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Beef Cattle Sciences

Techniques to improve seeding success of forage kochia in exotic annual grass invaded sagebrush rangelands[1]

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Synopsis

Seeding forage kochia during winter (February) generally increased its initial establishment compared to fall seeding (November). The performance of year-old seed that had been properly stored was not markedly different compared to freshly harvested seed when both were seeded during the winter.

Summary

The objectives of this study were to determine which seeding techniques are appropriate for enhancing the establishment of forage kochia, a promising revegetation species for sagebrush rangelands prone to invasion by exotic annual grasses. Specifically, we evaluated three seeding methods, two timings of seeding, and the efficacy of stored versus freshly harvested at two sites with five replicated randomized blocks per study site. Our findings indicate shallow drill seeding forage kochia during late winter (February) will generally increase its initial establishment success over broadcast seeding in winter and broadcast or drill seeding during the fall. In addition, we did not observe a marked difference in the performance of year-old seed that had been properly stored compared to freshly harvested seed when both were seeded during the winter. Lastly, seed enhancement treatments designed to improve germination and emergence did not improve establishment of forage kochia compared to shallow drill seeding in the winter, suggesting seed germination and emergence may not be limiting factors for establishment if appropriate planting timing and techniques are employed.

Introduction

Revegetation of arid sagebrush rangeland invaded by exotic annual grasses is arguably the most pressing management challenge that contemporary rangeland managers face. This challenge is particularly acute on warmer and dry sagebrush rangelands. Not only are these rangelands most susceptible to invasion by exotic annual grasses, but, because of inherently low and erratic precipitation and extremes in temperature, they are also the most difficult to rehabilitate once degradation has occurred. The relatively harsh environment associated with these areas greatly limits the number of revegetation species that can be

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successfully established. Crested wheatgrass has been effectively used to revegetate exotic annual grass invaded rangeland (Davies 2010), whereas other species have not consistently established (Davies and Johnson 2015, OBC-funded research project).

The challenge of revegetating arid sagebrush rangeland is particularly acute for livestock managers who rely on these rangelands to provide a reliable proportion of their operation's forage base. Invasion by exotic annual grasses and associated degradation of rangeland productivity greatly limits forage availability and quality. Exotic annual grasslands can provide a sufficient quantity and quality of early season forage, but often fail to produce the availability of quality forage needed to meet the nutritional demands of livestock by early-summer through late fall. In addition, although crested wheatgrass has been successfully used to revegetate rangelands invaded by exotic annual grasses, these seedings are typically of a deficient quality by the middle to late summer to adequately meet the nutritional requirements of grazing livestock. Forage kochia is a revegetation species that could hold promise for improving the diversity, productivity, and later-season quality of rehabilitated arid sagebrush rangelands. Forage kochia can be used to significantly increase later season protein availability to wildlife and livestock when cool season grasses are dormant (Schauer et al. 2004).

However, efforts to establish forage kochia have produced inconsistent results in the northern Great Basin that may be related to seeding method (broadcast vs. drill), timing (fall vs. late winter/spring), and/or quality degradation of stored seed.

The objectives of this study were to determine which seeding techniques are appropriate for enhancing the establishment of forage kochia. Specifically, we evaluated three seeding methods, two timings of seeding, and the efficacy of stored versus freshly harvested seed.

Materials and Methods

Two study sites in central Harney County, Oregon were selected for inclusion in the study during 2014. Study sites were separated by 26 air miles and located in Loamy 10-12" Ecological Sites. The Loamy 10-12" PZ Ecological Site was selected because it comprises a large proportion of sagebrush rangeland for which forage kochia may be applicable as a revegetation species. We were also interested in evaluating the revegetation efficacy of forage kochia in areas invaded by exotic annual grasses, therefore, study sites were also selected because current vegetation is dominated by cheatgrass with a lesser amount of crested wheatgrass. Existing vegetation at each site was treated with glyphosate during the summer and then burned with a trailer mounted propane torch in the fall to prepare a seedbed for seeding treatments. The following seeding treatments were applied to 6 X 18 ft plots arranged in a randomized block design, with 5 replicated blocks per study site:

