RESEARCH

PHOSPHATE FERTILIZATION CAN INCREASE YIELD OF PRODUCTIVE GRASS PEA (*Lathyrus sativus* L.) CROPS IN P-RETENTIVE SOILS

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ABSTRACT

The effect of P fertilization on grass pea (*Lathyrus sativus* L.) yield and yield components was evaluated on soils with low P availability and high P retention capacity in small-scale farms of the Araucanía Region in southern Chile. Trials were conducted during 2000-2001, 2001-2002, and 2002-2003, in six sites; three sites in Lumaco and three in the Selva Oscura area. Six rates of P (0, 21.8, 43.6, 65.4, 87.2, and 109.0 kg ha^{-1}) were evaluated in a randomized complete block design with four replicates. Grass pea cv. Luanco-INIA was sown at 47 seeds m^{-2}. Mean grain yield for all trials was 2456 kg ha^{-1}. Phosphate fertilization increased grass pea grain yield in both areas during 2000 and 2001. There was no significant effect in 2002. The 2002 cropping season had an unusually high spring–summer rainfall, which may have enhanced the P mineralization rate from organic soil fraction, and thus P availability. According to this study, grass pea crops in soils with < 10 mg kg^{-1} of available P-Olsen should respond to P fertilization.

Key words: grass pea, *Lathyrus*, phosphorus, neglected crops, cool-season legumes.

INTRODUCTION

Grass pea is a grain legume crop used for human and animal consumption since ancient times (Hanbury *et al*., 2000). The presence of β-N-oxalyl-L-α,β-diaminopropionic acid (β-ODAP) in grass pea seeds is thought to increase vulnerability to neurolathyrism, a neurodegenerative disease (Lambein *et al.,* 2007). As a result, lowODAP lines (Campbell *et al.,* 1994) and cultivars (Siddique *et al.,* 2006) have been found that may enhance interest in this protein crop. The potential of grass pea for animal feed also depends on the achievement of yields that make it competitive with other protein-rich ingredients.

Grass pea is grown on a wide range of soils, including those with low fertility and poor structure (Siddique *et al*., 1996). In southern Chile, grass pea is cultivated by small farmers with limited resources, on typically eroded soils as a result of poor management. The Araucanía Region (37º30´-39º30´ S) has a particularly high number of such small farmers and its soils are characterized by low levels of available P-Olsen (Montenegro, 1991) though relatively high grain yields are often achieved. Hence, P fertilization is a determining factor in the yield of most crops.

Information on grass pea response to P fertilization is very scarce. Its effect on grain yield and yield components is largely unknown, particularly in soils with high P retention capacity. The comprehensive review by Campbell (1997) does not refer to P fertilization, but emphasizes that grass pea is considered a hardy crop requiring low or zero inputs. However, Sarkar *et al.* (2003) found that applying P increased grass pea grain yield grown in an Entisol of India with pH 7.5, 0.53% organic carbon, and 26 kg ha^{-1} of P_2O_5. In Chile, a clear effect of up to 65.4 kg ha^{-1} P on grass pea grain yield was reported by Ellena (1983) in an Andisol of Valdivia. Later, Montenegro *et al.* (2001) explained in a preliminary report that P fertilization was associated to higher grass pea yields in Araucanía soils with high P retention capacity. Krarup (2002) did not find any grass pea response to P fertilization in a soil of the Valdivia series belonging to the medial, mesic of the Duric Hapludands family (CIREN, 2003) with P-Olsen availability of 12 mg kg^{-1} or greater.

Araucanía Region soils have high levels of P retention, generally above 70% (Sadzawka *et al*., 1999) reaching levels as high as 95% in areas such as Victoria. Phosphorus retention of 70-99% has been reported for the A soil horizon in Andisols of southern Chile (Pino *et al*., 1998; Besoaín and Sadzawka, 1999). A wide range of farmers was surveyed in the Araucanía Region indicating that 90% of soils have available P-Olsen < 15 mg kg^{-1} (Sadzawka *et al*., 1999). Moreover, 60% of such soils have P-Olsen < 10 mg kg^{-1} which is considered a critical level for most crops. This level is frequent in small farms, with a mean of 7.5 mg kg^{-1} for grass pea producers in

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Lumaco (A. Montenegro, unpublished data, 2000), one of the areas of the Araucanía Region where the reported experiments were conducted.

