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# Evaluation of Cool Season Cover Crops in the Northwest Region



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# Acknowledgements

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# Preface

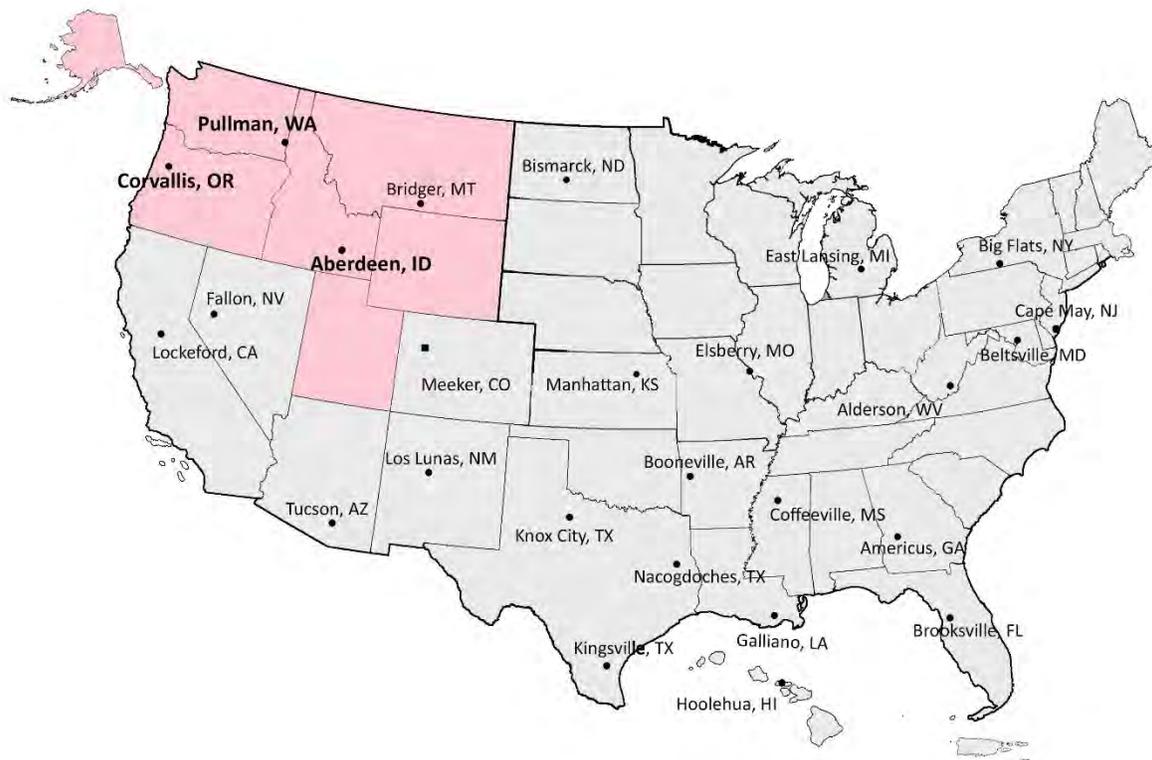
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The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Plant Materials Program has been involved in the evaluation of conservation plants and planting technology for more than 80 years.

Plant Materials Centers (PMCs) in Aberdeen, ID, Corvallis, OR, and Pullman, WA conducted a 2-year evaluation of 56 commercially available varieties of cereal rye, hairy vetch, crimson clover, red clover, winter/field pea, black oats, black seeded oats, and daikon radish to assess their adaptation and performance as cover crops in the North Central PMC region. 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/>).

## USDA NRCS Plant Materials Centers Northwest Region



## INTRODUCTION

Farmers 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). The PMCs assembled commercially available varieties of black oats, black seeded oats, cereal rye, crimson clover, daikon radish, hairy vetch, red clover, and winter/field pea to evaluate 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 the region, 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,
- develop mixes with species that mature at similar times to facilitate mechanical termination,
- use winterkill as a method of termination,
- use moderate levels of winterkill to manage competition of aggressive species, 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 Aberdeen, ID, Corvallis, OR and Pullman, WA in 2016-2017 and 2017-2018 (Table 1). Replicated plots were drilled in the fall 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. Non-legumes were fertilized with 40 lbs. N/acre, and all entries received 60 lbs. P/acre and 30 lbs. K/acre both years. Plots at Aberdeen, ID received irrigation during establishment while plots at Corvallis, OR and Pullman, WA received no irrigation.

Cover crop varieties were evaluated for:

- Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%,
- Fall stand quality—Yes is >65% emergence at 28 days after planting,
- Winter survival—Plant survival rating of Excellent >75%, Good 50-75%, Marginal 25-50%, Poor <25%,
- Maturity date—Days after planting to 50% bloom, data was grouped over the region by <250=Early, 251-265=Mid, >265=Late to identify varietal differences, and
- Disease and insect ranking—Damage observed was None, Low, Moderate, or High.

Table 1. Soil type, long-term yearly rainfall, average frost date, and low temperatures for Aberdeen, ID, Corvallis, OR and Pullman, WA.