1. Fall broadcast of year-old seed
2. Fall drill of year-old seed
3. Fall broadcast of pellets made with year-old seed
4. Fall drill of pellets made with year-old seed
5. Winter broadcast of year-old seed
6. Winter drill of year-old seed
7. Winter broadcast of pellets made with year-old seed
8. Winter drill of pellets made with year-old seed
9. Winter broadcast of freshly harvested seed
10. Winter drill of freshly harvested seed
11. Winter broadcast of pellets made with freshly harvested seed
12. Winter drill of pellets made with made with freshly harvested seed
13. Unseeded control
14. Fall drill of year-old seed with a hydrophobic coating

Year 1 fall and winter seeding treatments were conducted during early November 2014 and early February 2015, respectively. Forage kochia was seeded at 2 lbs/ac pure live seed in all plots that received a seeding treatment. Vegetation cover and

density by species were measured during the summers of 2015and 2016 in each Year 1 treatment.

In Year 2, the following seeding treatments were replicated at each study site:

1. Fall broadcast of year-old seed
2. Fall drill of year-old seed
3. Winter broadcast of year-old seed
4. Winter drill of year-old seed
5. Winter broadcast of freshly harvested seed
6. Winter drill of freshly harvested seed
7. Unseeded control

Year 2 fall and winter seeding treatments were conducted during early November 2015 and mid-February 2016, respectively. Forage kochia was seeded at 2 lbs/ac pure live seed in all plots that received a seeding treatment. Seeds or pellets were planted to a depth of approximately 0.5-inch in plots that received a drill seeding treatment. Seeds or pellets were hand broadcasted evenly across plots that received a broadcast seeding treatment. Vegetation cover and density by species were measured during the summers of 2016 and 2017 in each Year 2 treatment.

Year 1 and 2 results were summarized and are presented and discussed below.

Results

Differences occurred in forage kochia establishment success between Year 1 (seeded in fall 2014 and late winter 2015) and Year 2 (seeded in fall 2015 and later winter 2016) in the study. Overall establishment success associated with Year 2 seeding treatments was much lower than that associated with Year 1 seeding treatments (Figures 1-4). This disparity may have been related to differences in precipitation among the two establishment years (Table 1). While the sites experienced similar crop year (October – September) precipitation during 2014-2015 and 2015-2016 (Table 1), the additional half inch of precipitation received in Year 1 occurred largely during a potentially critical time for kochia establishment in late spring and summer.

Results from the Year 1 seeding suggested planting during the winter was a more effective time for establishing forage kochia than fall planting, regardless of whether stored (i.e., year-old) or freshly harvested seed was used (Figure 1). Site 1 demonstrated a similar result for the Year 2 seeding when kochia was drill seeded (Figure 2-A). It appears that fall-seeded forage kochia might germinate and emerge shortly after planting and subsequently suffer high winter mortality, whereas emergence of seed sown in the winter is likely delayed until a more favorable time during the spring. Site 2 experienced a longer period of snow cover after the Year 2 fall planting which may have mitigated winter mortality risk leading to similar establishment densities among fall and winter plantings (Figure 2-B).

Shallow drill seeding conducted in the winter tended to produce better initial establishment than broadcasting seed at both Sites 1 and 2 in the Year 1 seeding and at Site 1 in the Year 2 seeding (Figures 1-4). Results from the Year 1 seeding also indicated drilling bare seed outperformed seed sown during the winter in pellets (Figure 1), enhancements designed to improve seed germination and emergence, suggesting seed germination and emergence may not be major limiting factors for forage kochia establishment when seeding during the winter months. Similarly, seeds that had been stored for a year and then treated with a hydrophobic coating, an enhancement designed to delay germination of fall-planted seed until spring, performed poorly compared to similar untreated seed (i.e., year-old seed) planted in the winter (Figures 1 and 3). Again, results of this study indicate winter seeding is generally superior to fall seeding which suggests delaying germination of fall-seeded forage kochia until late winter or spring should improve establishment performance of forage kochia. Therefore, we suspect the amount and/or formulation of the hydrophobic coating tested in this study needs adjustment, and deserves further investigation.