Phosphorus is generally absorbed by crop plants to a moderate extent compared to other macronutrients. However, in P-retentive soils such as those in southern Chile, P fertilizers should be applied at high rates, for example, up to 87 kg ha^{-1} P for wheat (Montenegro *et al*., 1999a) and oilseed rape (Montenegro *et al*., 1999b).They should be localized in the furrow to increase efficiency. Consequently, it is important to gather information on the magnitude of yield response of grass pea to P fertilization in soils where its availability is limited.

MATERIALS AND METHODS

The study was conducted under dryland conditions during three cropping seasons (2000-2001, 2001-2002, and 2002-2003 referred hereafter as 2000, 2001, and 2002) in Lumaco (38°08'S, 72°55'W) and Selva Oscura (38°21'S, 72°11'W), Araucanía Region, located about 150 km NW and 60 km NE of Temuco, respectively. Experiments in Lumaco were conducted on a silty clay loam Inceptisols, Lumaco Series, belonging to the fine, mixed, termic, mesic of the Fluventic Dystrudepts family (CIREN, 2002). Experiments in Selva Oscura were conducted on a silty clay loam Andisols, Victoria Series, belonging to the medial, mesic of the Typic Durudands family (CIREN, 2002). Methodology for chemical determination was in accordance with Sadzawka *et al*. (2006). Specific sites within Lumaco and Selva Oscura were different each year.

The chemical characterization of soils (0-20 cm depth) is shown in Table 1. Available P-Olsen in Lumaco soils was low in all seasons. In Selva Oscura, available P-Olsen was considered low to medium in 2000, and low in 2001 as well as 2002. Traditional crops, like wheat (*Triticum aestivum* L.) and oilseed rape (*Brassica napus* L.), for which more agronomic information is available, are expected to clearly respond to P fertilization in soils at these P-Olsen levels. In Lumaco, exchangeable K was low in 2000 and 2002, medium in 2001, and extractable S was low, whereas Al saturation was low in 2000 and 2001, but high in 2002. In Selva Oscura, soils had relatively high exchangeable K, low extractable S, and medium to high Al saturation.

Luanco-INIA, a large-seeded grass pea cultivar (Mera *et al*., 2003), was sown at 47 seeds m^{-2}. Seeds were treated with carboxin + thiram, fipronil, and inoculated just prior to sowing with a cocktail of Rhizobium strains isolated from grass pea nodules provided by the Universidad de Concepción, Chillán, Chile. Sowing dates in Lumaco were 17 May 2000, 16 May 2001, and 7 May 2002. Sowing dates in Selva Oscura were 11 August 2000, 7 August 2001, and 3 September 2002. A randomized complete block design was used with four replicates, except in Lumaco in 2000 and 2001 where only three replicates were carried out. Plots had six rows, 4 m long and spaced

Table 1. Chemical characterization of soils (0-20 cm depth) from three different sites in two areas of southern Chile where experiments of P fertilization in grass pea were conducted during 3 years.

Chemical parameters and its unit	Lumaco			Selva Oscura		
	2000	2001	2002	2000	2001	2002
P-Olsen , mg kg^{-1}	9	5	5	11	6	4
Organic C, %	2.9	2.3	3.5	7.0	6.4	4.1
pH (water)	5.8	5.8	5.2	5.5	5.8	5.6
Exchangeable Ca, cmol kg^{-1}	4.9	3.35	1.97	4.9	5.18	9.05
Exchangeable Mg, cmol kg^{-1}	1.04	1.3	0.76	1.45	0.8	2.16
Exchangeable Na, cmol kg^{-1}	0.26	0.08	0.15	0.11	0.07	0.13
Exchangeable K, cmol kg^{-1}	0.07	0.52	0.13	0.88	0.96	0.38
Sum of bases, cmol kg^{-1}	6.3	5.25	3.01	7.38	7.01	11.72
Exchangeable Al, cmol kg^{-1}	0.09	0.07	1.24	0.79	0.28	1.2
Effective CEC, cmol kg^{-1}	6.4	5.32	4.25	8.17	7.29	12.92
Al saturation, %	1.4	1.3	29.2	9.7	3.8	9.3
Extractable S, mg kg^{-1}	2.4	6.5	-	4.5	1.3	-
Available Zn, mg kg^{-1}	0.3	0.1	-	1.5	0.1	-
Available B, mg kg^{-1}	0.4	0.2	-	0.5	0.2	-
Available Cu, mg kg^{-1}	3	1.4		2.5	0.6	-