Plant Materials Center	Soil type	Average Yearly Rainfall (inches)	Average Frost Date	Low Temperature (F)	
				2016-2017	2017-2018
Aberdeen, ID	Decllo silt loam	11	Sept 26	-23	-5
Corvallis, OR	Willamette silt loam	51	Nov 12	15	23
Pullman, WA	Palouse silt loam	21	Oct 8	-11	-7

Table 2. Planting date/year and planting method in Aberdeen, ID, Corvallis, OR and Pullman, WA.

Plant Materials Center	Planting Date (Year)		Planting Method
	2016	2017	
Aberdeen, ID	Aug 25	Aug 17	Drill
Corvallis, OR	Sept 30	Sept 18	Drill
Pullman, WA	Sept 21	Sept 26	Drill

Table 3. Cover Crop planting rates at NRCS Plant Materials Centers in Aberdeen, ID, Corvallis, OR and Pullman, WA.

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	Quick Fall Cover <sup>1/</sup>	Fall Stand Quality <sup>2/</sup>	Winter Survival <sup>3/</sup>	Maturity Date <sup>4/</sup>	Disease Ranking <sup>5/</sup>	Insect Ranking <sup>5/</sup>
Cosaque	Good/Poor <sup>a</sup>	Yes/No <sup>a</sup>	Good	Mid	Moderate	Low
Soil Saver	Good/Poor <sup>a</sup>	Yes/No <sup>a</sup>	Excellent/WK <sup>b</sup>	Early	Moderate	Low

<sup>1/</sup>Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%; <sup>2/</sup>Fall stand quality—Yes is >65% emergence at 28 days after planting; <sup>3/</sup>Winter survival—Plant survival rating of Excellent >75%, Good 50-75%, Marginal 25-50%, Poor <25%; <sup>4/</sup>Maturity date—Days after planting to 50% bloom: <250=Early, 251-265=Mid, >265=Late; and <sup>5/</sup>Disease and insect ranking—Damage observed was None, Low, Moderate, or High.

<sup>a</sup>Both cultivars provided good to excellent quick fall cover and fall stand quality in ID and OR; poor in WA; <sup>b</sup>Soil Saver had excellent winter survival in OR, in WA in 2017-2018 and winterkilled (WK) both years in ID.

**Expected Adaptation:** Cosaque (black seeded oats) and Soil Saver (Black oats) provided good to excellent quick fall cover and stand quality in Aberdeen, ID and Corvallis, OR. Lack of soil moisture during and after planting contributed to poor fall cover and stand quality in Pullman, WA both years. It is anticipated these cultivars would have performed better in Pullman had soil moisture not been a limiting factor at planting. Cosaque exhibited good to excellent winter survival in Aberdeen and Corvallis. Soil Saver displayed excellent winter survival in Corvallis but winterkilled at Aberdeen. Disease and insect damage were observed on both cultivars, but the severity of damage was considered low to moderate on surviving plants. Cosaque had fewer disease issues and matured later than Soil Saver.



*Soil Saver and Cosaque provided quick fall cover and good stand quality in Idaho and Oregon, but Soil Saver winterkilled in Idaho.*

## 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 grows 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.

### Performance of Cereal Rye Varieties in Idaho and Oregon

Cover Crop	Quick Fall Cover <sup>1/</sup>	Fall Stand Quality <sup>2/</sup>	Winter Survival <sup>3/</sup>	Maturity Date <sup>4/</sup>	Disease Ranking <sup>5/</sup>	Insect Ranking <sup>5/</sup>
Aroostook	Excellent	Yes	Excellent	Mid	Moderate	Low
Bates	Excellent	Yes	Excellent/Poor <sup>f</sup>	Mid	Moderate	Low
Brasetto	Good	Yes	Excellent	Mid	Low	Low
Elbon	Good	Yes	Excellent	Mid	Moderate	Low
FL 401	Good	Yes	Excellent/WK <sup>e</sup>	Early <sup>g</sup>	High <sup>g</sup>	Moderate <sup>g</sup>
Guardian	Excellent/Poor <sup>a</sup>	Yes/No <sup>d</sup>	Excellent	Mid	Moderate	Low
Hazlet	Excellent	Yes	Excellent	Mid	Moderate	Low
Maton	Good	Yes	Excellent	Mid	Moderate	Low
Maton II	Good	Yes	Excellent	Mid	Moderate	Low
Merced	Excellent	Yes	Excellent/WK <sup>e</sup>	Early <sup>g</sup>	High <sup>g</sup>	Moderate <sup>g</sup>
Oklon	Good	Yes	Excellent	Mid	Moderate	Low
Prima <sup>b</sup>	Good	Yes	Excellent	Late	Moderate	None
Rymin <sup>c</sup>	Excellent	Yes	Excellent	Mid	Moderate	Moderate
Wheeler	Excellent	Yes	Excellent	Mid	Moderate	Low
Wintergrazer 70	Good	Yes	Excellent/Marginal <sup>f</sup>	Mid	Moderate	Low
Wrens Abruzzi	Good	Yes	Excellent/Poor <sup>f</sup>	Mid	Moderate	Low

<sup>1/</sup>Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%; <sup>2/</sup>Fall stand quality—Yes is >65% emergence at 28 days after planting; <sup>3/</sup>Winter survival—Plant survival rating of Excellent >75%, Good 50-75%, Marginal 25-50%, Poor <25%; <sup>4/</sup>Maturity date—Days after planting to 50% bloom: <250=Early, 251-265=Mid, >265=Late; and <sup>5/</sup>Disease and insect ranking—Damage observed was None, Low, Moderate, or High. WK=winterkilled.

