United States Department of Agriculture

NRCS Corvallis Plant Materials Center 2015 Progress Report of Activities

March 2016

Figure 1. *Common madia and river lupine blooming in "Wetland Prairie Flowers 1" mix from Heritage Seedlings on 17 June 2015.*

Comparing Commercial Pollinator Mixes

There are many pollinator seed mixes available on the commercial market, but choosing which one to use can be a difficult task without knowing how well the mixes are likely to establish and perform in our region, and the quality of pollinator habitat provided by each. To address this issue, in 2015 the Corvallis PMC completed the first year of a 3-year study evaluating a number of commercially available pollinator mixes. Our criteria for a good pollinator mix included: 1) abundant bloom throughout the season, 2) inclusion of late-season nectar and pollen sources, 3) a balance of annuals and perennials, 4) variety of flower shapes and sizes, 5) reasonable cost, and 6) good establishment and cover to resist weed invasion and persist for multiple years. Based on these criteria we selected seven mixes to include in our trial (Table 1), and seeding rates were standardized to apply about 60 seeds/ft^2. In 2015 we collected data on establishment and cover of planted species, bloom period and abundance (every two weeks from late Feb. to Sept.),

Plant Materials Center Staff

Annie Young-Mathews, PMC Manager
Amy Bartow, Soil Conservationist
Tyler Ross, Farmer
Vanessa East, Horticulturist
Leanna Van Slambrook, Technician
Buck Duncan, Technician
Guy Banner, Technician

Oregon State Office Staff

Ron Alvarado, State Conservationist
Tom Makowski, State Resource Conservationist
Kathy Pendergrass, Plant Materials Specialist (western OR/WA)

Northwest Plant Materials Advisory Board

Astrid Martinez, WY STC (Chair)
Curtis Elke, ID STC
David Brown, UT STC
Lisa Coverdale, MT STC
Robert Jones, AK STC
Ron Alvarado, OR STC
Roylene Rides at the Door, WA STC

Corvallis Plant Materials Center
United States Department of Agriculture
Natural Resources Conservation Service
3415 NE Granger Ave.
Corvallis, OR 97330
Phone: (541) 757-4812
Fax: (855) 651-9082
http://www.nrcs.usda.gov/wps/portal/nrcs/main/plantmaterials/pmc/west/orpmc/

and pollinator visitation (once per month from March to Sept.). The same mixes were replanted in the fall of 2015, and all plots will be monitored for cover, bloom, and pollinator visitation in 2016 and 2017.

This study is a non-replicated demonstration, so no statistical comparisons are possible. However, trends from first year data, summarized in the Table 1 below, showed the most abundant bloom resources and most native bee visitation on the Xerces mix (Figure 2) that was composed of nearly all native western Oregon species, with only 25% annuals. Mixes with a higher composition of perennials will likely have more bloom in subsequent years once plants become established. The best individual species in year 1 for bloom abundance, long bloom period, and attracting native bees were lupines, common madia, farewell to spring, California poppy, tansy phacelia, and cornflower. The Xerces mix also had the most diverse establishment, with ten species showing up on the cover data. The American Meadow's mix had the lowest diversity, with only four species appearing in the cover data. Each mix was dominated by a few species, usually poppy, lupine, or farewell to spring.

***Figure 2**. Farewell to spring and California poppy blooming in Xerces Society pollinator mix on 25 June 2015.*

***Table 1.** Establishment, bloom, and bee visitation observations of seven commercially available pollinator mixes in a demonstration study at the Corvallis PMC in 2015.*

Vendor	Mix Name	Cost/ 1000 ft^2	Mix Composition		Avg. Blooms /ft^2	Avg. # Species in Bloom			Floral Visitors*	
			Native	Annuals		Early (Feb. - April)	Mid (May - June)	Late (July – Sep.)	Native Bees	Honey Bees
Xerces Society	Pollinator Mix 2014	$20	95%	25%	4.8	1.8	4.8	1.8	36.5	12.7
Nature's Seed	Northwest Wildflower Blend	$11	0%	80%	4.2	0.8	4.8	3.4	17.0	23.7
Heritage Seedlings	General Pollinator Mix	$79	100%	20%	1.3	1.2	3.8	1.2	15.4	4.0
Heritage Seedlings	Wetland Prairie Flowers 1	$26	100%	40%	7.8	0.6	4.5	2.4	12.6	8.1
American Meadows	Native Pacific Northwest Wildflower	$21	10%	80%	1.0	1.6	5.8	2.8	10.4	4.3
Silver Falls Seed	West Cascades Wildflower Economy	$14	70%	30%	1.4	2.6	5.3	1.8	10.0	1.4
Silver Falls Seed	Native Pollinator Mix	$20	65%	40%	1.9	3.2	6.5	2.2	5.3	12.1

