Southern Idaho Winter Triticale Forage P in Manured Fields

Brad Brown[1], Joe Dalton[1], Mireille Chahine[2], Bill Hazen[3], Scott Jensen[4], Stephanie Etter[5], Mir Seyedbagheri[6].

[1]Parma Research and Extension Center, [2]Twin Falls Research and Extension Center, [3]District III Cooperative Extension, Gooding, [4]Owyhee County CES, [5]Canyon County Extension Office, [6]Elmor County CES

ABSTRACT

Boot stage Triticale forage was collected from 44 manured fields in the Magic and Treasure Valleys and analyzed for total P to compare with the NRC value of 0.34% P used in the Idaho OnePlan for estimating P removal. Total P concentration ranged widely from 0.18 to 0.53% P with an overall mean of 0.33%, which did not differ from the NRC mean value. However, only one third of the samples were within 10% of the mean value. Using a mean Triticale P concentration value would over or under estimate P removal for most producers, but likely result over time in more uniform soil test P among manured fields. Estimates of P removal are most accurate when based on measured yields and forage P analyses. However, manuring rates based strictly on P removal using more accurate P removal estimates will tend to maintain current soil P differences among manured fields with soil test P > 40ppm.

INTRODUCTION

Southern Idaho dairymen are increasingly adopting double cropping practices to increase forage production and P removal that involve a boot stage winter triticale forage harvest. Whereas winter triticale P contents have been measured in local research trials from non-manured fields, those P contents may differ from the P contents of forages from heavily manured fields. Soil test P in manured fields can measure several-fold higher than in non-manured fields. Triticale P concentrations from southern Idaho manured fields are poorly documented. The default National Research Council (NRC) value (0.34% P) used in the Idaho OnePlan for P concentrations in triticale forage may not reflect the Idaho reality. The objective of this survey was to establish an Idaho baseline for the range in P concentrations in boot stage triticale forage from manured fields.

METHODS

Samples of triticale were collected in spring 2004 (April 23-May 14) from 34 southern Idaho fields managed by dairies for manure applications and from 10 fields in 2005 (May 12-23). The samples ranged in maturity from late stem extension to heading with most samples in the early boot stage. In western Idaho, samples were collected from discrete areas in order to calculate the total biomass and P uptake on a per unit area basis. Samples were oven dried, the percent dry matter determined, ground, and forwarded to Dr. Dale Westermann, USDA-ARS Kimberly for total mineral analysis using ICP. The elemental composition of the triticale forage samples are given in Table 1.

RESULTS AND DISCUSSION

The 2004 growing season was characterized by above normal temperatures during February and especially March. In 2005, the growing season was characterized by a cool and wet late fall but a dry and relatively warm winter and early spring during much of the triticale growth. Higher spring temperatures caused fall planted triticale to break dormancy earlier and hastened plant

development. The implications for this study are that greater biomass, P removal, and possibly lower triticale P concentrations occurred than would normally be the case.
Triticale total P concentration ranged widely from 0.18 to 0.53% P with a mean of 0.33% for boot stage samples (Fig. 1). This mean value is practically the same as the NRC mean value of 0.34% for triticale at heading. In Figure 1 the mean is bracketed by lines representing P concentrations differing by 10%. Forage P in most samples falls outside the range of 3.0-3.6% P. Almost two thirds of the fields were either above (43%) or below (23%) the 10% bracket on each side of the mean. Using a mean value for triticale P concentration for calculating P removal with triticale haylage would grossly under estimate P removal in some fields and over estimate P removal in others.

The threefold range in triticale P concentration was surprising. The lowest triticale P value may be high enough to support maximum triticale growth, but that is not clear from the literature or local research. The range nevertheless suggests considerable potential for accumulating P quantities above those required for growth.

Growth stage differences may account for some of the triticale P concentration variability, as samples were collected as early as mid stem extension, prior to any swelling of the head in the stem, and as late as late boot. Four fields were sampled twice in 2004, the samplings separated by about ten days in western Idaho (April 23 and May 3, mid stem extension to late stem extension) and seven days in the Magic Valley (May 7 and May 14, late stem extension to early boot). The decrease in P concentration from the first to second sampling ranged from 0 to as much as 0.14% P. Minimal P concentration changes might be expected if additional lagoon water P were applied between samplings.