Conclusions

In conclusion, results from this experiment indicate that shallow drill seeding forage kochia during late winter (February) will generally increase its initial establishment success over broadcast seeding in winter and broadcast or drill seeding during the fall. In addition, we did not observe a marked difference in the performance of year-old seed that had been properly stored compared to freshly harvested seed when both were seeded during the winter. We suspect struggles with using year-old seed are likely related more to the timing of seeding (fall vs winter) than seed age, whereby seed available for fall planting has, by definition, been stored for at least one year. Our results suggest this seed will perform satisfactorily if properly stored and planted in the winter. Lastly, seed enhancement treatments designed to improve germination and emergence did not improve establishment of forage kochia over shallow drill seeding in the winter, suggesting seed germination and emergence may not be limiting factors for establishment if appropriate planting timing and techniques are employed.

Acknowledgments

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Literature Cited

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Schauer et al. 2004. Rangelands 26:8-11.

Table 1. Crop year and monthly precipitation totals for Sites 1 and 2 during establishment Years 1 and 2 of the study.

	Site 1		Site 2	
	Year 1	Year 2	Year 1	Year 2
	(inches)		(inches)	
October	0.66	1.15	0.69	1.23
November	1.32	0.97	1.33	1.11
December	1.81	2.22	2.05	2.98
January	0.32	1.01	0.51	1.25
February	0.96	0.29	1.21	0.44
March	0.57	0.88	0.78	1.28
April	0.67	0.45	0.64	0.48
May	2.38	1.88	2.37	1.35
June	0.02	0.39	0.12	0.23
July	0.87	0.32	0.87	0.36
August	0.05	0.02	0.06	0.00
September	0.92	0.3	0.5	0.12
Total Crop Year	10.55	9.88	11.13	10.83