*Average of floral visitors counted in 15 minutes over a 200-ft transect in monthly counts Mar.-Sept.

Effects of Mixed-Species Cover Crops on Soil Health

In 2015 the Corvallis PMC completed a 3-year national study looking at the effects of different cover crop mixes and seeding rates on soil health. The no-till trial included a 2-species mix (cereal rye, crimson clover), 4-species mix (rye, clover, hairy vetch, radish), and 6-species mix (rye, clover, vetch, radish, oat, forage turnip) seeded at three rates (20, 40 and 60 seeds/ft^2), along with a non-cover cropped control, and a commodity crop of sweet corn grown each summer.

Figure 3. *Good early cover at 62 days after planting (mid-December) in 4-species mix seeded at 60 seeds/ft^2 in year 1 of the study at the Corvallis PMC.*

Providing quick cover in the fall is an important trait for a cover crop mix, not only to protect the soil surface from erosion and crusting, but also for weed suppression. Over the course of our 3-year study, plots seeded with the 4- and 6-species mix at the highest seeding rate (60 seeds/ft^2) had the best cover crop percent canopy cover, lowest weed cover, and least bare ground at 60 days after planting (DAP) in late November to mid-December (Figure 3). However, we had significant year-to-year variations, with very poor establishment/ production in the second year, largely due to a cold, dry October with heavy slug and bird predation.

Overall, the different cover crop mixes and seeding rates had no significant effect on total cover crop biomass production. Biomass differences were mostly due to year-to-year variations, with the most biomass the first year of the study, and very little in 2014 due to poor establishment (Figure 4). Brassica biomass was very low in 2015 due to a widespread light leafspot fungal infestation, and weed

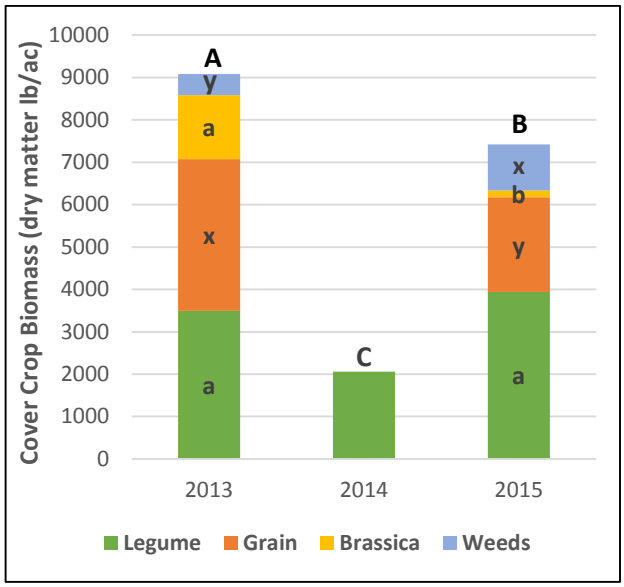


Figure 4. *Average aboveground cover crop dry matter production in all treatments in study at the Corvallis PMC. Means of each biomass component (legume, grain, brassica, and weeds) with the same letter are not significantly different in Tukey HSD tests at α=0.05.*

