United States Department of Agriculture

FINAL STUDY REPORT February 2026
Corvallis Plant Materials Center
Corvallis, Oregon

Productivity of 23 forb and legume forages from two methods of overseeding into a grass-dominated pasture, Willamette Valley, Oregon

Ian Silvernail

ABSTRACT

An evaluation of forage plant productivity from overseeding into an established pasture was performed in Corvallis, Oregon from October 2023 to June 2025. The established pasture was composed primarily of tall fescue (*Schedonorus arundinaceus*) and orchardgrass (*Dactylis glomerata*). Prior to seeding the study species, silage was cut and removed in June 2023. The pasture was flail mowed at 0.5-to-1-inch high one week prior to seeding. Fifteen cultivars/varieties of legumes and 8 forbs were overseeded in October 2023 using broadcast and no-till drill methods. No supplemental irrigation was applied. Established forages were harvested in spring and summer of 2024 and 2025. Depending on regrowth, some forages were harvested only once and others were harvested multiple times through the growing seasons. Resulting harvests were separated by functional group and dry matter production of the target species, grasses, and other species were determined. The annuals 'Yuchi' arrowleaf clover (*Trifolium vesiculosum*), VNS common vetch (*Vicia sativa*), and 'Vital' hairy vetch (*Vicia villosa*) produced significantly more dry matter than all other study entries, each composing over 50% of the total dry matter production. The hybrid 'AberLasting' (*Trifolium repens x T. ambiguum*) and alsike clovers (*Trifolium hybridum*) had the highest dry matter production of all seeded perennial species. Seeding method did not significantly affect dry matter yields of seeded forage species. Applications and directions for further investigation are discussed.

INTRODUCTION

Pastures in the Willamette Valley are often dominated by cool season perennial grasses with a minimal component of improved forage legumes and forbs. This limited plant diversity limits potential forage productivity, nutritional quality, atmospheric nitrogen fixation, and ecosystem services of the pasture. In some cases, a complete pasture reseeding may be useful to achieve forage quality and yield goals, but this process can be intensive, expensive and many pasture managers lack the necessary tools to implement this process, especially on smaller farms and on more marginal

Ian Silvernail, Corvallis Plant Materials Center Agronomist, 3415 NE Granger Ave, Corvallis, OR 97330, email: ian.silvernail@usda.gov

lands. Overseeding a pasture, defined here as seeding without eliminating the existing plant community, is a possible method to increase forage quality and diversity while minimizing inputs and equipment requirements. Overseeding can have several advantages as compared to more conventional tillage and complete reseeding, including cost savings, reduced risk of erosion, and reduction in lost productivity (Naylor et. al, 1983; Bartholomew, 2005). Additionally, while also a benefit in complete pasture reseeding, legumes overseeded into a grass-dominated pasture generally increase yield, improve forage quality, and reduce the need for additional nitrogen fertilization (Barnhart, 2004).

When overseeding, plant species and cultivar selection should be matched to the site characteristics, livestock type, and management system. Annual and perennial species tend to establish at different rates, with annual species generally establishing more rapidly. While there are exceptions, legumes often establish more slowly than grasses. Cool season species may have an establishment advantage as compared to warm season species when fall oversown into a cool-season dominant pasture because the new seedlings will initiate growth rapidly rather than waiting until warm spring temperatures to do so. A wide array of forage options exist for the Willamette Valley, and species may establish to different degrees in an overseeding scenario.

Effect of seeding method on establishment of overseeded forages may also be context dependent. Cuomo et. al (2001) tested four seeding methods (broadcasting, no-till drilling, broadcasting followed by harrowing, broadcasting followed by light discing) and found no differences in legume stands when seeded into existing cool-season grass pastures. In a cool-season grass pasture in Virginia, no difference in no-till drilled versus broadcast overseeded red clover or white clover biomass was observed for two years after seeding (Schlueter & Tracy, 2012). In a study of overseeding with Italian ryegrass and tall fescue in Oklahoma, no till drilling was generally more effective than broadcast seeding at achieving establishment of the seeded species, but when plant residue levels were high, broadcasting was equally effective (Bartholomew et al., 2011). While these studies suggest frequent lack of significant difference of seeding method on forage establishment, there are contexts in which it does make a difference.