Effective CEC: effective cation exchange capacity; Aluminium saturation percentage is Exchangeable Al divided by Effective CEC multiplied by 100.

35 cm apart. Treatments were 0, 21.8, 43.6, 65.4, 87.2, and 109.0 kg ha^{-1} P, as banded superphosphate below the seed (46% P_2O_5). Base fertilization was 83 kg ha^{-1} K and 36 kg ha^{-1} S as broadcast K_2SO_4 in all experiments and for all P treatments. In 2002, Al soil saturation recommended a liming treatment, so 3.5 and 3.0 t ha^{-1} $CaCO_3$ with an agronomic value of 92.44% was applied in Lumaco and Selva Oscura, respectively.

Aboveground biomass samples were taken in Lumaco during grass pea flowering to estimate nutrient contents only in year 2000. Grain was harvested 17 January 2001, 2 January 2002, and 16 January 2003 in Lumaco, and 26 January 2001, 21 January 2002, and 25 February 2003 in Selva Oscura. Nutrient content in biomass and grain was estimated at both locations only in 2000. Nitrogen content in biomass and grain was determined by digestion with sulphuric acid and Kjeldahl. Phosphorus content in aboveground biomass and grain was determined by calcination, digestion with HCl, and colorimetry by vanadate. Potassium, Ca, Mg, Zn, and Cu in aboveground biomass and grain were determined by calcination, digestion with HCl, atomic absorption, and emission spectrophotometry. Boron in the aboveground biomass and the grain was determined by calcination, digestion with HCl, and colorimetry with azomethine-H (Sadzawka *et al*., 2007). Samples of aboveground biomass were taken in Lumaco and Selva Oscura in 2001 during flowering in order to estimate aboveground dry biomass per hectare. Grain yield was estimated using 3.5 m of the four central rows at 14% moisture. Yield components were estimated from a row random sample of 25 cm. Nutrient content of grains from both areas was determined in 2000. Analysis of variance and regression were performed with SAS (SAS Institute, 1992).

RESULTS AND DISCUSSION

In 2000 and 2001, P fertilization increased grain yields in both areas, in agreement with previous findings (Ellena, 1983). However, no significant effect was found at any site in 2002 (Tables 2 and 3).

Grain yield mean was considerably higher in Lumaco (2908 kg ha^{-1}) than Selva Oscura (1268 kg ha^{-1}) in 2000. The higher level of Al saturation in Selva Oscura (Table 1) may have been detrimental to grain yield. Furthermore, soil structure in Selva Oscura was altered by extremely high rainfall in June 2000 (Figure 1), and a superficial soil crust resulted from the impact of raindrops (Casanova *et al*., 2006), probably affecting root development. In 2000, the effect of increasing P fertilization rates on grain yield fitted a quadratic model response with Equation [1] for Lumaco and Equation [2] for Selva Oscura:

$$y = 2335.39 + 18.2995\,P - 0.097557\,P^2,\ \text{with } R^2 = 0.60 \quad [1]$$
$$y = 875.14 + 8.300078\,P - 0.01356\,P^2,\ \text{with } R^2 = 0.77 \quad [2]$$

where y is the grain yield (kg ha^{-1}), P is the amount of P applied (kg P ha^{-1}), and R^2 is the coefficient of determination for the equation.

Contrary to 2000, there were higher mean yields in 2001 in Selva Oscura (2465 kg ha^{-1}) than in Lumaco (1687 kg ha^{-1}). Water availability in 2001 was less than

Table 2. Effect of P fertilization on stand, grain yield, and grain weight of grass pea cv. Luanco-INIA in Lumaco, southern Chile, during 3 years.