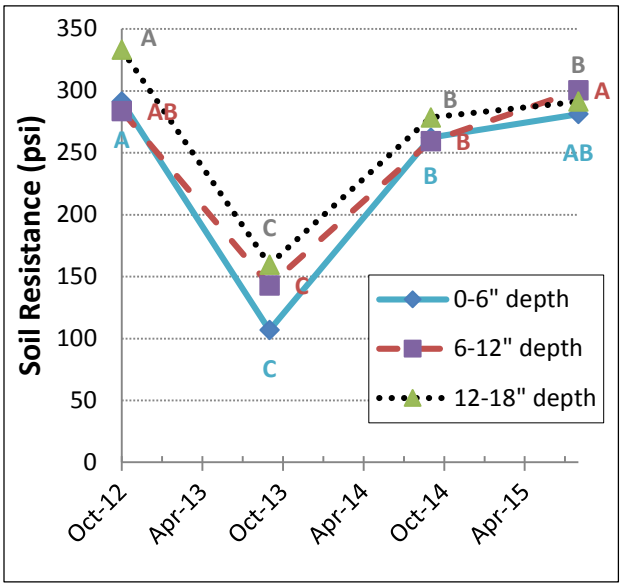


Figure 5*. Average soil resistance in all treatments over the course of the 3-year no-till cover crop trial at the Corvallis PMC. Means for each depth with the same letter are not significantly different in Tukey HSD tests at α=0.05.*

biomass increased over the course of the study, perhaps because of establishment of herbicide-resistant perennial weeds under no-till management.

Surface soil compaction as measured by average soil resistance in the top 6 inches was statistically higher in plots seeded with the 6-species mix than in the 4-species mix, with the 2-species mix in between (246, 228, and 232 psi, respectively), but all were within the moderate range (from 200-300 psi) where crop rooting ability is not likely to be impaired. Over the course of the study, soil resistance went down initially and then went back up (Figure 5), indicating that perhaps we were still in a transition period of our no-till management.

We saw few consistent treatment effects on plant available soil nutrients over the three years of the study; instead soil nutrient levels varied more by sampling date. Soil organic carbon levels and the Haney soil health score generally increased over the three years, particularly following large cover crop biomass production in 2013 and 2015, while soil nitrogen levels generally declined (Figure 6). The study protocol did not allow for addition of fertilizers, and sweet corn growth and productivity suffered from this lack of fertility in the second and third years of the trial. A full summary of data from this trial will soon be available on our website.