Potential overseeding processes and methods are numerous. Suppression of existing vegetation is generally considered essential in supporting the establishment of overseeded forages (Hoveland, 1997; Thom et al., 2011) because of effects on the availability of water, nutrients, and light to establishing seedlings (Blackmore, 1955). Cuomo et al. (2001) found that when overseeded into existing cool-season grass stands, cover of kura clover, alfalfa, red clover, and birdsfoot trefoil were 38% where herbicide was used to suppress the existing grasses prior to seeding and 3% without the herbicide suppression technique. Barnhart (2004) suggests that no-spray approaches such as grazing or close mowing prior to overseeding can support establishment of new seedlings. In a study of white clover and crimson clover overseeding into bermudagrass in Arkansas, grazing before or after planting to improve seed to soil contact did not significantly improve clover establishment (Smith et al., 2012). Effect of vegetation suppression will be context-dependent, necessitating examination under multiple contexts.

This study evaluates 23 forage species (15 legumes and 8 non-leguminous forbs) and two seeding methods by overseeding into an existing low-diversity cool season perennial grass dominated pasture. The existing pasture was managed with silage removal and low flail mowing prior to seeding to support establishment of the seeded species. Yields and percent compositions of the resulting seeded forages are discussed within the context of two seeding methods, and recommendations for implementation and further investigations are made.

MATERIALS AND METHODS

The study location was a 1.7-acre area at Hyslop Farm in Corvallis, Oregon, on 0-3 percent sloped Woodburn silt loam soil. Monthly mean minimum and maximum temperatures and total monthly precipitation at the study site are displayed in Figure 1. The study site was prepared with tillage, harrowing, and rolling, and on October 8, 2021, the area was planted with a mix of three grass species. Species were chosen to simulate a common species composition found in grass-based pastures in the Willamette Valley. Species and sowing rates were as follows: 21.8 lb/acre 'Penncross' creeping bentgrass (*Agrostis stolonifera*), 13.1 lb/acre 'Fawn' tall fescue (*Schedonorus arundinaceus*), and 9.7 lb/acre VNS (variety not stated) orchardgrass (*Dactylis glomerata*). Seed was broadcast with a Gandy drop spreader (Gandy Company, Owatonna, MN) and rolled afterwards with a sprocket roller. Subsequent management action across the 1.7 acres prior to seeding the study forages included flail mowing at three inches in July 2022, cutting silage with a flail chopper at two inches high and removing with a forage wagon in early June 2023, and flail mowing at one half to