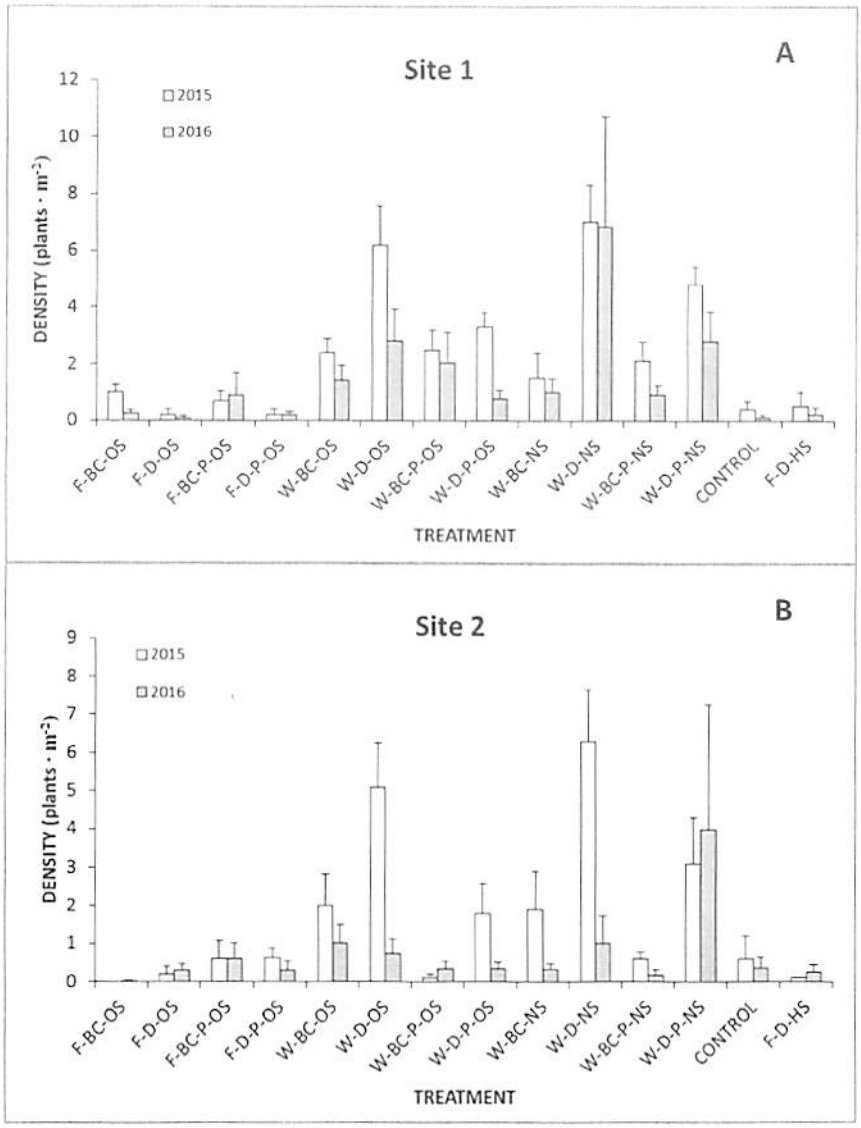

Figure 1. Density (mean + SE) of forage kochia the two growing seasons after Year 1 seeding treatments were applied. F-BC-OS: Fall broadcast of year-old seed; F-D-OS: Fall drill of year-old seed; F-BC-P-OS: Fall broadcast of pillows made with year-old seed; F-D-P-OS: Fall drill of pellets made with year-old seed; W-BC-OS: Winter broadcast of year-old seed; W-D-OS: Winter drill of year-old seed; W-BC-P-OS: Winter broadcast of pillows made with year-old seed; W-D-P-OS: Winter drill of pellets made with year-old seed; W-BC-NS: Winter broadcast of new seed; W-D-NS: Winter drill of new seed; W-BC-P-NS: Winter broadcast of pillows made with new seed; W-D-P-NS: Winter drill of pellets made with new seed; CONTROL: Not seeded; and F-D-HS: Fall drill of old seed with hydrophobic coating.