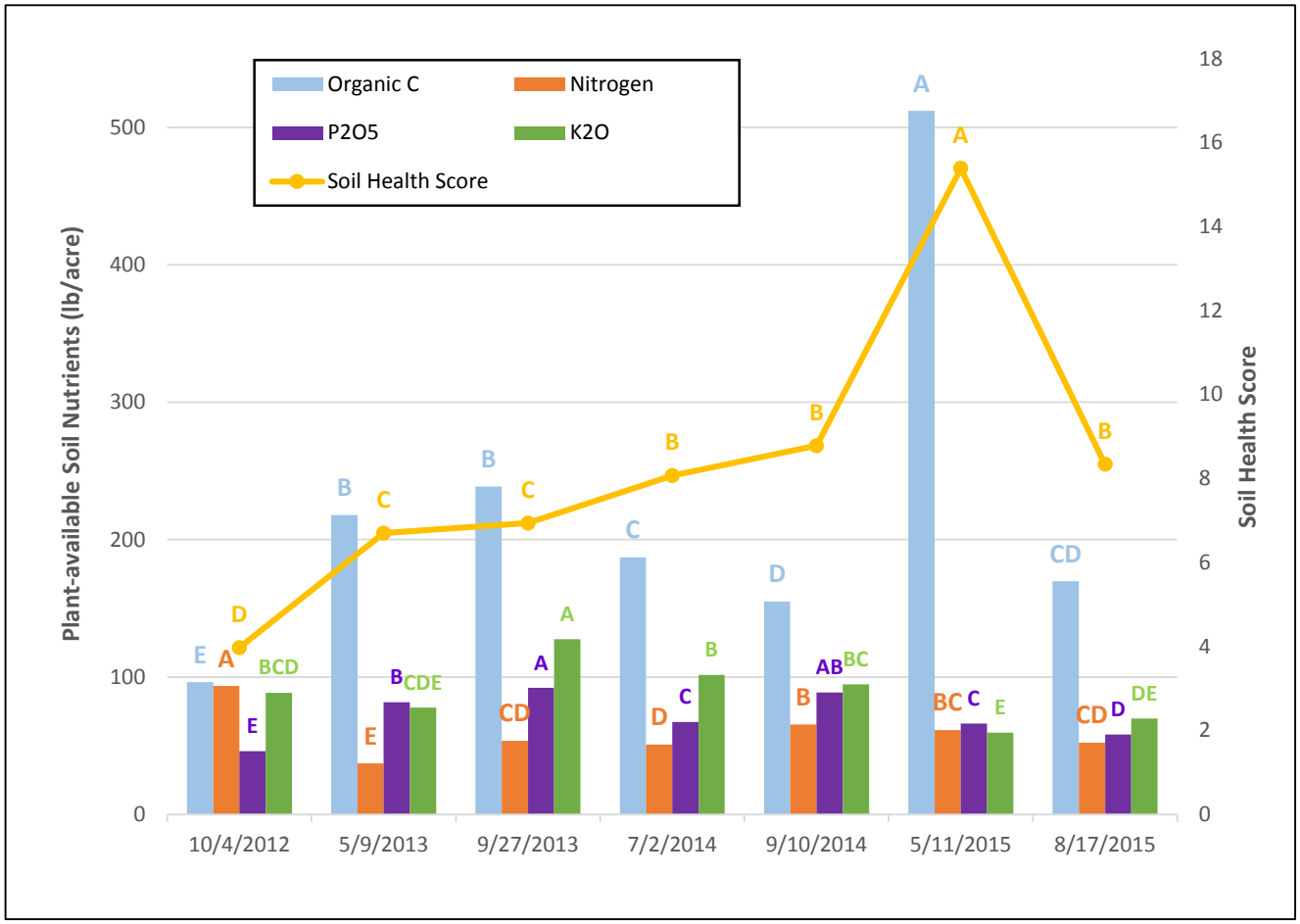


Figure 6. *Average plant available soil nutrients, measured by the Haney method of water and organic acid extraction, and soil health score for all treatments in the cover crop trial at the Corvallis PMC. Means for each nutrient marked with the same letter are not significantly different in Tukey HSD tests at α=0.05.*

Planting Date and Pollinator Mix Establishment

With the first fall rains in the Pacific Northwest, weed seeds germinate and grow rapidly in the last warm weeks of early fall. It may seem like a good idea to wait out this initial flush of weeds, apply herbicide to remove them, then proceed with seeding your site. But studies at the PMC are suggesting otherwise.

In the fall of 2013, we began a study looking at the effects of seeding date on establishment of a forb-rich, native Willamette Valley prairie seed mix. The field was tilled in mid-September, then the first plots were broadcast seeded by hand and received rain within a couple of days.

Figure 7. *Yarrow, self-heal, and edible thistle in full bloom in the September-seeded pollinator plot, a year and a half after planting at the Corvallis PMC, June 2015.*

Additional plots were seeded in mid-October and mid-November. These later plots were sprayed with glyphosate one week prior to seeding to remove weeds that had germinated and the soil surface was raked lightly to mimic the conditions of the September seeding.

In year two of this study, the majority of the trends we witnessed in year one had not changed. Native cover was still highest in the plots that were sown earliest (September). But native cover greatly increased in year 2 in the plots that were sown later (October and November). The trend of weed cover remained the same- lowest in early seeded plots with an increase in later seeded plots. It was surprising to see how much the native cover increased in year 2. Weed cover did not increase as much as the native cover in the later seeded plots.