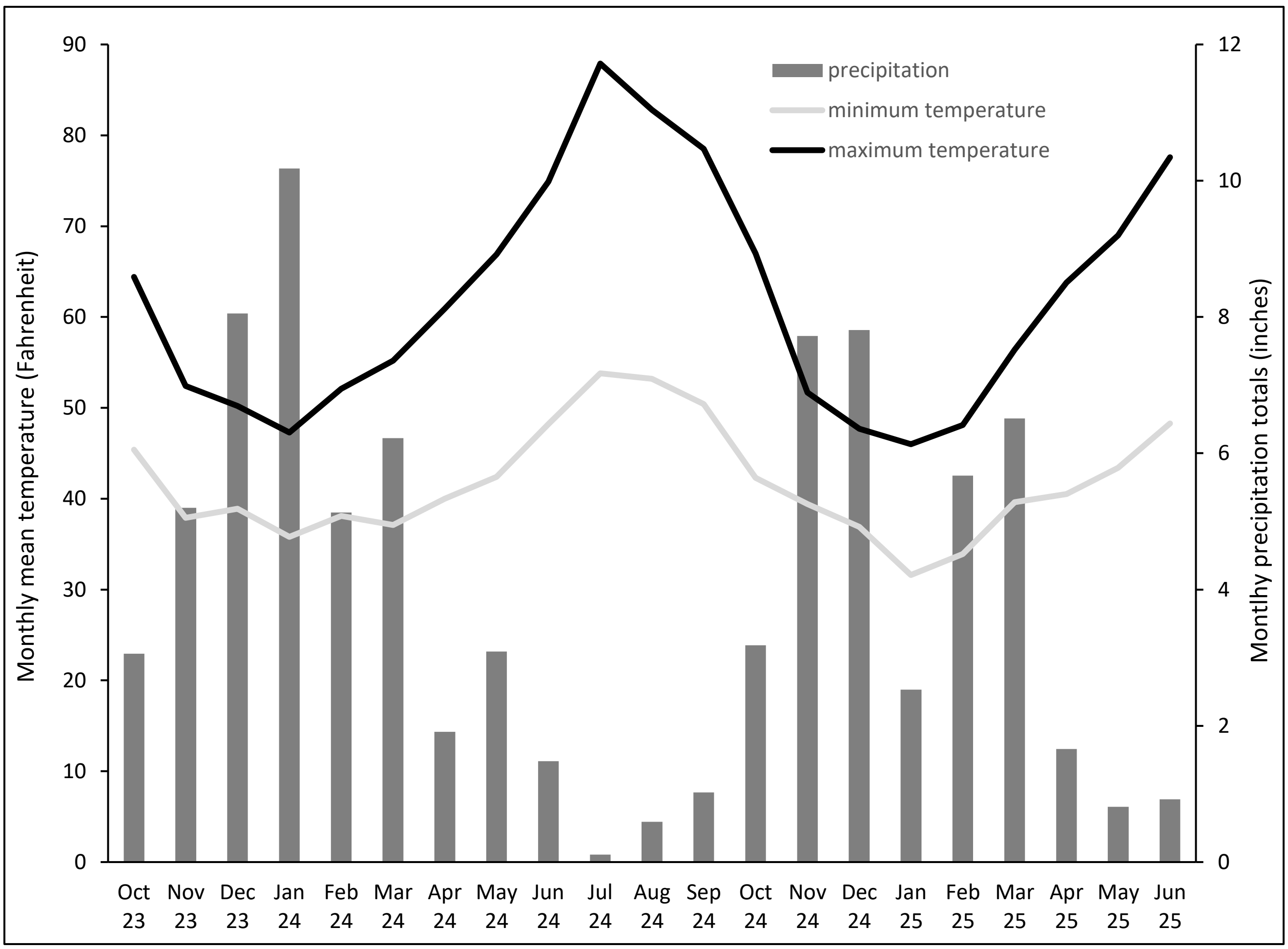


Figure 1: Monthly mean temperature (F) and precipitation totals (in) at the study site located in Corvallis, Oregon, October 2023-June 2025. PRISM/NACSE, Oregon State University.

one inch on September 28, 2023. This series of processes created low standing vegetation, reduced plant residue on the soil, and increased the amount of exposed dirt and interstitial spaces for new seedling establishment between existing perennial grasses.

Existing plant community data were collected on September 28, 2023, prior to flail mowing. Ten $1m^2$ plots were randomly placed throughout the study area. In each plot, percent cover of all species occurring in each plot was recorded.

Between October 4 and 6, 2023, 184 single species plots were established in a randomized stratified block design. Plots were 5 feet by 20 feet ($100ft^2$) with 2 feet between plots on the narrow end and 8 feet between plots on the wide end. These gaps were chosen to help facilitate mowing of access paths between plots and to facilitate post-harvest mowing of individual plots. Twenty-three study species were selected based on their performance in prior studies at the study location (Table 1). Each species was sown into a $100ft^2$ plot using broadcast or no-till drill methods with four replicates per seeding method per species. No-till seeding was completed using a Truax no-till drill (Truax Company, New Hope, MN) (Figure 2). The drill was calibrated for each species to achieve the seeding rates listed in Table 1. All species were sown at 0.25-to-0.5-inches deep. Broadcast seeding was completed at the same sowing rates by hand after bulking the seed with sand. After seeding, the entire study area was rolled with a sprocket roller to improve seed to soil contact. All four brassica family species were resown at the beginning of the second year on October 18, 2024, following a one-inch flail mowing across the entire study area and a 0-to-0.5-inch scalping flail mowing over the brassica plots only. Seeding rates for the second brassica sowing are also listed in Table 1.

Figure 2: Farmer Tyler no-till drilling forage seeds into a study plot, October 5, 2023, Corvallis, Oregon.

No supplemental irrigation was applied for the duration of the study. A small amount of hand weed control was done on hairy vetch in the plots where it was not seeded, and some spot backpack applications of herbicide were done on Canada thistle. All plots were fertilized in October 2024 two weeks after reseeding of the brassica species with 50 lb/ac of nitrogen from a 33-0-0 synthetic fertilizer that also contained 12% sulfur. This is a common pasture fertilizer formulated for use in the Willamette Valley.

