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Corvallis Plant Materials Center
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Assessment of Five Understory Treatments on Shrub Establishment

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ABSTRACT

In 2021, the Corvallis Plant Materials Center launched a study to assess the effects of various understory management practices on the survival and growth of shrubs. The goal was to evaluate the potential of different vegetation types and mulch as alternatives to using herbicides to keep the understory bare. The study involved four shrub species and five distinct understory treatments. Over three growing seasons, the study measured the survival, height, and width of the shrubs. The survival rates varied significantly across the treatments. Notably, the plots with wood chips as the understory treatment exhibited significantly higher survival rates than any other treatment. The wood chips likely provided a more stable environment, protecting the roots and retaining moisture. Conversely, the plots with flowering plants in the understory had the lowest survival rates. This suggests that competition from the flowering vegetation for water and nutrients may have negatively impacted shrub establishment. Growth patterns also varied widely among treatments. Shrubs in plots without any vegetation in the understory (either herbicide-treated or wood chip mulched) showed significantly more growth compared to those in vegetated plots.

INTRODUCTION

The USDA Natural Resources Conservation Service (NRCS) is involved in a variety of conservation practices that often include the planting of trees and shrubs including but not limited to Critical Area Planting (342), Hedgerow Planting (422), and Tree and Shrub Establishment (612) to enhance ecosystems. Planting trees and shrubs can offer conservation benefits such as establishing forest cover, enhancing wildlife habitat, controlling erosion, improving water quality, capturing and storing carbon, conserving energy, or providing shelter for livestock. A common approach in these plantings is to remove all competing vegetation from the planting area and maintain a bare understory throughout the establishment period (usually with herbicides). This practice helps reduce competition from other vegetation for nutrients, water, and light—ensuring that newly planted shrubs establish and grow (Davies, 1985; Zutter et al., 1986). In loblolly pine plantations, researchers found a 16% increase in height in year 1 for seedings treated for herbaceous weed control (Yeiser, 1996). Zutter (1986) also found that a decrease in weed cover correlates with loblolly pine growth in the first years of seedling establishment. Other studies (Davies, 1985) looked at the effects of growth when vegetation was clipped or mowed to keep it from competing with shrubs for light, and the results were nearly the same as the non-mowed vegetation. These studies showed that the presence of vegetation decreased soil moisture, creating moisture stress in the seedlings.

In western Oregon and Washington, plantings need constant maintenance to remain free of vegetation. Applying mulch at planting time may save time and money during the years of tree and

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shrub establishment. Mulch can smother existing weeds and prevent new weeds from germinating. Wood chips are good option because they are coarser than other forms of mulch and create a less favorable surface for weed seed germination. For many practices, having bare soil around the trees lowers the ecological benefit of the planting, especially in pollinator hedgerows. It would be beneficial for pollinators and other wildlife to have an herbaceous planting under the trees and shrubs. The purpose of this study was to quantify the effects of vegetation around trees and shrubs during the establishment phase.

MATERIALS AND METHODS

Four different shrub species commonly used in conservation plantings in western Oregon and Washington were selected for use in this study. Red-oiser dogwood (*Cornus sericea*) is a sun loving wetland/riparian shrub that is established easily from hardwood cuttings. Pacific ninebark (*Physocarpus capitatus*) is a riparian shrub that is also established easily from hardwood cuttings and grows vigorously in moist and semi-shaded areas. Western viburnum (*Viburnum ellipticum*) is a shrub commonly found on uplands and forest edges that does well in full sun or partial shade but does not establish well from cuttings. Mock orange (*Philadelphius lewisii*) is a popular shrub used in pollinator hedgerows. It thrives in a wide range of conditions, but usually on forest edges.

Understory treatments were:

1)‘Elkton’ blue wildrye (*Elymus glaucus*): a tall native grass that can grow taller than the shrubs in year 2 when it flowers (sown at 80 seeds/ ft).