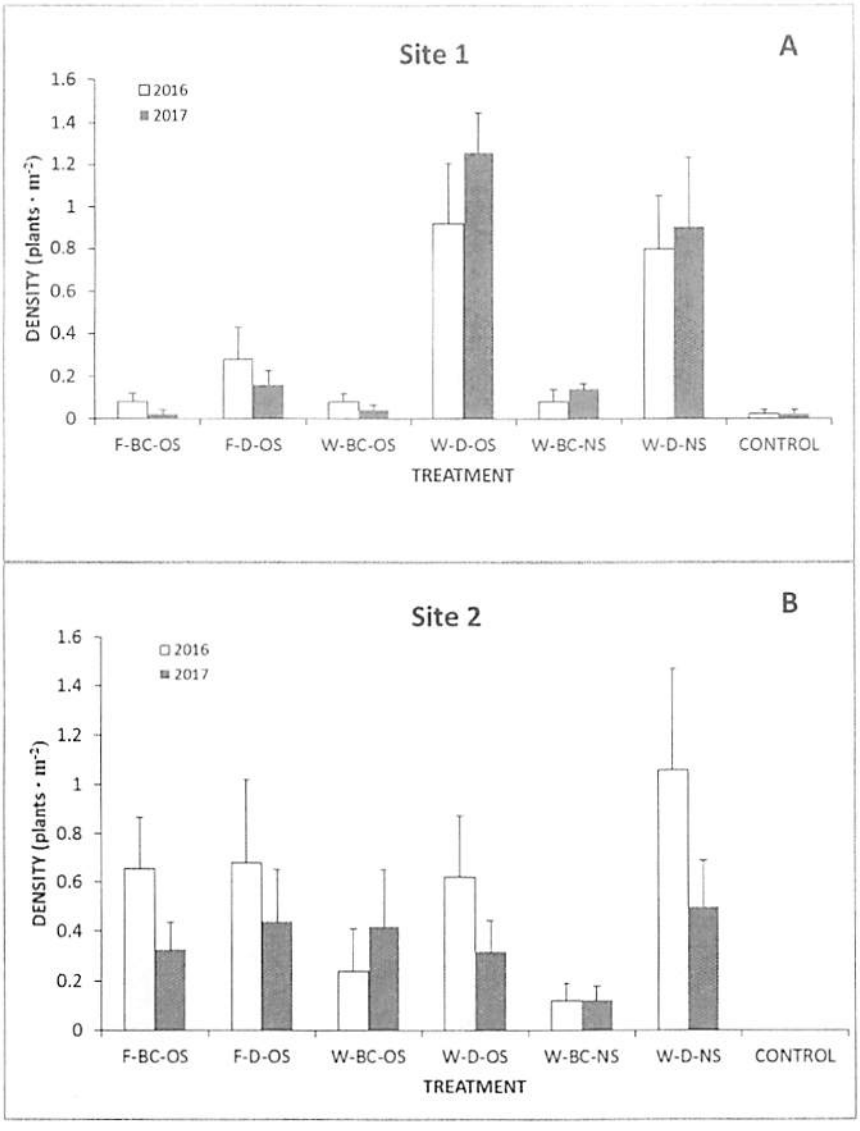

Figure 2. Density (mean + SE) of forage kochia the two growing seasons after Year 2 seeding treatments were applied. F-BC-OS: Fall broadcast of year-old seed; F-D-OS: Fall drill of year-old seed; W-BC-OS: Winter broadcast of year-old seed; W-D-OS: Winter drill of year-old seed; W-BC-NS: Winter broadcast of new seed; W-D-NS: Winter drill of new seed; CONTROL: Not seeded.