<sup>a</sup>Excellent in OR, poor in ID; <sup>b</sup>Tested in ID only; <sup>c</sup>Not tested in ID or OR in 2016-2017; <sup>d</sup>Unacceptable in ID; <sup>e</sup>Winter survival excellent in OR but winterkilled in ID; <sup>f</sup>Excellent winter survival in OR but inconsistent survival in ID; <sup>g</sup>Rating is for OR only.

**Expected Adaptation:** Except for Guardian, all the cereal rye varieties exhibited good to excellent quick fall cover and acceptable fall stand quality. Bates, Wintergrazer 70 and Wrens Abruzzi had poor to marginal winter survival in 2016-2017 in Aberdeen, ID but excellent survival in 2017-2018. FL 401 and Merced winterkilled in Aberdeen. For producers seeking a cereal rye cover crop that establishes quickly in the fall with acceptable fall stand quality that does not require mechanical or chemical termination, FL 401 and Merced may be good choices for incorporating into a cropping system in Idaho. Generally, higher disease and insect rankings were given in Corvallis, OR than in Aberdeen.



*Merced winterkilled in Aberdeen, Idaho.*

## 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 honey bees, 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*

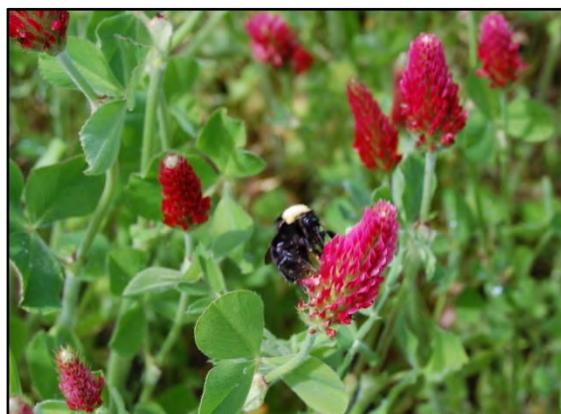
### Performance of Crimson Clover Varieties

Cover Crop	Quick Fall Cover <sup>1/</sup>	Fall Stand Quality <sup>2/</sup>	Winter Survival <sup>3/</sup>	Maturity Date <sup>4/</sup>	Disease Ranking <sup>5/</sup>	Insect Ranking <sup>5/</sup>
AU Robin	Good/Poor <sup>a</sup>	Yes	Good	Early-Late <sup>d</sup>	Low	Low
AU Sunrise	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent	Early-Late <sup>d</sup>	Low	Low
AU Sunup	Fair/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Good	Early-Late <sup>d</sup>	Low	Low
Contea	Fair/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Good	Early-Late <sup>d</sup>	Low	Low
Dixie	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent	Early-Late <sup>d</sup>	Low	Low
Kentucky Pride	Good/Poor <sup>a</sup>	Yes	Excellent	Early-Late <sup>d</sup>	Low	Low

<sup>1/</sup>Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%; <sup>2/</sup>Fall stand quality—Yes is >65% emergence at 28 days after planting; <sup>3/</sup>Winter survival—Plant survival rating of Excellent >75%, Good 50-75%, Marginal 25-50%, Poor <25%; <sup>4/</sup>Maturity date—Days after planting to 50% bloom: <250=Early, 251-265=Mid, >265=Late; and <sup>5/</sup>Disease and insect ranking—Damage observed was None, Low, Moderate, or High.

<sup>a</sup>Quick fall cover was good to fair in ID and OR, and poor in WA; <sup>b</sup>Acceptable fall stand quality in ID and OR, unacceptable in WA; <sup>c</sup>Acceptable fall stand in OR, unacceptable stand quality in ID and WA; <sup>d</sup>Early in OR, mid in WA and late in ID.

**Expected Adaptation:** Crimson clover varieties generally exhibited good field emergence and acceptable fall stand quality in Aberdeen, ID and Corvallis, OR. Lack of soil moisture at planting attributed to low germination and field emergence in Pullman, WA. All varieties had good to excellent winter survival in all locations in 2016-2017, but poor survival in 2017-2018 in Washington. Disease and insect damage were low to none. Maturity (50% bloom) dates for most varieties at each location were consistent, with Corvallis maturing at an average of 225 days, Pullman at 242 days, and Aberdeen at 292 days.