	2000			2001			2002		
Applied phosphorus	Stand plants	Grain yield	Grain weight	Stand plants	Grain yield	Grain weight	Stand plants	Grain yield	Grain weight
kg ha^{-1} P	plant m^{-2}	kg ha^{-1}	mg	plant m^{-2}	kg ha^{-1}	mg	plant m^{-2}	kg ha^{-1}	mg
0.0	41.4	2359	327	32.8	1036	286	40.2	3248	285
21.8	40.6	2695	333	33.1	1553	284	38.2	3126	305
43.6	40.8	2841	340	29.2	1553	279	38.6	3598	288
65.4	39.7	3155	341	32.0	1700	281	40.8	3482	283
87.2	38.8	3282	346	30.4	1945	294	38.6	3425	297
109.0	39.5	3114	330	35.0	2334	296	34.5	3014	292
Mean	40.1	2908	336	32.1	1687	287	38.5	3316	292
CV, %	4.7	7.8	2.7	12.3	16.4	6.3	12.40	14.0	6.1
F	0.79	6.91	2.04	1.10	9.83	0.59	0.86	0.93	0.88
P > F	ns	0.01	ns	ns	< 0.01	ns	ns	ns	ns

Grain weight is a mean value calculated from a random sample of 500 grains. ns = non significant.
CV: coefficient of variation. F: ratio of treatments mean square and experimental error mean square.

Table 3. Effect of P fertilization on stand, grain yield, and grain weight of grass pea cv. Luanco-INIA in Selva Oscura, southern Chile, during 3 years.

Applied phosphorus	2000			2001			2002		
	Stand plants	Grain yield	grain weight	Stand plants	Grain yield	grain weight	Stand plants	Grain yield	grain weight
kg ha^{-1} P	plant m^{-2}	kg ha^{-1}	mg	plant m^{-2}	kg ha^{-1}	mg	plant m^{-2}	kg ha^{-1}	mg
0.0	38.9	870	354	44.1	2143	298	45.7	2796	368
21.8	40.9	1065	365	39.2	2126	292	45.6	2952	357
43.6	37.7	1203	370	44.9	2386	297	42.3	3490	353
65.4	35.5	1342	365	35.9	2535	309	40.7	2833	359
87.2	38.2	1521	356	45.3	2966	299	43.6	3070	369
109.0	39.8	1610	370	43.6	2634	307	45.7	3584	371
Mean	38.5	1268	363	42.2	2465	300	43.9	3095	363
CV, %	5.1	11.9	2.8	11.0	9.0	3.2	11.1	13.9	5.6
F	3.61	13.68	1.8	2.65	8.26	1.69	0.74	1.98	0.55
P > F	0.05	0.01	ns	ns	< 0.01	ns	ns	ns	ns

Grain weight is a mean value calculated from a random sample of 500 grains. ns = non significant.
CV: coefficient of variation. F: ratio of treatments mean square and experimental error mean square.

in 2000, particularly in Lumaco, which probably caused the lower mean grain yield there in 2001, as compared with 2000 and 2002 (Table 2). The effect of increasing P fertilization rates on grain yield in Lumaco in 2001 fitted a linear model response and a quadratic model response for Selva Oscura with Equations [3] and [4], respectively:

$$y = 1129.10476 + 10.23309\ P, \text{ with } R^2 = 0.63 \quad [3]$$

$$y = 1890.05955 + 15.48615\ P – 0.06904\ P^2, \text{ with } R^2 = 0.54 \quad [4]$$

where y, P, and R^2 are described Equations [1] and [2].

There was no significant effect of P fertilization on grain yield at any site. Unlike previous years, liming was applied in 2002 due to the high percentage of Al saturation found at both sites (Table 1). As a result, plant growth at both sites was more vigorous during 2002 than in previous years. Although not the aim of the present experiment, development of the grass pea plant was found to be severely limited by medium to high Al saturation and its associated high soil acidity. As a consequence, corrective liming was very effective. In addition, rainfall in October-December 2002 was unusually high (Figure 1) and soil moisture was still abundant during the favorable temperatures of late spring. These conditions may have enhanced P mineralization from organic soil fraction. Thus, the lack of response to added P during 2002 may have resulted from more available P in the soil. This would explain the very high grain yields (3248 and 2796 kg ha^{-1} in Lumaco and Selva Oscura, respectively) achieved by controls where P was not applied.