Western Idaho triticale samples were rinsed prior to drying as lagoon water spots and manure residue were evident on some samples. This rinsing may have removed P on the tissue surface and thereby reduced the measured P concentration. Consequently, the rinsing may also have led to some of the variability. The two highest P concentrations occurred with Magic Valley triticale irrigated with lagoon water, and were samples that were not rinsed prior to sample processing.

Tissue P concentrations can be diluted with greater dry matter production and higher concentrations may occur when dry matter production is limited by factors other than available P. Total dry matter was estimated in fields where samples were collected from discreet areas. Western Idaho dry biomass ranged from 1.58 to 5.95 tons/A in 2004 and 2.95 to 3.81 in 2005. The P removed ranged from 7 to over 36 lb/A in 2004. In 2005 P removal ranged from 13.2 to 33.9 lb/A. Triticale forage P removal exceeding 30 lb/A is considerably more than we've documented in research trials to date involving non-manured soils. Biomass and P removal ranged every bit as much as P concentrations. Total P concentrations and dry matter production both should be measured for the most accurate estimates of P removal.

Using NRC based estimates of P removal has significant implications. Over estimating P removal (using a NRC triticale P value for the calculation that exceeds the actual forage P concentration) can lead to higher manuring rates that steadily increase soil test P values. This may be desirable in those cases where soil test P is initially low and limiting forage production, as would be the case perhaps when new land is acquired with a history of less sustainable P applied, or if producers were overly cautious and manuring rates were not sufficient to sustain productivity. The opposite occurs when NRC values underestimate P removal (when the NRC value is less than the actual forage P concentration), since manuring rates limited by the current statute would result in lower soil test P. This may be very acceptable if soil P is excessive, but lower manuring rates may ultimately increase dependence on commercial fertilizer N.

Theoretically, reduced manuring on high soil P fields and higher manuring in low soil P fields will cause all soil test P values to ultimately come to some central value that will depend on the P threshold governing manuring rates. In this survey, triticale P concentrations were exponentially related to soil test P. From this relation, using the current threshold of 40 ppm P from the NRCS 590 standard, the predicted value for triticale forage P is only about 0.28% P, well below the NRC default value of 0.34% P used in the Idaho OnePlan or the mean for the surveyed fields. Using the same relation, the NRC triticale % P value of 0.34% would be associated with over 60 ppm soil test P.

Using more accurate (measured yield and forage analysis based) P removal estimates also has significant implications for producers. In fields where manuring is limited to P removal (soil test P>40ppm in the first foot), producers with the lowest soil test P and forage P concentrations will be the most restricted in manuring rates, eventually the most dependent on commercial fertilizer N, and perhaps at a competitive disadvantage. Conversely, producers with the highest soil test P and triticale P concentrations and highest P removal estimates can use higher manuring rates, are less dependent on fertilizer N, and are possibly more competitive. However, manuring based on actual P removal may not do as much to reduce soil test P in high soil P fields, and will tend to maintain current differences in soil P among manured fields.

Forage triticale K ranged from 1.97 to 6.17 % and averaged 3.71%. Forage triticale K was high enough in some locations to be of concern, as milk fever incidence can be related to excessive forage K. There was a positive correlation of triticale K, Ca, and Mg concentrations with triticale P concentrations (Fig. 2). This might be expected as higher P, K, Ca, and Mg would all reflect higher manuring rates.

Other forage mineral element concentrations ranged widely. Triticale Cu differed by as much as tenfold. Elevated forage Cu may reflect contributions from foot baths. Forage Zn concentrations ranged from 12.7 to 102 ppm. Forage Zn < 20 ppm is marginal for many crop tissues and could be limiting boot storage forage production. Triticale Na concentrations varied the most of all minerals ranging from 146 to 7552 ppm. Forage Na likely reflects both the history of manuring as well as the amount of sodium salts used in the ration.

Knowing actual triticale forage P concentrations may be useful for adjusting P in the ration. Feeding high P concentration forages may reduce the need for P supplementation in the ration, reduce P in manures, and increase manuring rates.

SUMMARY

Triticale boot stage forage differed widely in % P concentrations. The range in triticale P concentrations indicate that using default NRC values or survey mean P concentrations can be very misleading when used for estimating P removal. Measurement of forage P concentration together with measured yields will generally improve P removal estimates. The use of NRC triticale P or more accurate estimates of P removal may have long term effects on manured field soil test P and the differences among manured fields in soil P.