*A stand of crimson clover (left) and crimson clover flowers with a pollinator (right) at the Corvallis PMC.*

## 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	Quick Fall Cover <sup>1/</sup>	Fall Stand Quality <sup>2/</sup>	Winter Survival <sup>3/</sup>	Maturity Date <sup>4/</sup>	Disease Ranking <sup>5/</sup>	Insect Ranking <sup>5/</sup>
Big Dog™	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	High <sup>e</sup>	Low <sup>f</sup>
Concorde	Fair/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	Moderate <sup>e</sup>	Low <sup>f</sup>
Control	Fair/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	Moderate <sup>e</sup>	Low <sup>f</sup>
Defender	Fair/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	Moderate <sup>e</sup>	Low <sup>f</sup>
Driller	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	High <sup>e</sup>	Low <sup>f</sup>
Eco-Till™	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	High <sup>e</sup>	Low <sup>f</sup>
Graza	Poor	No	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	Moderate <sup>e</sup>	Low <sup>f</sup>
Groundhog™	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	High <sup>e</sup>	Low <sup>f</sup>
Lunch	Fair/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	High <sup>e</sup>	Low <sup>f</sup>
Nitro™	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	High <sup>e</sup>	Low <sup>f</sup>
Sodbuster	Fair/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	High <sup>e</sup>	Low <sup>f</sup>
Tillage®	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	High <sup>e</sup>	Low <sup>f</sup>

<sup>1/</sup>Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%; <sup>2/</sup>Fall stand quality—Yes is >65% emergence at 28 days after planting; <sup>3/</sup>Winter survival—Plant survival rating of Excellent >75%, Good 50-75%, Marginal 25-50%, Poor <25%; <sup>4/</sup>Maturity date—Days after planting to 50% bloom: <250=Early, 251-265=Mid, >265=Late; and <sup>5/</sup>Disease and insect ranking—Damage observed was None, Low, Moderate, or High. WK=winterkilled.

<sup>a</sup>Quick fall cover was on average fair to good in ID and OR, poor in WA; <sup>b</sup>Acceptable fall stand quality in ID and OR, not in WA; <sup>c</sup>Excellent winter survival in OR, poor survival in WA and complete winterkill in ID; <sup>d</sup>Early maturity in OR and WA, WK in ID; <sup>e</sup>Disease ranking for OR, none in WA; <sup>f</sup>Insect ranking for OR and WA.

**Expected Adaptation:** Daikon radish varieties generally had good to fair quick fall cover with acceptable fall stand quality in Aberdeen, ID and Corvallis, OR. Dry conditions in Pullman, WA effected field emergence and stand quality both years. Winter survival of daikon radishes was excellent in Corvallis, poor in Pullman, and they winterkilled in Aberdeen. Maturity for varieties averaged 200 days in Corvallis and 247 days at Pullman. Disease and insect damage were an issue in Corvallis following spring green up. Daikon radish can be used as a winterkilled cover crop in Idaho or as an over winter cover crop in Oregon, but disease and insect problems may become an issue in the milder climate of Oregon.



*Daikon radish winterkilled in Idaho.*

## 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 and soil structure, pollinator habitat.



Hairy vetch flowers

### Performance of Hairy Vetch Varieties

Cover Crop	Quick Fall Cover <sup>1/</sup>	Fall Stand Quality <sup>2/</sup>	Winter Survival <sup>3/</sup>	Maturity Date <sup>4/</sup>	Disease Ranking <sup>5/</sup>	Insect Ranking <sup>5/</sup>
CCS Groff	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Marginal <sup>c</sup>	Late	Low	Low
Lana	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Marginal/Excellent <sup>d</sup>	Early	Low	Low
Purple Bounty	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Marginal <sup>c</sup>	Late	Low	Low
Purple Prosperity	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Marginal <sup>c</sup>	Late	Low	Low
TNT	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Marginal <sup>c</sup>	Late	Low	Low
Villana	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Marginal <sup>c</sup>	Late	Low	Low

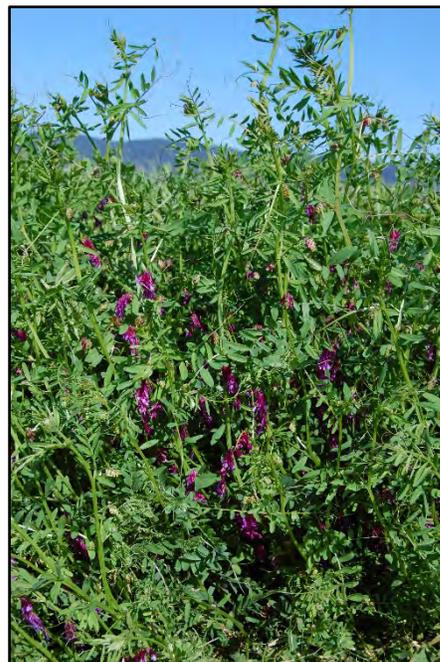
<sup>1/</sup>Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%; <sup>2/</sup>Fall stand quality—Yes is >65% emergence at 28 days after planting; <sup>3/</sup>Winter survival—Plant survival rating of Excellent >75%, Good 50-75%, Marginal 25-50%, Poor <25%; <sup>4/</sup>Maturity date—Days after planting to 50% bloom: <250=Early, 251-265=Mid, >265=Late; and <sup>5/</sup>Disease and insect ranking—Damage observed was None, Low, Moderate, or High.

<sup>a</sup>Good to fair quick fall cover in ID and OR, poor in WA; <sup>b</sup>Acceptable fall stand quality in ID and OR and unacceptable in WA;

<sup>c</sup>Excellent winter survival in ID and OR, and marginal winter survival in WA (good in 2016-2017 but poor in 2017-2018);

<sup>d</sup>Marginal winter survival in ID and WA, excellent in OR.