Phosphate fertilization did not have a significant effect on grain weight in any site or year despite the relatively

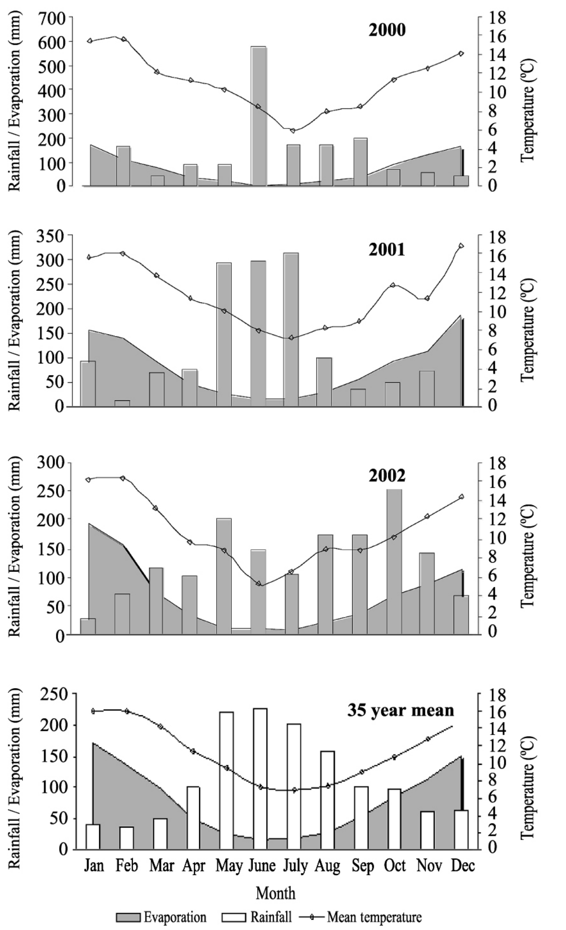

Figure 1. Monthly rainfall, evaporation, and mean temperature during 2000, 2001, 2002, and 35-yr mean at Carillanca, La Araucanía Region, southern Chile.

Table 4. Nutrient content of aboveground biomass of grass pea cv. Luanco-INIA during flowering stage in Lumaco, southern Chile in 2000-2001 for six rates of P fertilization.

Applied phosphorus	N	P	K	Ca	Mg	Zn	Mn	Cu	B
kg ha^{-1} P	%					mg kg^{-1}			
0.0	2.18	0.13	0.54	0.51	0.27	13.0	67.0	5.0	31.0
21.8	1.83	0.10	0.51	0.48	0.26	12.0	65.0	5.0	32.0
43.6	2.31	0.09	0.53	0.62	0.25	12.0	83.0	4.0	34.0
65.4	2.17	0.09	0.51	0.53	0.25	12.0	74.0	4.0	31.0
87.2	1.98	0.10	0.46	0.58	0.30	14.0	73.0	4.0	35.0
109.0	2.18	0.11	0.47	0.56	0.27	13.0	67.0	4.0	32.0
Mean	2.11	0.10	0.50	0.55	0.27	12.7	71.5	4.3	32.5

Data are from a compound sample of three replicates.

Table 5. Nutrient accumulation by aboveground biomass of grass pea cv. Luanco-INIA up to flowering stage in Lumaco, southern Chile in 2000-2001 for six rates of P fertilization.

Applied phosphorus	N	P	K	Ca	Mg	Zn	Mn	Cu	B
kg ha^{-1} P	g m^{-2}					mg m^{-2}			
0.0	14.9	0.89	3.7	3.5	1.8	8.9	45.6	3.4	21.1
21.8	17.0	0.93	4.7	4.5	2.4	11.1	60.3	4.6	29.7
43.6	22.7	0.88	5.2	6.1	2.5	11.8	81.4	3.9	33.4
65.4	20.3	0.84	4.8	5.0	2.3	11.2	69.3	3.7	29.0
87.2	25.6	1.30	6.0	7.5	3.9	18.1	94.5	5.2	45.3
109.0	23.5	1.20	5.1	6.0	2.9	14.0	72.3	4.3	34.5
Mean	20.7	1.00	4.9	5.4	2.6	12.5	70.6	4.2	32.2