2) Sand fescue (*Festuca ammobia*): a native clumping grass that should remain shorter than the shrubs (sown at 80 seeds/ft).

3) Flowers: A mix of native prairie grasses and forbs commonly planted in a pollinator hedgerow (sown at 100 seeds/ft).

4) Wood chips: 4-6 inches deep. Additionally, plots were hand weeded or sprayed with post emergent herbicide as needed to control weeds.

5) Bare ground: Plots were treated with post emergent herbicides to control weeds and keep the plot free of vegetation.

In October 2021, the study area was prepared by spraying herbicide to remove existing vegetation, then the ground was loosened using an offset disk followed by a harrow and roller to create a seed bed. The study was installed using a randomized block design. Each plot measured 25 feet long by 4 feet wide and consisted of 4 individuals of the same species planted 5’ apart. The understory treatment was contiguous throughout the 25 feet per plot. Each treatment was replicated four times. Rows of the plots were placed 15 feet apart on center and the space between the rows not covered by the treatments was seeded with common pasture/turf grasses. All plots with vegetated understory treatments were seeded in October 2021 by hand. Wood chips were installed in January 2022. All shrubs were planted in late January 2022. Red-osier dogwood and ninebark were established using cuttings taken from existing shrubs at the PMC. The Western viburnum was purchased from a local nursery in 1-gallon pots, and the mock orange was purchased as bare root material. The red-osier dogwood roots very well from cuttings therefore only one cutting per planting location in the plots

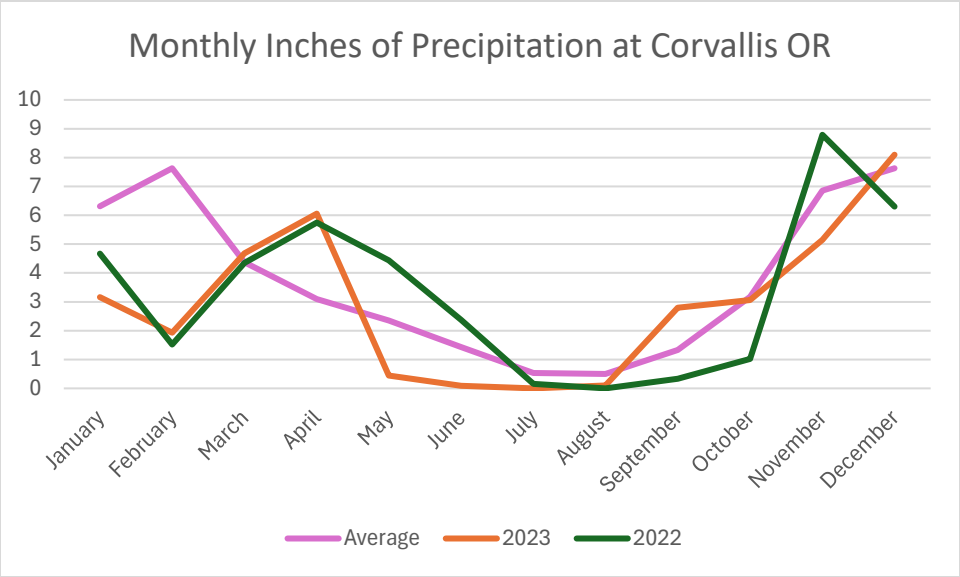

Figure 1. Monthly precipitation averages compared to 2022 and 2023 for Corvallis Oregon. (PRISM 2026)

was installed. Ninebark has a lower success rate; therefore two cuttings were installed at each location. In locations with two living cuttings, we removed one during the summer of 2022. All plant material was estimated to be about 1-2 years old at the time of planting.

The entire study was irrigated every two weeks from late June through August to aid in summer survival for the first year (2022). This is in line with current NRCS recommendations for hedgerow establishment (USDA-NRCS Hedgerow planting (422) for Pollinators in Western Oregon & Washington.). Treatment blocks with vegetated understories were not managed by mowing during the growing season in 2022. A weed whacker was used to knock down dead vegetation in winter of 2023. Bare plots and plots with wood chips were sprayed/weeded as needed.