**Expected Adaptation:** Hairy vetch varieties generally provided good quick fall cover with acceptable fall stands in Aberdeen, ID and Corvallis, OR. None of the varieties provided quick fall cover or stand quality in Pullman, WA. With adequate soil moisture these varieties may have performed much differently in Pullman. All varieties with the exception of Lana woollypod vetch had excellent to good winter survival in Aberdeen and Corvallis, but survival in Pullman was inconsistent from year to year and is likely due to limited moisture in the fall. Lana was the earliest maturing variety at all locations with other varieties maturing 2 to 3 weeks later. Disease and insect damage were low among varieties across locations.



Lana vetch in flower at the Corvallis PMC.

## 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, pollinator habitat.



*Red clover*

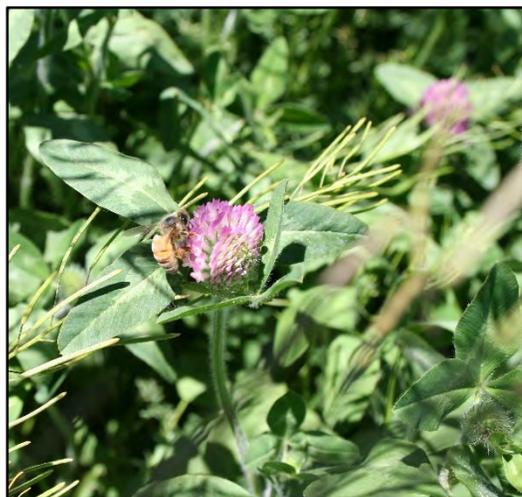
### Performance of Red Clover Varieties

Cover Crop	Quick Fall Cover <sup>1/</sup>	Fall Stand Quality <sup>2/</sup>	Winter Survival <sup>3/</sup>	Maturity Date <sup>4/</sup>	Disease Ranking <sup>5/</sup>	Insect Ranking <sup>5/</sup>
Cinnamon Plus	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Excellent/Marginal <sup>d</sup>	Late <sup>e</sup>	Low	Low
Cyclone II	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Excellent/Marginal <sup>d</sup>	Late <sup>e</sup>	Low	Low
Dynamite	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Excellent/Marginal <sup>d</sup>	Late	Low	Low
Freedom	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Excellent/Marginal <sup>d</sup>	Late	Low	Low
Kenland	Good/Poor <sup>b</sup>	Yes/No <sup>c</sup>	Excellent/Marginal <sup>d</sup>	Late <sup>e</sup>	Low	Low
Mammoth	Good/Poor <sup>b</sup>	Yes/No <sup>c</sup>	Excellent/Marginal <sup>d</sup>	Late <sup>e</sup>	Low	Low
Starfire II	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Excellent/Marginal <sup>d</sup>	Late	Low	Low
Wildcat	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Excellent/Marginal <sup>d</sup>	Late	Low	Low

<sup>1/</sup>Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%; <sup>2/</sup>Fall stand quality—Yes is >65% emergence at 28 days after planting; <sup>3/</sup>Winter survival—Plant survival rating of Excellent >75%, Good 50-75%, Marginal 25-50%, Poor <25%; <sup>4/</sup>Maturity date—Days after planting to 50% bloom: <250=Early, 251-265=Mid, >265=Late; and <sup>5/</sup>Disease and insect ranking—Damage observed was None, Low, Moderate, or High.

<sup>a</sup>Good to excellent quick fall cover in ID and OR, poor in WA; <sup>b</sup>Good in ID, Fair in OR, poor in WA; <sup>c</sup>Acceptable stand quality in ID and OR, unacceptable in WA; <sup>d</sup>Excellent winter survival in ID and OR, and marginal winter survival in WA (excellent to good in 2016-2017 but poor in 2017-2018); <sup>e</sup>Late maturity in ID, OR and not applicable in WA due to poor stand quality.

**Expected Adaptation:** Most red clover varieties exhibited good quick fall cover, acceptable fall stand quality and excellent winter survival at Aberdeen, ID and Corvallis, OR both years. Kenland and Mammoth provided fair quick fall cover in Corvallis. While varieties emerged quickly, growth through the fall and early spring was minimal in Corvallis. All varieties had excellent winter survival with the exception of the 2017-2018 year at Pullman, WA. Disease and insect issues were low among varieties across locations. Poor fall cover and fall stand quality in Pullman is related to dry conditions that limited seed germination and subsequent seedling growth.



*Bee foraging on red clover in Aberdeen, ID.*

## 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 Pea Varieties

Cover Crop	Quick Fall Cover <sup>1/</sup>	Fall Stand Quality <sup>2/</sup>	Winter Survival <sup>3/</sup>	Maturity Date <sup>4/</sup>	Disease Ranking at 50% Bloom <sup>5/</sup>	Insect Ranking at 50% Bloom <sup>5/</sup>
Arvica 4010	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Poor	NA <sup>h</sup>	NA <sup>h</sup>	NA <sup>h</sup>
Dunn	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Poor	NA <sup>h</sup>	NA <sup>h</sup>	NA <sup>h</sup>
Frost Master	Good/Poor <sup>b</sup>	Yes/No <sup>d</sup>	Good/Marginal <sup>e</sup>	Mid	Low/Moderate <sup>i</sup>	Low/Moderate <sup>i</sup>
Lynx	Poor	Yes/No <sup>d</sup>	Good/Poor <sup>f</sup>	Late	NA <sup>h</sup>	NA <sup>h</sup>
Maxum	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Poor	Early	Low/High <sup>i</sup>	Low/High <sup>i</sup>
Survivor 15	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Excellent-Good <sup>g</sup>	Late	Low/Moderate <sup>i</sup>	Low/Moderate <sup>i</sup>
Whistler	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Good	Mid	Low/High <sup>i</sup>	Low/High <sup>i</sup>
Windham	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Good	Mid	Low/High <sup>i</sup>	Low/High <sup>i</sup>