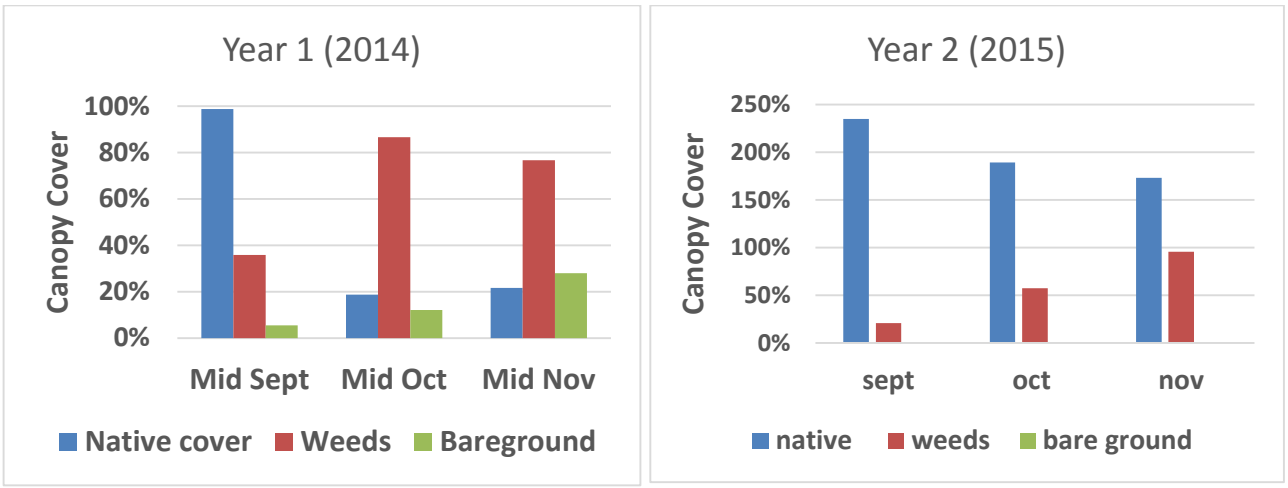


Figure 8*. Average percent canopy cover of natives, weeds, and bare ground in plots seeded in mid-September, October and November 2013 at the Corvallis PMC. Cover data were collected along 3 transects per plot in May 2014 (left) and 2015 (right). All canopy layers were counted for percent cover, so totals are sometimes greater than 100%.*

Cover Crops for Western Oregon

Over the last several years the Corvallis PMC has been performing a series of trials to evaluate the suitability of different cover crop species and varieties in our region to help planners and producers make more informed choices. Our 2014-2015 replicated trial included 41 fall-planted species/varieties, 12 spring-planted species, and 10 summer-planted species. The relatively mild winter allowed most fall-planted crops to over-winter fairly well, but the brassicas were almost completely wiped out by a fungal disease (light leaf spot) in mid-March. Spring-planted crops were severely stunted by below average spring rainfall, while the summer-planted, irrigated crops performed quite well with the warmer than average summer.

Some of the top performers from this year's trials are summarized below (Table 2), according to different cover crop purposes. A complete summary of the trial is available on our website.

***Figure 9**. Fall-planted common vetch plot on 15 May 2015 (above) and summer-planted phacelia, sunflowers, and buckwheat on 10 Aug. 2015 (below) in cover crop adaptation trials at the Corvallis PMC.*

***Table 2**. Top performing cover crops according to four traits (biomass, quick cover, bloom abundance, and legume biomass) in the 2014-2015 cover crop adaptation trials at the USDA-NRCS Plant Materials Center, Corvallis, OR.*

Trait *Purpose*	**Biomass** *Increase soil organic matter*	**Quick Cover** *Erosion reduction & weed suppression*	**Bloom Abundance** *Food for pollinators/ beneficial insects*	**Legume Biomass** *Nitrogen fixation*
Fall	barley triticale annual ryegrass berseem clover	barley daikon radish common vetch triticale flax	berseem clover crimson clover common vetch hairy vetch flax	berseem clover common vetch hairy vetch crimson clover subclover
Spring	triticale	triticale spring lentil	chickling vetch buckwheat phacelia	spring lentil chickling vetch
Summer	sorghum-sudangrass teff buckwheat sunflower sunnhemp hybrid pearl millet	buckwheat sorghum-sudangrass hybrid pearl millet phacelia	buckwheat phacelia sunflower safflower	soybean sunnhemp

Field Trial: Oak Woodland Understory Seeding

In early 2014, Plant Materials staff began working with Yamhill County field office staff on a field trial with a vineyard owner who was interested in reseeding the understory of an oak woodland that had recently been thinned. After a year of brush management (3 mechanical treatments and limited spot spraying), the site exhibited some bare ground, but also had a carpet of tiny shining geranium seedlings. We felt it was important to seed the site while there was still some bare ground available. The geranium looked like it was going to be a terrible weed, and we weren't sure if the seeds we put down would be able to outcompete it.