Shrub survival data was taken twice per year, usually in May, to assess winter survival and again in August or September to assess summer survival. Baseline height and width data was collected at planting time. Two width measurements were collected per plant. One was at the widest point of the canopy and the second was measured perpendicular to the first. Height and width measurements were also taken in late summer to assess the yearly growth of each shrub. A herd of elk occasionally browsed on the tallest shrubs; this was noted when collecting data. Elk browse did not affect shrub survival but did have an impact on shrub height. This was partially random but affected taller individuals more than short individuals.

RESULTS AND DISCUSSION

We hypothesized that plots with wood chips understory would have the highest rates of shrub growth and survival due to the added benefits of moisture retention and lack of competition from other vegetation. Bare ground plots would also be free of competing vegetation but would experience high levels of moisture loss in the summer months which could slow down growth. The effects of vegetation in the understory on shrub growth were mostly unknown but were assumed to affect growth negatively.

Survival per species per treatment: Each species had 16 individual plants per treatment, randomized throughout four blocks. Figure 2 shows the number of individuals that died after two growing seasons. Overall, ninebark had the highest rate of death, this mostly occurred during a very dry summer in the second growing season (see Figure 1). Plants experienced below average rainfall

in May-October of 2023. Note that only 25% of the ninebark plants died in the wood chips plots compared to 56%, 56%, 63%, 50% of the bare, blue wildrye, flower, and fescue plots respectively.

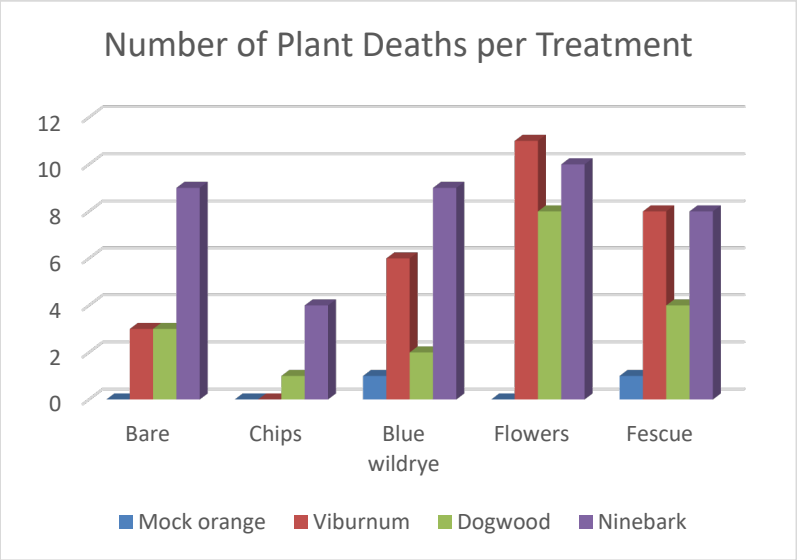

Figure 2. Number of plants of four species of shrubs that died out of 16 planted per understory treatment after two growing seasons in Corvallis, OR.

We surmise this is likely due to the added moisture retention provided by the wood chips. Mock orange had highest survival of all species across all understory treatments. Only two mock orange plants died, both in vegetated plots (one in blue wildrye and one in fescue). The viburnum plots had the most variable treatment effects compared to the other species. It had the highest survival in the unvegetated plots. No plants died in the wood chips plots and only three died in the bare plots. Survival in wood chips was 100% and survival in the flowers was 30%. Red-osier dogwood had mixed results. The highest survival was in the wood chip plots, followed by the blue wildrye plots, and then the bare plots.

Percent shrub survival was analyzed using a one-way analysis of variance (ANOVA) using Statistix 10 Analytical Software (Tallahassee, FL). Means with difference at 5% level of probability were separated using Tukey's Honest Significant Difference at $P< 0.05$ (Table 1).