<sup>1/</sup>Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%; <sup>2/</sup>Fall stand quality—Yes is >65% emergence at 28 days after planting; <sup>3/</sup>Winter survival—Plant survival rating of Excellent >75%, Good 50-75%, Marginal 25-50%, Poor <25%; <sup>4/</sup>Maturity date—Days after planting to 50% bloom: <250=Early, 251-265=Mid, >265=Late; and <sup>5/</sup>Disease and insect ranking—Damage observed was None, Low, Moderate, or High.

<sup>a</sup>Good to excellent quick fall cover in ID and OR, poor WA; <sup>b</sup>Good quick fall cover in OR and poor to fair in ID and WA; <sup>c</sup>Acceptable fall stand in ID and OR, not in WA; <sup>d</sup>Acceptable fall stand quality in OR only; <sup>e</sup>Good winter survival in ID and marginal in OR and WA; <sup>f</sup>Good survival in ID and WA, poor in OR; <sup>g</sup>Excellent survival in ID, marginal in OR, good in WA; <sup>h</sup>Not applicable due to low plant numbers; <sup>i</sup>Low insect and disease ranking in ID and WA and moderate to high in OR.

**Expected Adaptation:** Field pea varieties generally provided good quick fall cover and acceptable fall stand quality in Aberdeen, ID and Corvallis, OR. Winter survival varied widely among varieties by year and location. Survivor 15 had the best survival across locations but varied by year. Field pea varieties Arvica 4010, Dunn and Maxum generally had poor winter survival across all locations. Maturity dates also varied depending on location with the earliest on average in Corvallis, followed by Pullman, WA and the latest dates were in Aberdeen. Disease and insect damage were observed more in the milder climate of Oregon and less in the drier climates of Idaho and Washington.



Field pea blooming in Idaho.

## Comparison of Cool Season Cover Crops and Varieties in the Northwest Region

Cover Crop	Quick Fall Cover <sup>1/</sup>	Fall Stand Quality <sup>2/</sup>	Winter Survival <sup>3/</sup>	Maturity Date <sup>4/</sup>	Disease Ranking <sup>5/</sup>	Insect Ranking <sup>5/</sup>
<b>BLACK OATS</b>						
Soil Saver	Good/Poor <sup>a</sup>	Yes/No <sup>a</sup>	Excellent/WK <sup>b</sup>	Early	Moderate	Low
<sup>a</sup> Soil Saver provided good to excellent quick fall cover and fall stand quality in ID and OR; poor in WA; <sup>b</sup> Soil Saver had excellent winter survival in OR, in WA in 2017-2018 and winterkilled both years in ID.						
<b>BLACK SEEDED OATS</b>						
Cosaque	Good/Poor <sup>a</sup>	Yes/No <sup>a</sup>	Good	Mid	Moderate	Low
<sup>a</sup> Cosaque provided good to excellent quick fall cover and fall stand quality in ID and OR; poor in WA.						
<b>CEREAL RYE</b>						
Aroostook	Excellent	Yes	Excellent	Mid	Moderate	Low
Bates	Excellent	Yes	Excellent/Poor <sup>f</sup>	Mid	Moderate	Low
Brasetto	Good	Yes	Excellent	Mid	Low	Low
Elbon	Good	Yes	Excellent	Mid	Moderate	Low
FL 401	Good	Yes	Excellent/WK <sup>c</sup>	Early <sup>g</sup>	High <sup>g</sup>	Moderate <sup>g</sup>
Guardian	Excellent/Poor <sup>a</sup>	Yes/No <sup>d</sup>	Excellent	Mid	Moderate	Low
Hazlet	Excellent	Yes	Excellent	Mid	Moderate	Low
Maton	Good	Yes	Excellent	Mid	Moderate	Low
Maton II	Good	Yes	Excellent	Mid	Moderate	Low
Merced	Excellent	Yes	Excellent/WK <sup>c</sup>	Early <sup>g</sup>	High <sup>g</sup>	Moderate <sup>g</sup>
Oklon	Good	Yes	Excellent	Mid	Moderate	Low
Prima <sup>b</sup>	Good	Yes	Excellent	Late	Moderate	None
Rymin <sup>c</sup>	Excellent	Yes	Excellent	Mid	Moderate	Moderate
Wheeler	Excellent	Yes	Excellent	Mid	Moderate	Low
Wintergrazer 70	Good	Yes	Excellent/Marginal <sup>f</sup>	Mid	Moderate	Low
Wrens Abruzzi	Good	Yes	Excellent/Poor <sup>f</sup>	Mid	Moderate	Low
<sup>a</sup> Excellent in OR, poor in ID; <sup>b</sup> Tested in ID only; <sup>c</sup> Not tested in ID or OR in 2016-2017; <sup>d</sup> Unacceptable in ID; <sup>e</sup> Winter survival excellent in OR but winterkilled in ID; <sup>f</sup> Excellent winter survival in OR but inconsistent survival in ID; <sup>g</sup> Rating is for OR only.						
<b>CRIMSON CLOVER</b>						
AU Robin	Good/Poor <sup>a</sup>	Yes	Good	Early-Late <sup>d</sup>	Low	Low
AU Sunrise	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent	Early-Late <sup>d</sup>	Low	Low
AU Sunup	Fair/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Good	Early-Late <sup>d</sup>	Low	Low
Contea	Fair/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Good	Early-Late <sup>d</sup>	Low	Low
Dixie	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent	Early-Late <sup>d</sup>	Low	Low
Kentucky Pride	Good/Poor <sup>a</sup>	Yes	Excellent	Early-Late <sup>d</sup>	Low	Low
<sup>a</sup> Quick fall cover was good to fair in ID and OR, and poor in WA; <sup>b</sup> Acceptable fall stand quality in ID and OR, unacceptable in WA; <sup>c</sup> Acceptable fall stand in OR, unacceptable stand quality in ID and WA; <sup>d</sup> Early in OR, mid in WA and late in ID.						
<sup>1/</sup> Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%; <sup>2/</sup> Fall stand quality—Yes is >65% emergence at 28 days after planting; <sup>3/</sup> Winter survival—Plant survival rating of Excellent >75%, Good 50-75%, Marginal 25-50%, Poor <25%; <sup>4/</sup> Maturity date—Days after planting to 50% bloom: <250=Early, 251-265=Mid, >265=Late; and <sup>5/</sup> Disease and insect ranking—Damage observed was None, Low, Moderate, or High. WK-winterkilled.						