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Table 1. Southern Idaho Triticale forage mineral analysis in 2004 and 2005.

P	K	S	Ca	Mg	Cu	Mn	Na	Zn
--------------------------%					---------------------ppm			
					2004			
0.36	4.98	0.22	0.40	0.20	19.1	29.0	1308	50.7
0.43	5.34	0.20	0.40	0.19	7.8	25.1	2338	42.9
0.35	4.96	0.19	0.40	0.20	6.5	27.5	2108	41.4
0.29	2.87	0.13	0.23	0.12	2.7	21.6	401	21.9
0.24	4.09	0.17	0.31	0.15	5.1	33.2	1278	32.7
0.34	5.73	0.20	0.35	0.17	7.5	35.8	1858	37.8
0.22	3.32	0.15	0.29	0.15	4.8	31.4	2058	31.2
0.35	4.82	0.19	0.39	0.14	8.4	29.2	1698	42.2
0.26	4.32	0.17	0.34	0.13	6.0	25.6	1358	34.8
0.26	4.94	0.19	0.34	0.19	13.9	28.7	1798	36.9
0.36	4.73	0.22	0.58	0.24	38.3	42.8	1948	55.3
0.23	2.24	0.07	0.19	0.08	3.2	23.6	223	20.1
0.33	3.77	0.26	0.33	0.15	6.4	36.4	229	31.4
0.37	3.69	0.24	0.31	0.14	5.6	22.0	366	31.7
0.38	3.77	0.28	0.34	0.14	6.1	31.9	289	32.2
0.28	2.51	0.10	0.22	0.10	2.4	25.7	180	24.2
0.37	3.70	0.18	0.35	0.15	5.4	24.5	620	35.1
0.38	3.66	0.20	0.32	0.14	4.9	20.0	498	28.0
0.35	3.25	0.24	0.34	0.16	4.9	18.5	7552	27.3
0.46	5.43	0.27	0.37	0.22	10.5	41.2	821	102.0
0.52	6.17	0.24	0.40	0.18	14.7	35.9	1488	39.3
0.40	4.26	0.22	0.39	0.20	6.7	36.9	586	51.1
0.38	4.67	0.23	0.34	0.15	9.4	32.1	881	29.9
0.41	4.87	0.20	0.32	0.17	5.9	24.8	688	45.1
0.40	4.33	0.25	0.31	0.16	5.9	21.0	585	41.7
0.42	4.24	0.27	0.34	0.19	18.9	35.1	439	19.6
0.31	2.97	0.13	0.33	0.14	5.5	27.7	728	25.2
0.48	3.28	0.16	0.25	0.12	5.1	23.8	214	36.6
0.53	5.31	0.22	0.38	0.18	29.4	51.0	830	34.9
0.38	4.40	0.17	0.29	0.14	5.5	19.9	449	29.5
0.32	3.01	0.09	0.26	0.11	3.7	25.3	146	20.8
0.37	3.41	0.22	0.36	0.14	6.0	26.4	4442	36.8
0.28	2.68	0.12	0.31	0.13	4.3	26.2	190	19.8
0.24	1.97	0.08	0.29	0.17	3.1	34.6	178	16.2
					2005			
0.39	4.87	0.22	0.31	0.18	7.9	11.28	971	38.4
0.18	2.26	0.09	0.20	0.11	1. 7	18.88	1691	18.0
0.24	3.18	0.21	0.33	0.16	7.0	20.13	1137	33.7
0.27	2.96	0.10	0.30	0.15	7.8	15.05	672	28.7
0.20	2.01	0.05	0.17	0.09	1.8	12.99	624	12.7
0.36	4.06	0.14	0.25	0.16	7.3	29.72	2298	37.1
0.48	4.84	0.14	0.29	0.15	8.7	30.17	693	44.5
0.24	1.97	0.06	0.32	0.13	1.5	19.06	1489	16.1
0.23	2.08	0.08	0.35	0.14	1.3	20.84	682	13.9
0.32	3.24	0.11	0.36	0.14	4.4	21.82	1161	23.3