Table 1. Percent Survival of Shrubs After Two Growing Seasons with Varying Understory Treatments. Corvallis, OR, 2023-24.

Treatment	Mock orange	Viburnum	Ninebark	Dogwood	Mean*
Chips	1.00	1.00	0.750	0.940	0.921 a
Bare	1.00	0.81	0.438	0.810	0.765 a, b
Blue wildrye	0.94	0.63	0.438	0.875	0.718 b, c
Fescue	0.94	0.50	0.500	0.750	0.671 b, c
Flowers	1.00	0.31	0.375	0.500	0.546 c

*= Means followed by the same letter are not statistically different in Tukey HSD comparisons.

Survival per treatment- The plots with a wood chips understory had the highest survival of all treatments (Figure 3). The survival differences between the bare plots and the blue wildrye plots were surprisingly close. The plots with flowers in the understory had survival rates of 55%. The flower plots were dominated in the first growing season by a very tall annual wildflower, showy tarweed (*Madia elegans*). The dense foliage created a better habitat for rodents such as voles. Voles created tunnels around the shrubs, damaged the shrubs by girdling them, and created holes that dried

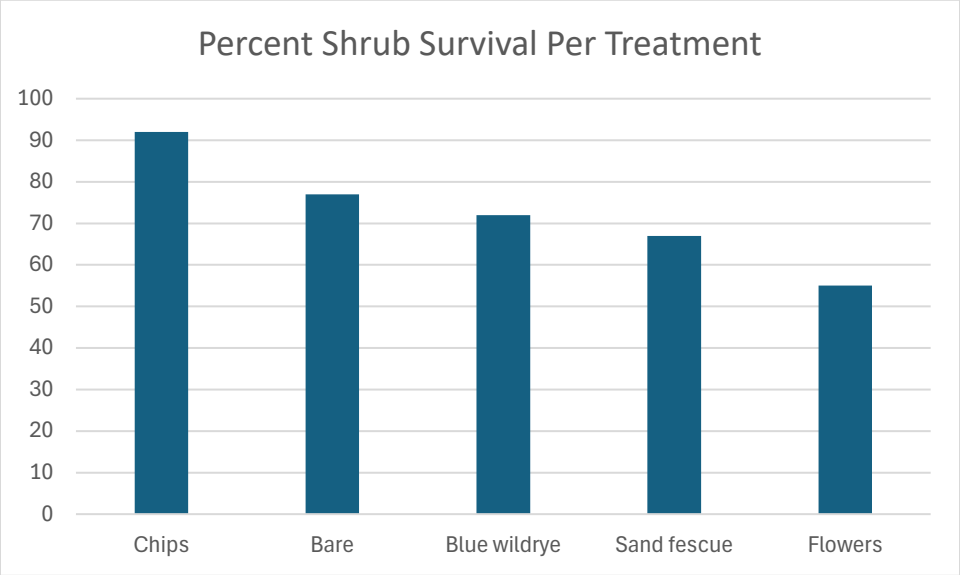

Figure 3. Percent survival of shrubs with varying understory treatments after two growing seasons in Corvallis, OR.

out the root zone. Many holes were noticed very close to the base of the shrubs. Vole damage was not as impactful in the grass plots because the vegetation was not very tall in the first year. Raptors and coyotes are the most common predator of voles at the PMC and the tall vegetation in the flower plots made it difficult for the raptors to locate/hunt the voles.

Growth per species per treatment- All species exhibited the highest rates of growth in the non-vegetated plots. For example, mock orange growing in a plot with chips had a mean increase in height of 15 inches in 2 years. In contrast, mock orange growing in the plots with blue wildrye had mean increase in height of only 3.6 inches in 2 years. This is statistically significant and quite a difference in the growth and establishment of shrubs in a conservation planting. Even if a plant managed to co-exist within the competing vegetation, the growth of the shrub was severely affected. This effect was seen across all the species in vegetated plots (Table 2). Ninebark was the only shrub to show a lack of clear statistical significance in the height growth between vegetated and non-vegetated plots, this was due to low and variable number of plants that survived.