Biomass harvesting for data collection occurred between April 16, 2024, and June 16, 2025. Plots were harvested from one to several times depending on growth and regrowth of the target species. Harvest was timed by developmental stage of the target species, with legumes harvested in bud to early bloom and other forbs harvested at maximum vegetative growth, ideally prior to the initiation of flowering. Two 30cm x 30cm subplots were placed in a representative location within each larger study plot. Subplots were located a minimum of one foot from the outer edge of the plot to avoid edge effects. All vegetation in each subplot was cut by hand two inches above the soil surface. After collection, all harvested plots were mowed at two inches and the resulting thatch was left to lie on the plot. Plots were reharvested if and when regrowth reached the appropriate developmental stage. After harvest, each sample collected from a subplot was sorted into one of three different categories: 1) target plant, 2) grasses, 3) all other species. The fresh weight of all samples by category within each plot was recorded. Samples were dried in a heated greenhouse until their dry weight stabilized and did not change with further drying. Drying duration varied from 3 to 7 days; after drying, dry weights were recorded.

Table 1: Pasture overseeding study species, cultivar/variety names, duration, and seeding rates, Corvallis, OR. Four species from the brassica family were sown in fall 2023 and again in fall 2024; both sowing rates are indicated for these species.

Common Name	Cultivar/Variety	Scientific Name	Duration	Seeding Rate (lb/acre)
alfalfa	'WSL550'	*Medicago sativa*	perennial	28.0
birdsfoot trefoil	'Bruce'	*Lotus corniculatus*	perennial	8.0
burnet, small	'Persist'	*Sanguisorba minor*	perennial	21.0
chicory	'Antler'	*Cichorium intybus*	perennial	6.0
clover, alsike	VNS	*Trifolium hybridum*	perennial	9.0
clover, arrowleaf	'Yuchi'	*Trifolium vesiculosum*	annual	13.0
clover, balansa	'Fixation'	*Trifolium michelianum*	annual	13.0
clover, berseem	'Frosty'	*Trifolium alexandrinum*	annual	32.0
clover, Persian	VNS	*Trifolium resupinatum*	annual	24.0
clover, red	'Alta-Swede Mammoth'	*Trifolium pratense*	perennial	12.0
clover, rose	VNS	*Trifolium hirtum*	annual	32.0
clover, strawberry	'Palestine'	*Trifolium frageriferum*	perennial	22.0
clover, subterranean	'Campeda'	*Trifolium subterraneum*	annual	28.0
clover, white	'Stamina'	*Trifolium repens*	perennial	6.0
clover, white x kura	'AberLasting'	*Trifolium repens x T. ambiguum*	perennial	13.0
kale	'Bayou'	*Brassica oleracea*	biennial	8.0, 6.3
mustard	'Shield'	*Brassica juncea*	annual	5.0, 4.8
plantain	'Boston'	*Plantago lanceolata*	perennial	10.0
radish	'Graza'	*Raphanus sativus X Raphanus maritimus X Brassica oleracea*	perennial	8.0, 8.0
turnip	'Purple Top'	*Brassica rapa*	annual	4.0, 5.1
vetch, common	VNS	*Vicia sativa*	annual	32.0
vetch, hairy	'Vital'	*Vivia villosa*	annual	40.0
yarrow	North Coast Oregon	*Achillea millefolium*	perennial	1.6

VNS = Variety Not Stated

Due to a physical sample processing error, values for the first of two biomass harvests of rose clover (*Trifolium hirtum*), hairy vetch, and common vetch were not weighed and were instead visually estimated from photographs. The second of two harvests for each of these species was performed as described for other species.

Target plant dry matter production data were assessed using a factorial analysis of variance (ANOVA) test to determine differences across cultivars/varieties and seeding methods. Total dry matter production data were assessed using a one-way ANOVA to determine differences across cultivars/varieties with results from seeding methods combined. In both cases, the Shapiro-Wilk test was used to determine normality and Tukey's Honestly Significant Difference test was done to assess pairwise comparisons.

