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IMPACT OF NITROGEN FERTILIZATION AND STUBBLE BURNING ON THE DOWNY BROME SEEDBANK IN A WHEAT-FALLOW ROTATION.

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INTRODUCTION

Downy brome (*Bromus tectorum* L.) is one of the major weed problems facing dryland winter wheat growers in the Pacific Northwest. Many of the practices used for the production of dryland winter wheat have an impact on downy brome, either directly or indirectly. For example, it has been shown that application of nitrogen fertilizer, if improperly timed, can increase downy brome growth (Anderson, Ball et al.). Burning of wheat crop residue after harvest has commonly been used as a method of controlling downy brome (Rasmussen). The objective of field burning is to destroy downy brome seed produced in the previous wheat crop. The effectiveness of stubble burning in reducing downy brome seed has not been well documented, although its use for this purpose is common. Knowing the relative contribution of nitrogen fertilization and stubble burning to the overall downy brome problem could help our understanding of why downy brome is such a problem for growers of winter wheat. Practices that affect the distribution, viability, and number of seeds in the seedbank have a definite impact on weed populations (Ball). The "seedbank" is defined as the reserve of seeds in the soil that give rise to weed infestations.

Experimental plots initiated in 1931 at the Pendleton Experiment Station have been used to study the long-term the effects of crop residue management practices such as nitrogen fertilization and stubble burning on soil properties and crop production in a dryland winter wheat crop rotation. Our objective was to utilize this long-term study to examine the effects of nitrogen fertilization and stubble burning on the quantity of downy brome in the seedbank.

METHODS AND MATERIALS

The study site is located at the Columbia Basin Agricultural Research Center near Pendleton, OR. The crop rotation is dryland winter wheat-fallow with conventional moldboard plow tillage. Experimental treat-ments employed on the site in each crop cycle since 1931 include nitrogen fertilization rates, organic amendment application, and stubble burning. This site is one of the oldest replicated research experiments in the western United States with a documented history of crop variety, tillage, date of seeding, and grain yield (Rasmussen and Parton). Treatments are imposed on plots each crop year in the wheat-fallow rotation, and a corresponding set of plots are treated in alternate years so that both fallow and cropped plots are available for observation in any given year. Soil samples were taken in both post-harvest stubble and pre-plant winter wheat in November 1994 to evaluate differences in downy brome seed populations due to various long-term treatments.

The experimental design is an ordered block consisting of nine treatments and two replications. Plot size is 38 by 132 ft. Treatments included: no burning + 80 lb/A N, no burning + 40 lb/A N, no burning + 0 lb/A N, no burning + pea vine addition (equivalent to 30 lb/A N), no burning +

manure addition (equivalent to 100 lb/A N), spring burning of wheat stubble + 80 lb/A N, spring burning of wheat stubble + 40 lb/A N, spring burning of wheat stubble + 0 lb/A N, and fall burning + 0 lb/A N. These treatments have been applied in each crop year since initiation of the study in 1931. Treatments that received N (32-0-0 shanked 6 inches deep with 10 inch spacing) were fertilized in October prior to seeding. Pea vines, or manure were broadcast in April prior to plowing down wheat stubble.

Multiple soil cores to a depth of 2 inches were taken in November of 1994 in post-harvest winter wheat stubble and to a depth of 6 inches in the pre-plant winter wheat plots. Downy brome seed was separated from the soil mineral fraction by flotation in a magnesium sulfate solution and sieving to extract seed. Downy brome seed were counted and expressed as number of apparently viable seed per m^2. Seeds that were physically damaged or decayed were also counted and recorded as dead seed per m^2.

RESULTS AND DISCUSSION

A general comparison between live and dead downy brome seed for samples taken in November pre-plant to wheat, and for samples taken in post-harvest wheat stubble illustrates that considerable downy brome seed mortality occurs during the time between the post-harvest period and when wheat is again seeded after a year of fallow (Table 1).

Long-term application of 40 or 80 lb/A of N to winter wheat without stubble burning resulted in higher post-harvest levels of live downy brome seed in the soil than in the control (0 lb/A) (Table 1). The higher level of seed from 40 compared to 80 lb/A N pre-plant and post-harvest may have been a function of increased wheat competitiveness with downy brome at the

Table 1. Downy brome seedbank estimates from soil samples taken in November 1994 from pre-plant winter wheat (6 inch depth) and post-harvest wheat stubble (2 inch depth) - Pendleton.

		Pre-plant (1995 crop)			Post-harvest (1994 crop)		
Burn	Nitrogen	Live	Dead	Total	Live	Dead	Total
	lb/A	seed/m^2					
NB	80	26	1395	1421	947	39	986
NB	40	197	1842	2039	1500	26	1526
NB	0	13	237	250	237	53	290
NB	M(100)	132	1000	1032	592	0	592
NB	P(30)	26	513	539	224	13	237
SB	80	53	671	961	329	0	329
SB	40	66	171	237	105	0	105
SB	0	39	368	407	118	0	118
FB	0	26	53	49	118	0	118
LSD	(0.10)	89	535	576	359	NS	392

NB = No residue burning, SB = spring burn, FB = fall burn, M(100) = manure supplied approximately 100 lb N/A, P(30) = pea vines supplied approximately 30 lb N/A.

higher N application rate. This suggests that optimum N fertilization of winter wheat, although necessary for maximal wheat yields, can also be a long-term factor contributing to the overall downy brome problem by increasing the size of the downy brome seedbank. Mineral N fertilizer, as applied in this study, increased the downy brome seedbank.

Organic amendments of pea vines or manure did not significantly increase ($p > 0.10$) post-harvest downy brome seedbank levels to the extent of mineral N application, even though the rates of N applied were comparable to, but in a different form than the mineral N treatments. This indicates that the form of applied N and the time that N is available to the wheat crop and downy brome plant can control the size of the downy brome seedbank.

Spring burning of wheat stubble reduced the post-harvest downy brome seedbank in the 40 and 80 lb/A N fertilization treatments. Spring burning reduced the pre-plant levels of live downy brome seed only at the 40 lb/A N fertilization rate. From these results, it can be concluded that long-term burning of wheat stubble can be used to reduce downy brome seedbank levels.

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