Excellent/Fair ^a	Excellent/Fair ^c	Mid	None	Low/Moderate ^e
Sodbuster	Excellent/Fair ^a	Excellent/Fair ^c	Mid	None	Low/Moderate ^e
Tillage®	Excellent/Fair ^a	Excellent/Fair ^c	Mid	None	Low/Moderate ^e
<p>^aGood to excellent at all locations both years except CO in 2018 where emergence was mostly fair for all varieties and poor for Big Dog and Defender; ^bPoor to fair in CO and MT both years, poor in ND in 2017 and excellent in 2018; ^cGood to excellent 28 day emergence at all locations both years except CO in 2018 where emergence was fair for all varieties and poor for Big Dog, Concorde, Defender and Groundhog; ^dPoor emergence in CO and MT in 2017, fair in CO in 2018 and good to excellent in MT in 2018 and ND both years; ^eLow damage in MT 2017, moderate damage at all locations and years.</p>					
HAIRY VETCH					
CCS Groff	Fair/Good ^a	Fair/Excellent ^c	Mid	None/Low ^e	None/Low ^e
Lana	Fair/Good ^a	Fair/Excellent ^c	Early	None/Low ^e	None/Low ^e
Purple Bounty	Fair/Good ^b	Fair/Excellent ^c	Mid	None/Low ^e	None/Low ^e
Purple Prosperity	Fair/Good ^b	Fair/Excellent ^c	Mid	None/Low ^e	None/Low ^e
TNT	Fair/Good ^a	Fair/Excellent ^c	Late	None/Low ^e	None/Low ^e
Villana	Fair/Good ^a	Good/Excellent ^d	Late	None/Low ^e	None/Low ^e
<p>^aFair in CO both years and MT in 2017, good to excellent in MT 2018 and ND both years; ^bPoor in CO both years, good in MT in 2017 and ND both years; ^cFair in CO both years, good to excellent both years in MT and ND; ^dGood emergence in CO, excellent in MT and ND; ^eNo disease or insect damage observed in CO and ND both years or in MT in 2017, low disease and insect damage observed in 2018 in MT.</p>					
RED CLOVER					
Cinnamon Plus	Poor/Good ^a	Fair/Excellent ^b	Late	None/Low ^d	None/Low ^d
Cyclone II	Poor/Good ^a	Fair/Excellent ^b	Late	None/Low ^d	None/Low ^d
Dynamite	Poor/Good ^a	Fair/Excellent ^b	Late	None/Low ^d	None/Low ^d
Freedom	Poor/Good ^a	Fair/Excellent ^b	Late	None/Low ^d	None/Low ^d
Kenland	Poor/Good ^a	Fair/Excellent ^b	Late	None/Low ^d	None/Low ^d
Mammoth	Poor/Good ^a	Fair/Excellent ^b	Late	None/Low ^d	None/Low ^d
Starfire II	Poor/Good ^a	Poor/Excellent ^c	Late	None/Low ^d	None/Low ^d
Wildcat	Poor/Good ^a	Fair/Excellent ^b	Late	None/Low ^d	None/Low ^d
<p>^aMostly poor in CO in 2018 and MT both years, fair in CO in 2017, good to excellent in ND both years; ^bFair in CO in 2017, poor in 2018, fair to good in MT both years, excellent both years in ND; ^cStarfire II rated poor to fair in MT and CO both years; ^dNo disease or insect damage observed in CO and ND both years, low disease damage in MT 2018, low insect damage observed in MT both years at 50% bloom.</p>					
<p>^{1/}Emergence at 14 and 28 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25; ^{2/}Maturity date—Days after planting to 50% bloom: <65=Early, 66-79=Mid, >80=Late; and ^{3/}Disease and insect ranking—Damage observed was None, Low, Moderate, or High.</p>					

Comparison of Spring Seed Cover Crop Varieties in CO, MT, and ND (cont.)

Cover Crop	14-Day Emergence ^{1/}	28-Day Emergence ^{1/}	Maturity Date ^{3/}	Disease Ranking ^{5/}	Insect Ranking ^{5/}
Winter/Field Peas					
Arvica 4010	Poor/Good ^a	Fair/Excellent ^b	Mid	Low/High ^e	Low ^e
Dunn	Poor/Good ^a	Fair/Excellent ^b	Mid	Low/High ^e	Low ^e
Frost Master	Poor/Good ^a	Fair/Excellent ^b	Mid	Low/High ^e	Low ^e
Lynx	Poor/Good ^a	Fair/Excellent ^b	Mid	Low/High ^e	Low ^e
Maxum	Poor/Good ^a	Fair/Excellent ^b	Mid	Low/High ^e	Low ^e
Survivor 15 ^{6/}	Poor/Good ^a	Fair/Excellent ^b	NB ^d	Low/High ^e	Low ^e
Whistler	Poor/Good ^a	Fair/Excellent ^b	Mid	Low/High ^e	Low ^e
Windham	Poor/Good ^a	Fair/Excellent ^b	Early	Low/High ^e	Low ^e
^{6/} Not planted in CO.					
^a Mostly poor in CO both years, poor in MT in 2017, fair to good emergence in ND in 2017, good to excellent in MT and ND in 2018; ^b Mostly fair to poor in CO both years, good to excellent in MT and ND both years; ^d NB=Never bloomed in MT or ND; ^e Very low to no disease and insect damage in CO and MT both years, high disease damage in ND both years but no insect damage.					
^{1/} Emergence at 14 and 28 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25; ^{2/} Maturity date—Days after planting to 50% bloom: <65=Early, 66-79=Mid, >80=Late; and ^{3/} Disease and insect ranking—Damage observed was None, Low, Moderate, or High.					

References

Clark, A., editor. 2012. Managing cover crops profitably, 3rd Edition. Sustainable Agriculture Research and Education. Handbook Series Book 9.

USDA, NRCS. 2019. The PLANTS Database (<http://plants.usda.gov>), 30 September 2019. National Plant Data Team, Greensboro, NC 27401-4901 USA.

For More Information

Analysis of the data used for compiling the tables in this regional report can be found at:
https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/natpmtncatsupp.pdf

Final study reports with more details on the performance of the cover crop varieties at each PMC location can be found at:

Bridger, Montana

https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/mtpmcsr13643.pdf

Bismarck, ND

https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/ndpmsr13547.pdf