RESULTS AND DISCUSSION

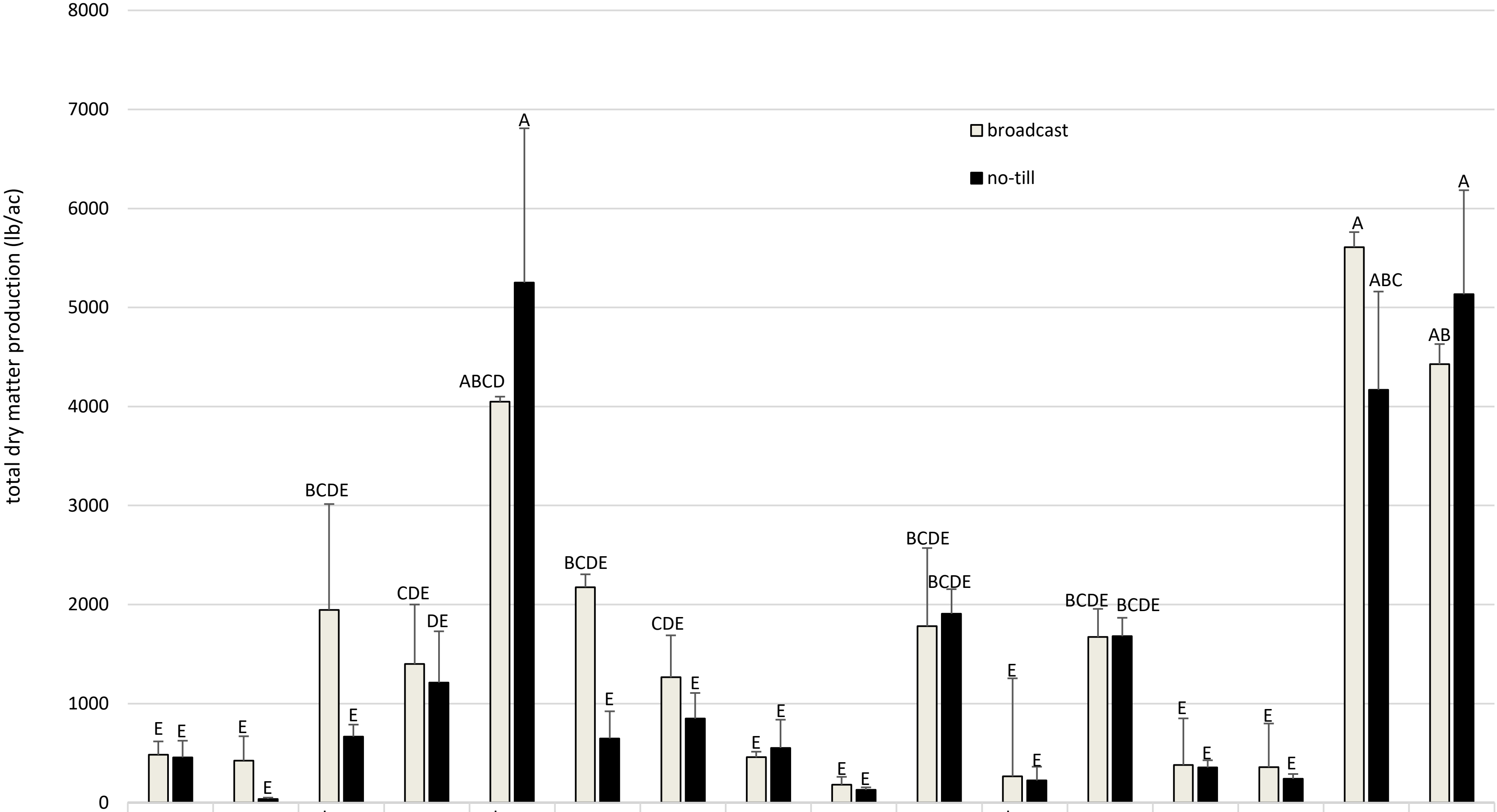
Plant community one week prior to overseeding of the 23 study species was primarily tall fescue and orchardgrass, with less than 1% cover of weedy forb species. Bentgrass, the dominant species seeded in the study area, was not present two years later when data was collected. Results are in Table 2. Ground cover was 74% thatch at the time of seeding. Tall fescue was the dominant plant at 13.6% cover.