## Comparison of Cool Season Cover Crops and Varieties in the Northwest Region (Cont.)

Cover Crop	Quick Fall Cover <sup>1/</sup>	Fall Stand Quality <sup>2/</sup>	Winter Survival <sup>3/</sup>	Maturity Date <sup>4/</sup>	Disease Ranking <sup>5/</sup>	Insect Ranking <sup>5/</sup>
<b>DAIKON RADISH</b>						
Big Dog™	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	High <sup>e</sup>	Low <sup>f</sup>
Concorde	Fair/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	Moderate <sup>e</sup>	Low <sup>f</sup>
Control	Fair/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	Moderate <sup>e</sup>	Low <sup>f</sup>
Defender	Fair/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	Moderate <sup>e</sup>	Low <sup>f</sup>
Driller	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	High <sup>e</sup>	Low <sup>f</sup>
Eco-Till™	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	High <sup>e</sup>	Low <sup>f</sup>
Graza	Poor	No	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	Moderate <sup>e</sup>	Low <sup>f</sup>
Groundhog™	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	High <sup>e</sup>	Low <sup>f</sup>
Lunch	Fair/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	High <sup>e</sup>	Low <sup>f</sup>
Nitro™	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	High <sup>e</sup>	Low <sup>f</sup>
Sodbuster	Fair/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	High <sup>e</sup>	Low <sup>f</sup>
Tillage®	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Poor <sup>c</sup>	Early/WK <sup>d</sup>	High <sup>e</sup>	Low <sup>f</sup>
<sup>a</sup> Quick fall cover was on average fair to good in ID and OR, poor in WA; <sup>b</sup> Acceptable fall stand quality in ID and OR, not in WA; <sup>c</sup> Excellent winter survival in OR, poor survival in WA and complete winterkill in ID; <sup>d</sup> Early maturity in OR and WA, WK in ID; <sup>e</sup> Disease ranking for OR, none in WA; <sup>f</sup> Insect ranking for OR and WA.						
<b>HAIRY VETCH</b>						
CCS Groff	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Marginal <sup>c</sup>	Late	Low	Low
Lana	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Marginal/Excellent <sup>d</sup>	Early	Low	Low
Purple Bounty	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Marginal <sup>c</sup>	Late	Low	Low
Purple Prosperity	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Marginal <sup>c</sup>	Late	Low	Low
TNT	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Marginal <sup>c</sup>	Late	Low	Low
Villana	Good/Poor <sup>a</sup>	Yes/No <sup>b</sup>	Excellent/Marginal <sup>c</sup>	Late	Low	Low
<sup>a</sup> Good to fair quick fall cover in ID and OR, poor in WA; <sup>b</sup> Acceptable fall stand quality in ID and OR and unacceptable in WA; <sup>c</sup> Excellent winter survival in ID and OR, and marginal winter survival in WA (good in 2016-2017 but poor in 2017-2018); <sup>d</sup> Marginal winter survival in ID and WA, excellent in OR.						
<b>RED CLOVER</b>						
Cinnamon Plus	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Excellent/Marginal <sup>d</sup>	Late <sup>e</sup>	Low	Low
Cyclone II	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Excellent/Marginal <sup>d</sup>	Late <sup>e</sup>	Low	Low
Dynamite	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Excellent/Marginal <sup>d</sup>	Late	Low	Low
Freedom	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Excellent/Marginal <sup>d</sup>	Late	Low	Low
Kenland	Good/Poor <sup>b</sup>	Yes/No <sup>c</sup>	Excellent/Marginal <sup>d</sup>	Late <sup>e</sup>	Low	Low
Mammoth	Good/Poor <sup>b</sup>	Yes/No <sup>c</sup>	Excellent/Marginal <sup>d</sup>	Late <sup>e</sup>	Low	Low
Starfire II	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Excellent/Marginal <sup>d</sup>	Late	Low	Low
Wildcat	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Excellent/Marginal <sup>d</sup>	Late	Low	Low
<sup>a</sup> Good to excellent quick fall cover in ID and OR, poor in WA; <sup>b</sup> Good in ID, Fair in OR, poor in WA; <sup>c</sup> Acceptable stand quality in ID and OR, unacceptable in WA; <sup>d</sup> Excellent winter survival in ID and OR, and marginal winter survival in WA (excellent to good in 2016-2017 but poor in 2017-2018); <sup>e</sup> Late maturity in ID, OR and not applicable in WA due to poor stand quality.						
<sup>1/</sup> Quick fall cover—Emergence at 14 days after planting: Excellent >90%, Good 61-90%, Fair 25-60%, Poor <25%; <sup>2/</sup> Fall stand quality—Yes is >65% emergence at 28 days after planting; <sup>3/</sup> Winter survival—Plant survival rating of Excellent >75%, Good 50-75%, Marginal 25-50%, Poor <25%; <sup>4/</sup> Maturity date—Days after planting to 50% bloom: <250=Early, 251-265=Mid, >265=Late; and <sup>5/</sup> Disease and insect ranking—Damage observed was None, Low, Moderate, or High. WK=winterkilled.						