We created a mix of native seed that we hoped would establish quickly and thrive in the moderately shady conditions of the oak understory (Table 3). The mix was applied using a belly-grinder spreader at approximately 15 pounds per acre on February 21, 2014. Tarps were spread out and placed randomly to create non-seeded "control" plots.

***Table 3**. Species in oak woodland mix seeded after oak thinning February 21, 2014.*

Species	Common name	% of mix
Elymus glaucus	blue wildrye	42
Lupinus rivularis	riverbank lupine	20
Eriophyllum lanatum	Oregon sunshine	15
Camassia leichtlinii	great camas	11
Festuca roemeri	Roemer's fescue	5
Plectritis congesta	sea blush	5
Elymus trachycaulus	slender wheatgrass	2

***Figure 10.** After oak thinning and a year of brush management, this oak woodland in Yamhill County had a lot of bare ground.*

When we returned to the site in the spring of 2015, the results were stunning. Not only did the seeding establish very well, but the native plants outcompeted the geranium. The blue wildrye thrived in the semi-shaded woodland (Fig. 7), while the riverbank lupine became very dominant in the sunny areas (Fig. 8). We plan to continue monitoring the site over the next few years to see if the native cover is maintained.

***Figure 11.** By June 2015, the non-seeded control (lighter green rectangle, covered by a tarp during seeding) had a dense cover of shining geranium; the darker green surrounding seeded area was dominated by native species.*

***Figure 12**. Riverbank lupine dominated the sunnier seeded areas in June 2015, 15 months after seeding.*

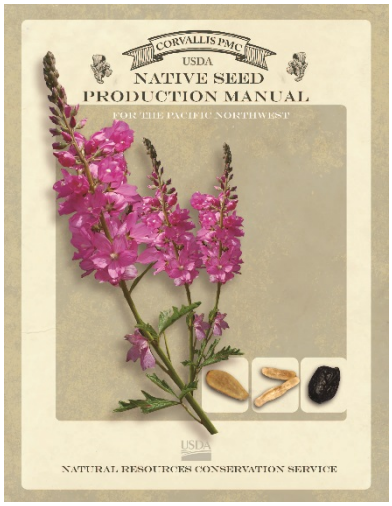
Partnerships

The Corvallis PMC partners with many federal agencies to provide plant materials for projects on federal lands when suitable materials are not available from private growers. In 2015, the PMC contracted with:

- USFWS and the Oregon Military Dept. for production of 5 Threatened & Endangered plant species and over 13 additional species to support habitat for endangered butterflies
- Four BLM districts to produce seed and plants of over 60 native species
- Six National Forest districts for technology development on 20 native species
- Three National Parks to provide seeds and plants for restoration projects within the parks

Publications

The highlight of our year was wrapping up a three-year project with the publication of the *Native Seed Production Manual for the Pacific Northwest.* This 191-page tome, available on our website and in spiral-bound print format, captures seed production information for over 50 native forbs and 24 native grasses/grass-like species, as well as an overview of specialty seed harvesting and cleaning equipment. The Native Seed Production Manual, as well as our past publications, are available on the Corvallis PMC Publications page:



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Training, Presentations, and Outreach

Our plant materials training, field days, and outreach activities this year included the following:

- Spring & Summer Cover Crop/Soil Health Field Days – PMC Staff, Corvallis PMC
- *Comparison of Native Plant Establishment Based on Seeding Date* – A. Bartow, National Native Seed Conference, Santa Fe, NM
- *Cover Crops for Soil Health* – A. Young-Mathews, NEDC Soil Health & Sustainability for Field Staff, Portland, OR
- *Tips for Wetland and Prairie Restoration* – A. Bartow, NRCS Central Coast/Upper Willamette/Southwest Basin Team Meeting, Tangent, OR
- *Hedgerows and Windbreaks: Woody Perennials for Pollinator Habitat and Biodiversity* – A. Young-Mathews, Introduction to PNW Agroforestry Practices Workshop, Marion/Polk/Yamhill SWCDs, Kaizer, OR
- NRCS Soil Health tabling event – A. Young-Mathews, Oregon Small Farms Conference, Corvallis, OR
- Native Plant Identification Game – A. Young-Mathews, OSU Middle School 4-H Diversity Camp, Salem, OR