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Defining Optimum Nitrogen Fertilization Practices for Perennial Ryegrass and Tall Fescue Seed Production Systems in the Willamette Valley

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ABSTRACT

Oregon grass seed growers do not monitor crop or soil nitrogen (N) levels during the growing season and often apply fertilizer N in excess of recommended rates. Excessive fertilizer N use may result in leaching losses. This is the second year of a three-year study with the following objectives: 1) Determine the level of spring applied nitrogen fertilizer needed for optimizing both crop and economic returns over the life of the stand; 2) Update OSU Extension Service Fertilizer Guidelines; and 3) Develop educational programs to reduce excessive N fertilization. Large scale on-farm plots were established during the spring, 1998 in three perennial ryegrass and three tall fescue fields. The fields were selected to represent soil types typically used for seed production in the Willamette Valley. Spring fertilizer treatments of 0, 45, 90, 135, 180, 225, and 270 lb N/a were split-applied (50/50) using precision application equipment. Normal grower equipment was used to swath and combine plots. Yields were measured using a weigh-wagon. Crop and soil samples were obtained for N uptake, soil N levels, and yield components. Results from the second-year crop indicated N levels above 135-180 lb N/a for perennial ryegrass and 90-135 lb N/a for tall fescue did not statistically increase seed yield.

INTRODUCTION

Improved environmental quality, energy and resource conservation, and increased economic sustainability through better nitrogen use is the long-term goal of this project. Oregon's Willamette Valley is one of the premier grass producing areas in the United States. Nitrogen (N) is the most critical nutrient affecting grass seed yield. The timing, rate, and type of N material used are all factors under the control of land managers. Traditionally, Oregon grass seed growers do not monitor crop or soil N during the season and often apply fertilizer N in excess of recommended rates. Mismanagement of fertilizer N could result in high N losses through leaching, thus, impacting water quality. Excessive N rates also may be detrimental to seed yield and quality.

Several studies during the last decade by the research and Extension faculty committed to this proposal have addressed N fertilization in grass seed production systems. However, some grass seed growers continue to use N fertilizer rates in excess of that recommended by OSU soil fertility guides for seed crops. Horneck and Hart¹ reported results from a grass grower survey in which the average N application rates for perennial ryegrass and tall fescue were 29% greater than OSU Extension Fertilizer Guide recommendations. Their data reported Willamette Valley grass growers typically apply between 125 to 250 lb/a of N annually to grass seed production fields. We estimate that fertilizer rates between 90 and 120 lb N/a for tall fescue and between 100 and 140 lb N/a for perennial ryegrass may be sufficient for maximum seed yield. Rates higher than current OSU Extension guidelines have shown in previous research to reduce grass seed yields or have a null affect. Furthermore, excessive fertilizer use contributes to economic losses.

¹ Horneck, D.A. and J.M. Hart. 1988. A survey of nutrient uptake and soil test values in perennial ryegrass and turf type tall fescue fields in the Willamette Valley. p. 13-14. In H.W. Youngberg (ed.) 1988 Seed Production Research. Dept. of Crop Sci., EXT/CrS 74. Oregon State Univ., Corvallis.

In addition, public concern for water quality in agricultural systems has pointed out the need to reexamine and improve current fertilizer recommendations for grasses grown for seed. These intensely managed grass cropping systems are suited for poorly drained to well drained soil types, but the extent to which they affect water quality is poorly understood. A major USDA-ARS, USEPA, and OSU collaborative research project headed by S.M. Griffith to determine long term impacts that grass seed production has on surface and ground water quality in poorly-drained soils is currently underway. In addition to the water quality project, a long-term grass seed cropping system project that Griffith, Young, and Chastain serve as cooperators is studying the fertility of tall fescue, perennial ryegrass, and fine fescue under non-thermal residue management conditions and legume rotations. Recent changes in residue management to non-thermal systems, a desire to improve grower economic yields, and better understanding of water quality impacts must be connected to current farming practices.