Table 2: Mean percent cover and standard error of species present in the study area prior to seeding study species, September 28, 2023, Corvallis, Oregon.

Species	Mean % cover	Standard Error
tall fescue (*Schedonorus arundinaceus*)	13.6	1.3
orchardgrass (*Dactylis glomerata*)	7.6	0.7
unknown forb seedling	0.35	0.1
radish seedling	0.05	0.1
thatch	74	1.2
bare ground	5.8	1.0

Through the duration of the study, the following species were not harvested due to little to no growth: alfalfa (*Medicago sativa*), birdsfoot trefoil (*Lotus corniculatus*), yarrow (*Achillea millefolium*), and all four of the brassica family species (Table 1). All brassicas germinated in the fall after sowing in both years but only a few individuals survived through the winter. Few to no individuals of alfalfa, birdsfoot trefoil, or yarrow could be located throughout the course of the study. Data analyses that follow exclude the unharvested species listed above.

The following factors differed significantly across all harvested study species (p=0.000): dry matter production of the target forage species, dry matter production of all grass within target species plots, dry matter production of all species other than the study species and grass (i.e. weeds) within study plots, dry matter production of all species combined within a study plot, and target species percentage of total dry matter production. Target species dry matter production was significantly higher for common vetch, hairy vetch, and arrowleaf clover than for all other species (Figure 3), including all perennial species for which dry matter production was collected for two years as compared to the single year of collection for these annual species. The next group of significance



	burnet, small	chicory	clover, Aber-Lasting	clover, alsike	clover, arrow-leaf	clover, balansa	clover, berseem	clover, Persian	clover, red	clover, rose	clover, straw-berry	clover, sub	clover, white	plantain	vetch, common	vetch, hairy
broadcast	483	424	1947	1399	4049	2176	1266	458	180	1781	265	1673	380	358	5610	4427
no-till	457	37	667	1213	5251	648	848	553	128	1908	224	1680	355	240	4168	5133

Figure 3: Total dry matter production of the target forage species for all harvested study species for two different seeding methods. Data represent one year of dry matter production for annual species and two years for biennial and perennial species. Bars represent standard errors. Means not sharing a letter are significantly different at the 5% level of significance according to a Tukey's Honestly Significant Difference test.

for target species dry matter production includes subterranean clover (*Trifolium subterraneum*), rose clover, and broadcast-seeded balansa (*Trifolium michelianum*) and 'AberLasting' (*Trifolium repens x T. ambiguum*) clovers.

Figure 4: Hairy vetch establishment from an October overseeding into orchardgrass and tall fescue, April 15, 2023, Corvallis, Oregon.

Seeding method was not a significant predictor of target species dry matter production, total dry matter production, or target species percentage of total dry matter production. Mean values across all species for target species percentage of total dry matter production were 25.4% for broadcast seeded species and 21.9% for no-till drill seeded species.

Based on these results and given that broadcast seeding and rolling is usually simpler and more cost effective to implement for most pasture managers than is no-till drilling, broadcast seeding can be generally recommended. It is possible that some species in this study were buried too deeply with the no-till drill, limiting their establishment.