Table 2. Average height of shrubs after growing seasons with varying understory treatments, Corvallis OR, 2022-2023.

Treatment	Mock orange (in)	Viburnum (in)	Ninebark (in)	Dogwood (in)	Mean*(in)
Chips	15.2 a	15.2 a	15.8 a	27.5 a	17.9 a
Bare	13.3 a	14.7 a	11.3 a, b	25.6 a	16.7 a
Blue wildrye	3.6 b	6.4 b	4.0 b	14.4 b	7.1 b
Fescue	5.4 b	4.6 b	6.0 a, b	10.6 b, c	6.7 b
Flowers	1.5 b	2.1 b	1.7 b	2.8 c	2.0 c

*= Means followed by the same letter are not statistically different in Tukey HSD comparisons.

Each of the four shrub species included in this study has its own unique growth habit and growth rate. A change in height doesn't always explain all the growth that a shrub exhibited in the first two years of establishment. We collected data on width each spring and fall to try to capture different dimensions of the variable growth forms of the different shrubs. We also wondered if the shrubs would grow more upright in the presence of competing vegetation. The results show a decrease in

height in plots with a vegetated understory, so this hypothesis was false. Width data was collected by measuring the shrub at its widest point, then taking an additional width measurement perpendicular the first point. For data analysis, the two width data points collected at planting time (spring of 2022) were added together and then subtracted from the combined width data points collected in the fall of 2024. These numbers follow a similar pattern to the height data in which the plots with a vegetated understory show significantly less grow than the non-vegetated plots.

Table 3. Comparison of calculated width of shrubs after two growing seasons with varying understory treatments, Corvallis, OR, 2022-23

Treatment	Mock orange (in)	Viburnum (in)	Ninebark (in)	Dogwood (in)	Mean*(in)
Chips	36 a	21.8 a	28.5 a	65.9 a	38.1 a
Bare	29 a	17.1 a	17.5 a, b	48.5 b	28.2 b
Blue wildrye	12.3 b	3.5 b	7.7 b	7.9 c	7.1 c
Fescue	8.8 b	3.5 b	5.1 b	5.3 c	6.5 c
Flowers	3.9 b	0.3 b	2.8 b	0.6 c	1.6 c

*= Means followed by the same letter are not statistically different in Tukey HSD comparisons.

One notable difference in the width data is plots with a wood chips understory, are statistically significant from the bare plots. This is likely due to the growth patterns of the ninebark and red osier dogwood. Since these shrubs were installed using cuttings, the initial points of growth are limited to the few buds on the cutting, creating a few long shoots in two planes (perpendicular), which are easy to measure. Also, the differences in growth within a treatment are likely to be more distinct when using cuttings because there is less variability in the starting material. The cuttings were all the same height, age class, and diameter, and usually had the same number of buds. Potted material, like the mock orange, were variable in size at planting time and had many buds. This creates variability in the initial vigor of the individual shrubs and affects the placement of overall growth. A mock orange plant might have 30 buds and each bud grows 1 inch of new growth. This type/amount of growth wouldn't be fully captured in the width data collection methods used in this study.

CONCLUSION

Many sources recommend removing vegetation around trees and shrubs during their establishment phase. However, data is limited for showing the effects of vegetation around trees and shrubs in western Oregon and Washington. This study confirmed that having a non-vegetated understory during tree and shrub establishment is important for growth and survival. Vegetation had a significant impact on the growth of the trees and shrubs evaluated in this study. This study also showed that using wood chips as mulch around shrubs provided the best environment for growth and survival among the treatments. Further studies about this topic would include a more specific study to understand the minimum size of a non-vegetated area around the plant that won't compromise survival and growth.

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