Is Phosphorus Fertilizer Needed in Winter Pea and Lentil Production in Central Montana?

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Fertilizer Facts
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Introduction

Application of phosphorus (P) has been reported to improve grain yield of dry pea in the Canadian prairies (Henry et al., 1995). Increased yield of spring pea and lentil with P application to soils containing moderate available P in central Montana has also been reported, although the results were not consistent over years and among legume species tested (Chen et al., 2006).

Winter pea and lentil can grow in central Montana and have some advantages over spring types in adapting to the local environment and producing higher yields. Discovering ways to optimize production with minimal cost is critical to producers. The following research was conducted to investigate winter pea and winter lentil response to P fertilizer application in central Montana.

Methods

In a two-season experiment (2003-2005), two breeding lines of winter peas [PS9430706 (P706) and PS9530726 (P726)] and two winter breeding lines of lentils [LC9979010 (L010) and LC9976079 (L079)] were selected. Seeds were directly seeded in the fall of 2003 and 2004 into winter cereal stubble at the Central Agricultural Research Center (CARC). The soil texture was clay loam with a pH of 6.5, organic matter of 4.3%, and an Olsen P concentration of 14 ppm, which is nearly adequate for most crops including legumes (critical level = 16 ppm). Triple super phosphate (0-45-0) was applied with the seed at four rates (0, 15, 30 and 45 lb P_2O_5/ac). Plot size was 5 ft by 20 ft. Biomass forage and grain were harvested before and after the crop reached maturity in the summer following seeding, respectively. Lentil forage was not harvested for the 2004-2005 crop-year.

Results

Grain Yield: Phosphorus application had a limited effect on grain yield (Table 1). Only the lentil line L010 grown in the 2003-2004 season, that received 15 lb P_2O_5 /ac, produced a greater yield than the control (0 lb P/ac). A parabolic yield response curve to the rate of P addition was found with the lentil L010 ($y = -0.19X^2 + 9.22X + 1500$; $r = 0.41$, $P < 0.10$), strongly suggesting that the yield response was due to P addition. Similarly, in an experiment previously conducted at CARC (2003-2004), the spring pea and lentil varieties that received 30 lb P_2O_5/ac showed an increased yield of more than 10% compared to the control in that study (Chen et al., 2006).

Within the same breeding lines, either in peas or lentils, the yield was much higher in 2003-2004 than in 2004-2005, due to better moisture conditions in 2003-2004. Pea grain yields of the breeding line P726 were 2009 and 1434 lb/ac in 2004 and 2005, respectively, and were consistently greater than yields of the P706 line (1791 and 1273 lb/ac respectively). Yields with lentil line L010 harvested in 2004 and 2005 (1554 and 938 lb/ac respectively) were superior to that of line L079 (1225 and 661 lb/acre, respectively).

Forage Yield: A more positive response to P applications was found with forage yield than with grain (Table 1). Addition of P to pea line P726 at 15 and 45 lb P_2O_5/ac in 2004-2005 significantly increased forage yield compared with the control. This response curve is parabolic ($y = -1.09 X^2 + 54.9 X + 3094$; $r = 0.46$, $P < 0.10$), implying that increasing the rate of P application further would minimize the beneficial effect on yield.

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Table 1. Influence of P application (lb P_2O_5/ac) on winter pea and winter lentil grain and forage yield (lb/ac).

Year	Species	Cultivar	Grain Yield (lb/ac)				Forage Yield (lb/ac)			
			0 P_2O_5	15 P_2O_5	30 P_2O_5	45 P_2O_5	0 P_2O_5	15 P_2O_5	30 P_2O_5	45 P_2O_5
2003-2004	Pea	P706	1822	1776	1789	1777	4993	5358	5264	5334
		P726	1990	2155	1984	1905	3623	4000	4215	3915
	Lentil	L079	1289	1226	1307	1157	1477	1918	1710	1519
		L010	1484	1638*****	1558	1538	1987	2117	2027	1998
2004-2005	Pea	P706	1343	1240	1126	1382	5052	4139	4098	4446
		P726	1499	1417	1380	1435	2929	4168*****	3267	3526*****
	Lentil	L079	616	714	609	706	NA	NA	NA	NA
		L010	1059	870	914	910	NA	NA	NA	NA

***** denotes a significant difference compared to the control (0 lb P_2O_5/ac) in the same row at $P<0.05$

A similar response curve was also found with lentil L079 in 2003-2004 ($y = -0.70 X^2 + 31.0 X + 1510$; $r = 0.44$, $P < 0.10$). The forage yields for winter pea line P706 were 5247 and 4434 lb/ac, in 2004 and 2005, respectively, which were greater than the yields of line P726 in the same years (3928 and 3473 lb/ac, respectively). In this study, line P706 produced more forage than line P726. Forage yield with lentil L010 (2032 lb/ac) was superior to that of line L079 (1656 lb/ac) in the 2003-2004 crop year.

Fertilizer Facts:

- Application of P to soils containing nearly adequate available P may promote yield in winter pea and lentil.
- Forage yield increases from P were generally greater than increases in grain yield from P.
- The rate of P application should be in the range of 15-30 lb P_2O_5 /ac, but could be altered based on soil test P results and cultivar selection.
- The cultivar selected may affect yield as much, or more than, P application.

References

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