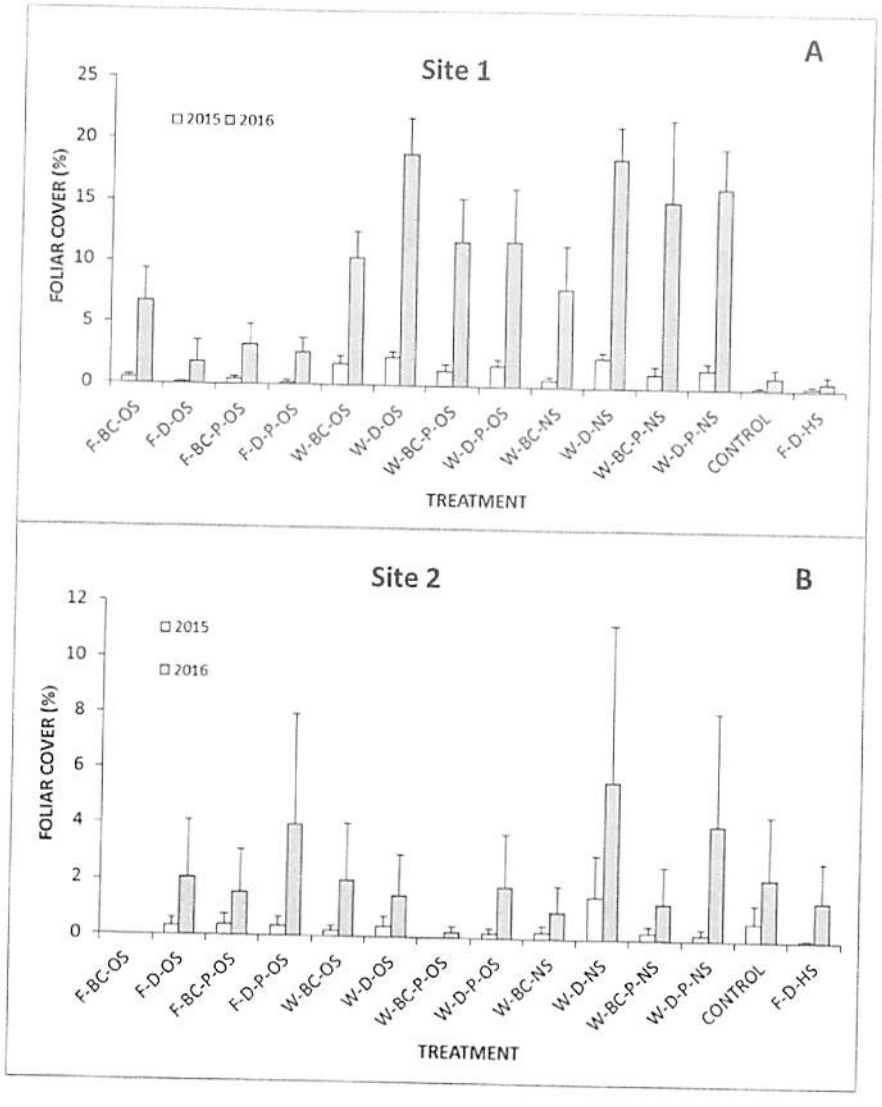

Figure 3. Foliar cover (mean + SE) of forage kochia the two growing seasons after Year 1 seeding treatments were applied. F-BC-OS: Fall broadcast of year-old seed; F-D-OS: Fall drill of year-old seed; F-BC-P-OS: Fall broadcast of pillows made with year-old seed; F-D-P-OS: Fall drill of pellets made with year-old seed; W-BC-OS: Winter broadcast of year-old seed; W-D-OS: Winter drill of year-old seed; W-BC-P-OS: Winter broadcast of pillows made with year-old seed; W-D-P-OS: Winter drill of pellets made with year-old seed; W-BC-NS: Winter broadcast of new seed; W-D-NS: Winter drill of new seed; W-BC-P-NS: Winter broadcast of pillows made with new seed; W-D-P-NS: Winter drill of pellets made with new seed; CONTROL: Not seeded; and F-D-HS: Fall drill of old seed with hydrophobic coating.

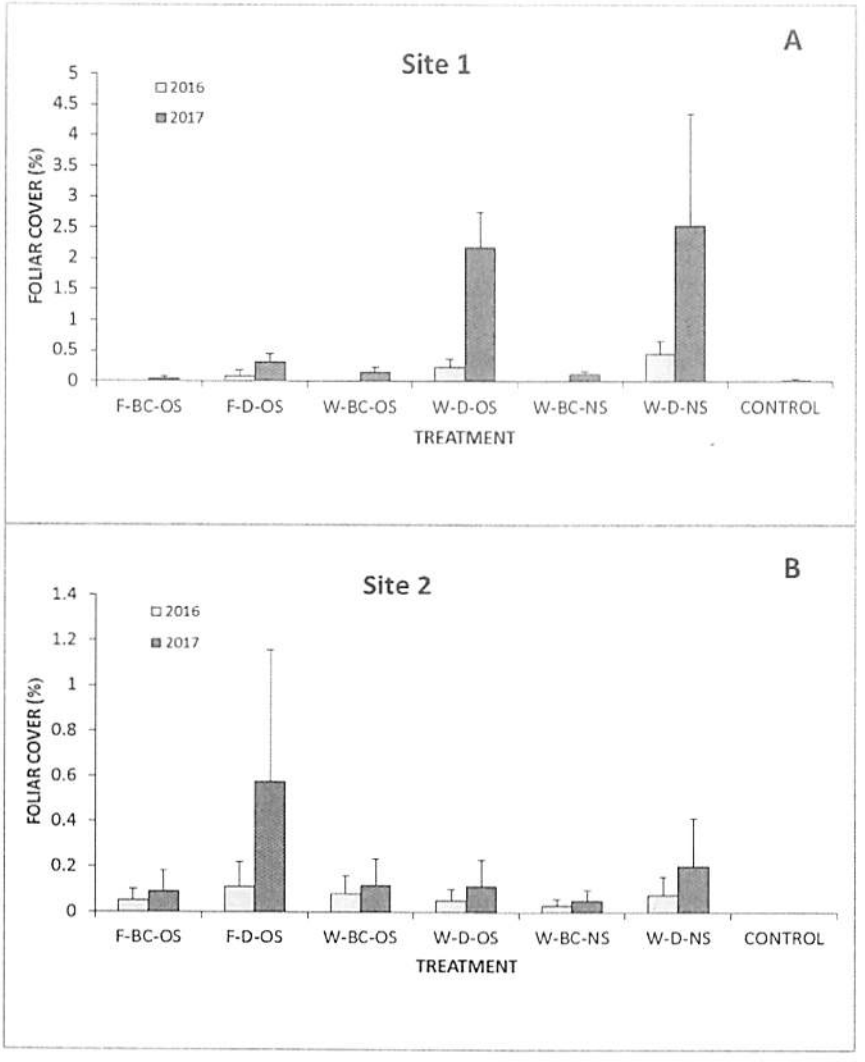

Figure 4. Foliar cover (mean + SE) of forage kochia the two growing seasons after Year 2 seeding treatments were applied. F-BC-OS: Fall broadcast of year-old seed; F-D-OS: Fall drill of year-old seed; W-BC-OS: Winter broadcast of year-old seed; W-D-OS: Winter drill of year-old seed; W-BC-NS: Winter broadcast of new seed; W-D-NS: Winter drill of new seed; CONTROL: Not seeded.