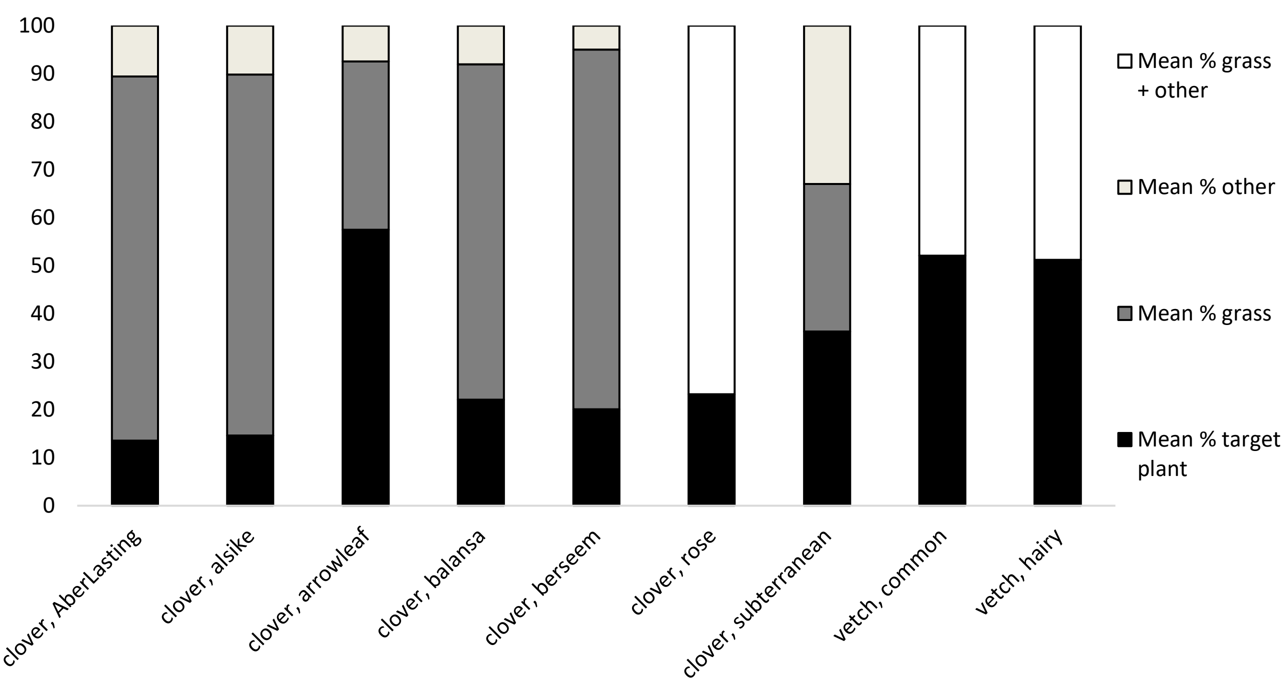


Figure 5: Mean percent contribution of functional group dry matter for all species producing more than 1000 lb/ac dry matter total across both seeding treatments. 'Grass' and 'Other' functional groups for rose clover and the two vetches are not separated.

Mean percent dry matter by functional group for all study species producing more than 1000 lb/acre of dry matter when seeding methods are combined is represented in Figure 4. Composition of the eight annual legume species as a percentage of the total dry matter ranged from 17% to 58%, with a mean of 35%. Arrowleaf clover, common vetch, and hairy vetch (Figure 5) all composed over 50% of the stand total dry matter. For functional grazing purposes, this may be too high and seeding rates may need to be lowered accordingly when seeding into similar circumstances. Composition of the five perennial legume species as a percentage of total dry matter ranged from 5% to 15%, with a mean of 9%. 'AberLasting' clover and alsike clover (*Trifolium hybridum*) were the highest at 14% and 15% respectively. Composition of the three perennial forb species as a percentage of total dry matter ranged from 5% to 7%, with a mean of 6%. Excluded from these data are all the species that were not harvested. Of those, two are perennial legumes (alfalfa and bird's-foot trefoil), three are biennial/perennial forbs (yarrow, radish, kale), and two are annual forbs (turnip, mustard). It is clear that annual legumes are the most successful functional group for overseeding into this study pasture, and that agronomically valuable levels of some perennial legume species were able to be achieved through overseeding.

In Figure 4, both arrowleaf clover and subterranean clover plots had a mean grass composition of less than half of that of all other measured species, suggesting these species may suppress grass growth at these densities. Due to sampling errors mentioned previously, grass and weed (other) composition is not represented separately for rose clover and both vetches.

Total dry matter production of all plants in a plot (Table 3) was highest in plots containing 'AberLasting', alsike, arrowleaf (Figure 6), white, and balansa clovers, and small burnet. Rose clover and both vetches are excluded from this analysis.

Table 3: Target forage species and mean total dry matter production and standard error of all plants found in plots containing the target forage species. Means not sharing a letter are significantly different at the 5% level of significance according to a Tukey's Honestly Significant Difference test.