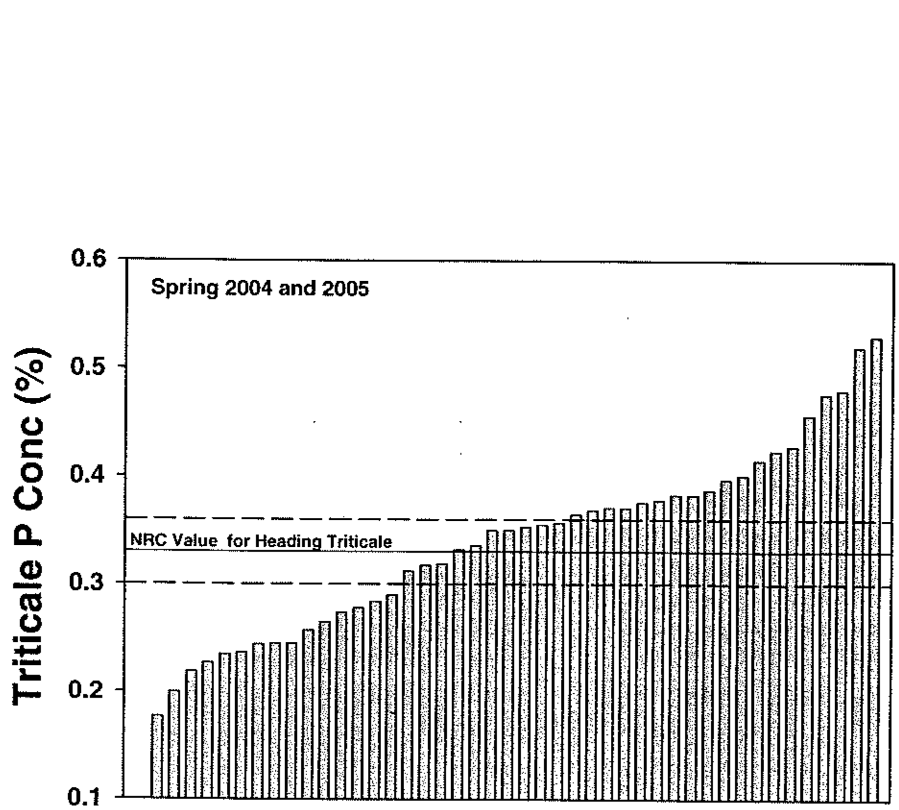

Figure 1. Distribution of boot stage triticale total P concentrations in spring 2004 and 2005.

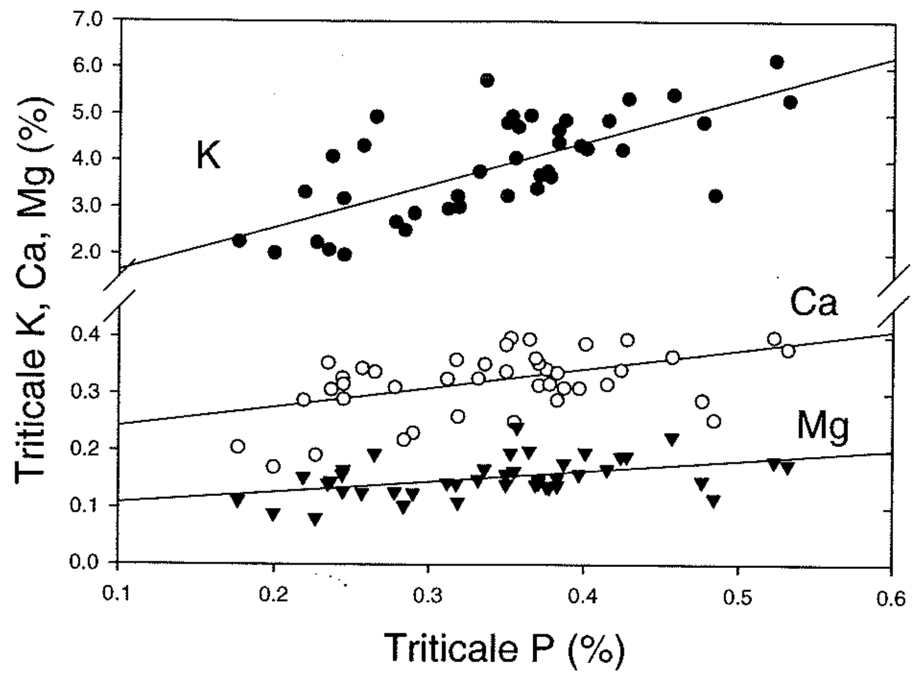

Figure 2. The relationship of boot stage Triticale forage P and K, Ca, and Mg concentrations.