Nutrient accumulation was calculated by multiplying nutrient content by aboveground biomass.

low coefficients of variation for this trait. The 3-yr mean grain weight was higher in Selva Oscura (342 mg) than in Lumaco (305 mg), due to the relatively higher water availability during the pod filling stage in Selva Oscura. Variations in grain yield were not related to mean grain weight nor associated to the number of grains per pod, which had a mean of ~1.6. The number of pods per plant was the yield component that largely explained variations in grain yield. In 2000, plots that yielded 900-1600 kg ha^{-1} had 6-12 pods per plant, whereas those yielding 2300-3300 kg ha^{-1} had 13-24 pods per plant (data not shown). This noticeable difference was observed in plots with similar stands of 38-40 plants m^{-2}.

Phosphate fertilization did not affect aboveground biomass in 2000, but did in 2002. In Lumaco and Selva Oscura, dry matter at flowering increased from 2919 kg ha^{-1} in controls where P was not applied to 7483 kg ha^{-1} with 109 kg P ha^{-1} and 3489 to 5560 kg ha^{-1}, respectively (data not shown). Plant height increased at least 10 cm as a result of P fertilization. Controls with no P were 47 cm tall during full flowering, whereas plots receiving P measured 57-63 cm with no significant differences between P rates.

The chemical characterization of the aboveground biomass during grass pea flowering in Lumaco in 2000 is shown in Table 4. Phosphate fertilization did not apparently affect neither N content, which was relatively high nor P, K, Ca, Mg, and micronutrients. Nutrient absorption by the aboveground biomass up to the flowering stage in Lumaco is presented in Table 5. In general, macro and micronutrients appeared to be absorbed to a greater extent with higher rates of P fertilization.

Nutrient content in the grass pea grain from both sites was unaffected by P treatments in 2000 (Table 6). However, mean N content of grain from Selva Oscura was less than that from Lumaco, probably due to limitations on symbiotic N fixation from high soil acidity associated with the above-mentioned Al saturation condition. On the contrary, P, K, Zn, and Cu were notably greater in grain from Selva Oscura than from Lumaco, and this was true to a lesser extent for Ca, Mg, Mn, and B. In general, nutrient absorption by grass pea grain was higher with increased P fertilization (Table 7), due to the better yield associated with it. Absorption means were lower in Selva Oscura because of lower yields.

Table 6. Nutrient content of grass pea grain cv. Luanco-INIA in Lumaco and Selva Oscura, southern Chile in 2000-2001 for six rates of P fertilization.

Applied phosphorus	N	P	K	Ca	Mg	Zn	Mn	Cu	B
kg ha^{-1} P	%					mg kg^{-1}			
Lumaco									
0.0	4.0	0.23	0.67	0.10	0.09	23	22	5	6
21.8	4.2	0.28	0.73	0.10	0.09	24	19	5	8
43.6	3.9	0.20	0.67	0.11	0.09	19	22	5	8
65.4	4.5	0.20	0.69	0.10	0.08	21	22	5	9
87.2	4.0	0.23	0.65	0.10	0.09	24	21	5	8
109.0	4.2	0.18	0.67	0.11	0.09	20	23	5	8
Mean	4.1	0.22	0.68	0.10	0.09	21.8	21.5	5.0	7.8
Selva Oscura									
0.0	3.6	0.37	0.90	0.13	0.11	32	24	8	10
21.8	3.6	0.37	0.90	0.12	0.11	31	23	7	8
43.6	3.3	0.36	0.91	0.12	0.11	30	24	8	9
65.4	3.6	0.37	0.91	0.11	0.11	30	24	7	9
87.2	3.8	0.34	0.91	0.12	0.11	30	22	7	11
109.0	3.8	0.36	0.90	0.11	0.11	30	25	7	10
Mean	3.6	0.36	0.91	0.12	0.11	30.5	23.7	7.3	9.5

Data are from a compound sample of three (Lumaco) and four (Selva Oscura) replicates.