Culminating from the projects listed above, and other studies using small plots, is information on N fertility management of grasses grown for seed. This information needs to be demonstrated with large scale on-farm plots for the purpose of revising current fertilizer guides and demonstrating to producers the need to carefully monitor and/or reduce their annual N inputs. We feel that this can be accomplished through revised fertilizer guides and educational outreach programs. Possible reductions in the average grower annual N input could be 30% or more.

MATERIALS AND METHODS

Large scale on-farm plots averaging 4.2 acres per site were established in 1998 at 6 locations (3 perennial ryegrass, 3 tall fescue) prior to fertilizer applications. One North Valley and two South Valley sites for each species were established, encompassing soils in poorly drained to moderately well drained conditions (e.g., Concord-Amity and Woodburn soil types). All sites were in their first crop year and specific information for each site is shown in Table 1.

Plots were approximately 22 ft wide by 300 ft long (depending on fit in the field and grower equipment size). Spring fertilizer treatment rates of 0, 45, 90, 135, 180, 225, and 270 lb N/a were used. The seven treatments were replicated three times in a randomized complete block. Experimental data was analyzed using appropriate statistical analyses (e.g., ANOVA, Regression).

Table 1. Site information for the perennial ryegrass and tall fescue locations.

Location	County	Variety	Planted	Soil type
<u>Perennial ryegrass</u>				
J Bar V Farms	Marion	Cutter	Fall 97	Woodburn silt loam
L3 Farms	Linn	DLF-1	Fall 97	Concord and Amity silt loam
Venell Farms	Benton	SR 4200	Fall 97	Dayton silt loam
<u>Tall fescue</u>				
Malpass Farms	Linn	Kittyhawk SST	Fall 96	Bashaw silty clay
Nixon Farms	Lane	Duster	Spring 97	Malabon silty clay loam
Roselawn Farms	Marion	Tomahawk	Fall 98	Woodburn silt loam

All sites were fertilized between March 23 and April 19 at the pre-determined rates using a split application (50/50) about three weeks apart. Applications were done between approximately 400 and 800 growing degree days (GDD) as is generally recommended. The 400 GDD and 800 GDD points were March 13 and April 27, 1999, respectively. Accumulated GDD using the Tsum method was calculated by summing the daily degree day values obtained by adding the maximum and minimum temperatures for the day, dividing by two and subtracting the base temperature, which for temperate grass is 0°C. Accumulated GDD was calculated beginning January 1. Additional details regarding calendar dates of N application and harvest at each site

are shown in Table 2. Fertilizer was applied using a Gandy Orbit-air spreader pulled by a four-wheeler or small Kubota tractor. In addition to fertilizer N treatments, each site also fertilized with 275 lb/a of 0-1520-10 at the same time as the first N application to ensure there were no other nutrient limitations. The plots were managed the same as the rest of the field for all other cultural management practices (weed control, fall fertilizers, disease control, etc.) by the grower cooperator.

Table 2. Dates of fertilization, windrowing, and combining for optimum N study, 1999.

Location	Variety	Fertilizer application		Windrow	Combine
		1 st	2 nd		
Perennial ryegrass					
J Bar V Farms	Cutter	3/23	4/14	7/17	8/3
L3 Farms	DLF-1	4/7	4/19	7/15	8/3
Venell Farms	SR 4200	3/25	4/16	7/19	8/17
Tall fescue					
Malpass Farms	Kittyhawk SST	4/7	4/19	7/12	7/20
Nixon Farms	Duster	3/25	4/16	7/12	7/21
Roselawn Farms	Tomahawk	3/23	4/14	7/10	7/21

Plant samples were taken approximately 2 weeks following the first N application, at heading (May 12-15), and at maturity (June 26-30). Yield components samples were obtained at or following pollination during June. Plots were swathed into windrows between July 10 and July 19 and combined between July 20 and August 17 using grower equipment (Table 2). Seed yield from each plot was measured using a Brent YieldCart and adjusted for clean seed yield following an assessment of percent cleanout from sub-samples taken at harvest. Sub-samples taken at harvest will also be used to determine seed size and will be submitted to the OSU Seed Testing Laboratory for purity and germination analysis.