## Comparison of Cool Season Cover Crops and Varieties in the Northwest Region (Cont.)

Cover Crop	Quick Fall Cover <sup>1/</sup>	Fall Stand Quality <sup>2/</sup>	Winter Survival <sup>3/</sup>	Maturity Date <sup>4/</sup>	Disease Ranking <sup>5/</sup>	Insect Ranking <sup>5/</sup>
<b>WINTER/FIELD PEA</b>						
Arvica 4010	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Poor	NA <sup>h</sup>	NA <sup>h</sup>	NA <sup>h</sup>
Dunn	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Poor	NA <sup>h</sup>	NA <sup>h</sup>	NA <sup>h</sup>
Frost Master	Good/Poor <sup>b</sup>	Yes/No <sup>d</sup>	Good/Marginal <sup>c</sup>	Mid	Low/Moderate <sup>i</sup>	Low/Moderate <sup>i</sup>
Lynx	Poor	Yes/No <sup>d</sup>	Good/Poor <sup>f</sup>	Late	NA <sup>h</sup>	NA <sup>h</sup>
Maxum	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Poor	Early	Low/High <sup>i</sup>	Low/High <sup>i</sup>
Survivor 15	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Excellent-Good <sup>g</sup>	Late	Low/Moderate <sup>i</sup>	Low/Moderate <sup>i</sup>
Whistler	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Good	Mid	Low/High <sup>i</sup>	Low/High <sup>i</sup>
Windham	Good/Poor <sup>a</sup>	Yes/No <sup>c</sup>	Good	Mid	Low/High <sup>i</sup>	Low/High <sup>i</sup>
<p><sup>a</sup>Good to excellent quick fall cover in ID and OR, poor WA; <sup>b</sup>Good quick fall cover in OR and poor to fair in ID and WA; <sup>c</sup>Acceptable fall stand in ID and OR, not in WA; <sup>d</sup>Acceptable fall stand quality in OR only; <sup>e</sup>Good winter survival in ID and marginal in OR and WA; <sup>f</sup>Good survival in ID and WA, poor in OR; <sup>g</sup>Excellent survival in ID, marginal in OR, good in WA; <sup>h</sup>Not applicable due to low plant numbers; <sup>i</sup>Low insect and disease ranking in ID and WA and moderate to high in OR.</p> <p><sup>1/</sup>Quick fall cover—Emergence at 14 days after planting: Excellent &gt;90%, Good 61-90%, Fair 25-60%, Poor &lt;25%; <sup>2/</sup>Fall stand quality—Yes is &gt;65% emergence at 28 days after planting; <sup>3/</sup>Winter survival—Plant survival rating of Excellent &gt;75%, Good 50-75%, Fair 25-50%, Poor &lt;25%; <sup>4/</sup>Maturity date—Days after planting to 50% bloom: &lt;250=Early, 251-265=Mid, &gt;265=Late; and <sup>5/</sup>Disease and insect ranking—Damage observed was None, Low, Moderate, or High.</p>						

## 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/natpmtnccatsupp.pdf](https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/natpmtnccatsupp.pdf)

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

Aberdeen, Idaho

[https://www.nrcs.usda.gov/Internet/FSE\\_PLANTMATERIALS/publications/idpmcsr13533.pdf](https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/idpmcsr13533.pdf)

Corvallis, Oregon

[https://www.nrcs.usda.gov/Internet/FSE\\_PLANTMATERIALS/publications/orpmcsr13456.pdf](https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/orpmcsr13456.pdf)

Pullman, Washington

[https://www.nrcs.usda.gov/Internet/FSE\\_PLANTMATERIALS/publications/wapmcsr13617.pdf](https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/wapmcsr13617.pdf)