Species	Mean total dry matter (lb/ac)	Standard Error
clover, 'AberLasting '	9183^{A}	470
clover, alsike	8104^{AB}	798
clover, arrowleaf	7861^{ABC}	840
clover, white	7803^{ABC}	321
burnet, small	6810^{ABCD}	436
clover, balansa	6694^{ABCD}	695
plantain	6115^{BCDE}	738
clover, berseem	5271^{CDEF}	610
clover, subterranean	4531^{DEF}	243
chicory	3646^{EF}	268
clover, strawberry	3543^{EF}	533
clover, red	3494^{EF}	327
clover, Persian	3359^{F}	506
clover, rose	no data	
vetch, common	no data	
vetch, hairy	no data	

Figure 6: Heavy establishment of arrowleaf *clover from no till overseeding, May 29, 2024, Corvallis, Oregon.*

CONCLUSION

As a functional group, annual legumes had the highest percent contribution to overall total forage biomass as compared to perennial legumes and forbs. Among the annual legumes, 'Yuchi' arrowleaf clover, VNS common vetch, and 'Vital' hairy vetch all composed more than 50% of the stand's total dry matter. The only perennial species composing more than 10% of the total stand dry matter were 'AberLasting' and alsike clovers. Alfalfa, birdsfoot trefoil, and yarrow had poor to no establishment and were not harvested. All four of the brassica species were planted in both years of the study and germinated sufficiently each time, but did not establish further, dying mostly in the cotyledon stage in both years. None of these species that failed to grow to maturity are recommended for overseeding under similar circumstances.

Seeding method (broadcast versus no-till drill) did not significantly affect any of the measured parameters across all species nor within any species, suggesting that the simpler and more cost-effective broadcast and roll method is adequate. It is likely that the site preparation process prior to seeding of study species and the species composition and density of the existing study pasture contributed strongly to the ability of some of the study species to adequately establish.

One goal of this study was to assess overseeding in a typical Willamette Valley low-input pasture community with a significant component of bentgrass. The creeping bentgrass ('Penncross') that was initially seeded failed to persist into the second summer, leaving bunch grasses into which overseeding is likely to be more successful. Further investigations should assess overseeding in pasture communities dominated by the dense sod typical of bentgrasses *A. stolonifera* and *A. capillaris*. These grass species spread laterally and can leave little interstitial space between plants for establishment of new forage plant seedlings. Further investigations can emphasize the higher yielding forages from this study and incorporate the lesson that seeding method did not significantly affect seeded forage yields. This would create an opportunity to assess the contribution of different pre-seeding site preparation techniques to overseeded forage establishment and persistence, such as hay/silage cutting, heavy temporary grazing, or non-systemic herbicide application.

LITERATURE CITED

Barnhart, S.K. (2004). Interseeding and No-till Pasture Renovation. Iowa State University Extension and Outreach. *PM 1097,* 1-4.

Bartholomew, P. W. and R.D. Williams. (2010). Overseeding Unimproved Warm-Season Pasture with Cool- and Warm-Season Legumes to Enhance Forage Productivity. *Journal of Sustainable Agriculture*, *34(1–2),* 125–140.

Bartholomew, P.W., Schneider J.M., and R.D. Williams. (2012). Pasture residue amount and sowing method effects on establishment of overseeded cool-season grasses and on total annual production of herbage. *Grass and Forage Science, 66*, 560-568.

Bartholomew, P.W. (2005). Comparison of conventional and minimal tillage for low input pasture improvement. *Forage and Grazinglands, 3(1),* 1-14.

Cuomo, G.J., Jonhson, D.G, and W.A. Head Jr. (2001). Interseeding kura clover and birdsfoot trefoil into existing cool-season grass pastures. *Agronomy Journal, 93(2)*, 458-462.

Hoveland, C.S. (1997). Problems in establishment and maintenance of mixed swards. *Proceedings of the 18th International Grassland Congress 3,* 411-416.

PRISM Group, Oregon State University, https://prism.oregonstate.edu, data accessed 12 Feb 2026.

Schlueter, D. and B. Tracy. (2012). Sowing method effects on clover establishment into permanent pasture. *Agronomy Journal, 104(5)*, 1217-1222.

Smith, S.A., Popp, M., and D. Philipp. (2012). Seedling survival and establishment costs: crimson and white clover in bermudagrass pastures. *Agronomy Journal, 104(6),* 1517-1522.

Thom, E.R., Fraser, T.J., and D.E. Hume. (2011). Sowing methods for successful pasture establishment – a review. *Pasture Persistence – Grassland Research and Practice Series, 15,* 31-38.