RESULTS AND DISCUSSION

Crop yield and response

Perennial ryegrass: Seed yield in perennial ryegrass increased as fertilizer rates increased up to the 135 lb N/a rate. Nitrogen rates higher than 135 lb/a did not significantly increase yields (Table 3).

Table 3. Seed yield (lb/a) of perennial ryegrass following varied rates of spring applied N, 1999.

Spring N rate (lb/a)	L3 Farms	Venell Farms	J Bar V Farms	3-site average
0	913 d*	653 c	593 d	720
45	1219 c	1163 b	1120 c	1167
90	1323 bc	1353 ab	1384 b	1353
135	1461 ab	1403 a	1759 a	1541
180	1561 a	1383 ab	1775 a	1573
225	1582 a	1416 a	1878 a	1625
270	1581 a	1382 ab	1887 a	1617
LSD 0.05	180	221	134	--
P-value	0.000	0.000	0.000	

*Means in columns followed by the same letter are not significantly different by Fisher's protected LSD values (p=0.05).

Tall fescue: Seed yield response in tall fescue was not as different from the response of perennial ryegrass sites in 1999 as it was in 1998 (see last years' final report for 1998 data). Seed yield (Table 4) at the Nixon site was the most responsive to higher N rates, the Malpass site yield peaked around the 90-135 lb N/a rate and the Roselawn site did not show any response to increased N rates.

Table 4. Seed Yield (lb/a) of tall fescue following varied rates of spring applied N, 1999.

Spring N rate (lb/a)	Malpass Farms	Nixon Farms	Roselawn Farms	3-site average
0	939 c	689 e	2161	1263
45	1182 ab	912 d	2276	1457
90	1275 ab	1267 c	2470	1671
135	1361 a	1511 b	2265	1712
180	1130 b	1651 ab	2224	1668
225	1133 b	1710 a	2410	1751
270	1161 b	1743 a	2400	1768
LSD 0.05	186	197	NS	--
P-value	0.010	0.000		

SUMMARY

Optimum levels of spring applied N for this second year crop (1999) was similar to the 1998 first- year crop. By looking at all three sites for each species, rates above the 135-180 lb N/a in the perennial ryegrass and 90-135 lb N/a in the tall fescue did not ensure higher yields. In addition, these data indicate each site responded differently, which demonstrates the need to fine tune fertility requirements to the soil type and stand age. It must be noted that these results are from second-year seed crops, and only by continuing these trials over the life of these stands will a good management strategy be assessed. Seed yields this year were close to typical yields with the exception of the Roselawn site which was well above Willamette Valley average yields (1372 lb/a for perennial ryegrass and 1332 lb/a for tall fescue) in the 1995-97 period. These sites will be continued for a important third year (except the J Bar V site, which was rotated to another crop) if continued funding will support this research to determine the long-term economic and agronomic effects of these treatments. Yield components, soil nitrogen impacts and other factors of plant uptake will be available when the data is collected and analyzed this fall.

Presentations to date:

- 1) Linn County Spring Extension Tour (L3 Farms site) for seed growers and company field representatives on May 19, 1998. M.E. Mellbye, W.C. Young III and S.M. Griffith (50 attendees).
- 2) Linn County Agricultural Tour (L3 Farms site) for local and elected officials and county commissioners on June 25, 1998. M.E. Mellbye (15 attendees).
- 3) Progress report to the Grass Seed Cropping Systems for a Sustainable Agriculture (GSCSSA) annual meeting at Spokane WA., November, 1998. W.C. Young III and T.G. Chastain (The USDA-ARS CSREES is also a granting supporter in other aspects of this research through GSCSSA).
- 4) Summary of first-year results at the annual Western Farm Service, Inc. Grower Meeting at Salem Fairgrounds on January 6, 1999. W.C. Young III (365 attendees).

Publications to date:

W.C. Young III, M.E. Mellbye, G.A. Gingrich, T.B. Silberstein, S.M. Griffith, T.G. Chastain, and J.M. Hart. *Defining Optimum Nitrogen Fertilization Practices for Perennial Ryegrass and Tall Fescue Seed Production Systems in the Willamette Valley*. 1998 Seed Production Research, Dept. of Crop and Soil Science Ext/Crs 112, 4/99 (1-6).