Table 7. Nutrient accumulation by grass pea grain cv. Luanco-INIA in Lumaco and Selva Oscura, southern Chile, 2000-2001, for six rates of P fertilization.

Applied phosphorus	N	P	K	Ca	Mg	Zn	Mn	Cu	B
kg ha^{-1} P	kg ha^{-1}					g ha^{-1}			
Lumaco									
0.0	81	4.7	13.6	2.0	1.8	47	45	10	12
21.8	97	6.5	16.9	2.3	2.1	56	44	12	19
43.6	95	4.9	16.4	2.7	2.2	46	54	12	20
65.4	122	5.4	18.7	2.7	2.2	57	60	14	24
87.2	113	6.5	18.3	2.8	2.5	68	59	14	23
109.0	113	4.8	17.9	2.9	2.4	54	62	13	21
Mean	103.5	5.5	17.0	2.6	2.2	54.7	54.0	12.5	19.8
Selva Oscura									
0.0	27	2.8	6.7	1.0	0.8	24	18	6	8
21.8	33	3.4	8.2	1.1	1.0	29	21	6	7
43.6	34	3.7	9.4	1.2	1.1	31	25	8	9
65.4	42	4.3	10.5	1.3	1.3	35	28	8	10
87.2	50	4.4	11.9	1.6	1.4	39	29	9	14
109.0	53	5.0	12.5	1.5	1.5	42	35	10	14
Mean	39.8	3.9	9.9	1.3	1.2	33.3	26.0	7.8	10.3

Nutrient accumulation was calculated by multiplying nutrient content by grain yield.

CONCLUSIONS

Phosphate fertilization was associated with higher grass pea yields in soils with low P availability and retention capacity. The grain yield potential of grass pea in southern Chile was confirmed to be quite high, although grain yield was linked to the amount of rainfall during the cropping season. In a dryland area, high rainfall in spring may decrease the effect of P fertilization on grain yield. With a limited water supply, a growing condition that is frequent for this crop, grass pea crops should respond to P fertilization in soils with available P-Olsen ≤ 10 mg kg^{-1}.

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RESUMEN

La fertilización fosfatada puede incrementar el rendimiento de cultivos productivos de chícharo (*Lathyrus sativus* L.) en suelos con retención de fósforo. La información sobre el requerimiento de fósforo de cultivos de chícharo (*Lathyrus sativus* L.) es muy escasa, particularmente en suelos que retienen este elemento. En consecuencia, se evaluó el efecto de la fertilización fosfatada sobre el rendimiento y peso del grano de chícharo (variedad Luanco-INIA) en suelos con baja disponibilidad de P y alta capacidad de retención de P, en campos de pequeños agricultores de la Región de La Araucanía, sur de Chile (37°30'-39°30'S). Los ensayos se realizaron durante 2000-2001, 2001-2002 y 2002-2003 en seis sitios; tres en el área de Lumaco y tres en el área de Selva Oscura. Se evaluaron seis dosis de P (0; 21,8; 43,6; 65,4; 87,2 y 109,0 kg ha^{-1}) en un diseño de bloques completos al azar con cuatro repeticiones. Se sembró a razón de 47 semillas m^{-2}. El rendimiento de grano de todos los ensayos promedió 2456 kg ha^{-1}. La fertilización fosfatada incrementó el rendimiento de grano del chícharo durante las temporadas agrícolas 2000-2001 y 2001-2002, en ambas áreas. No hubo efecto significativo en 2002-2003, temporada de cultivo con una caída pluviométrica inusualmente elevada en primavera-verano, lo cual podría haber aumentado la tasa de mineralización de P desde la fracción orgánica del suelo y en consecuencia la disponibilidad de P. Asimismo, es posible que el crecimiento del sistema radical haya sido favorecido y con ello la exploración de un mayor volumen de suelo. De acuerdo a este estudio, cultivos de chícharo de esta variedad, en suelos con menos de 10 mg kg^{-1} de P-Olsen disponible, deberían responder a la fertilización fosfatada.

Palabras clave: almorta, *Lathyrus*, fósforo, cultivos desatendidos, leguminosas de grano de estación templada fría.

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