AGRI-FACTS
Practical Information for Alberta's Agriculture Industry

April 2002 Agdex 142/532-2

Pea Nutrient Requirements in Alberta

With the introduction of new pea cultivars that featured improved agronomic traits, Alberta pea acreage rose from less than 10,000 acres in the mid 1970's to more than 640,000 acres in 2000.

As acreage grew, so did the demand for information on the nutrient requirements for pea being grown in Alberta. Much of this interest focused on whether inoculant, nitrogen and phosphate fertilizers were needed for this crop under Alberta conditions.

Alberta Agriculture, Food and Rural Development led a study from 1995 to 1998 to find out what effects rhizobia inoculation, starter nitrogen (N), phosphorus (P), potassium (K) and sulfur (S) fertilizers had on the yield and protein content of four semi-leafless pea cultivars. Trials were conducted at 58 sites across Alberta over a wide range of agro-eco zones.

The study was done in partnership with Agriculture and Agri-Food Canada and Westco, with funding from the Alberta Agricultural Research Institute, Alberta Pulse Growers Commission, Agrium and Westco.

The study had four objectives:

- to examine the responsiveness of different types of pea cultivars to rhizobium bacteria.
- to determine the need for additional nitrogen fertilizer for optimum crop production.
- to correlate pea response to phosphate fertilizer with plant-available soil phosphorus.
- to examine the need for K and S fertilizers.

The pea cultivars (all semi-leafless) used in the study:

- Baroness (large yellow)
- Carneval (small yellow)
- Majoret (medium green)
- Radley (small green)

Results of pea cultivar trials – cultivar response

The newer pea cultivars recommended for Alberta conditions have better agronomic characteristics than previously available cultivars and are potentially more profitable because the varieties:

- are semi-leafless with shorter vine length and upright growth habit, both of which increase the ease of harvest.
- have higher yield potential and are more suitable for human consumption than previous cultivars.

Newer pea cultivars have better agronomic characteristics.

Since the new varieties have higher potential yield, they are assumed to have higher fertility requirements than did the older cultivars.

The study found:

- different pea cultivars differ in their genetic yield and protein potential. Pea cultivars varied significantly in yield at 71 per cent of the conducted trials, while protein differed at 85 per cent.
- nutrient levels required by higher-yielding pea cultivars will generally be proportionally higher than cultivars with lower yield potential.
- Radley pea consistently had the lowest yield and the highest protein concentration.
- Carneval and Majoret pea frequently had the highest yields, while Carneval pea had the lowest protein concentration.
- Baroness pea produced yields similar to Carneval pea and Majoret pea, except in the Black soil zone, where it was lower.

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- Majoret pea consistently had the highest seed N yield (total nitrogen in the seed), which was 9 to 27 per cent higher than Radley pea. Radley had the lowest seed N yield simply due to lower yield.

A general rule of thumb is 50 bu/ac of peas requires 150 lb of nitrogen, 45 lb of phosphate, 140 lb of potassium, and 13 lb of sulfur. These requirements are supplied through soil, rhizobia and fertilizer.

Nitrogen (N) fertilizer and inoculant response

To determine pea responsiveness to nitrogen and inoculant, 58 field trials using urea (46-0-0) were done over a wide range of soil types across Alberta. Four rates of 0, 18, 36 or 54 lb N/ac (0, 20, 40 or 60 kg N/ ha) were banded before seeding with and without pea seed inoculation. Table 1 shows the research site locations, mean yield and mean protein of all treatments, per cent yield and protein increases when using inoculant and nitrogen fertilizer.

The trials showed:

- rhizobia inoculation increased pea seed yield in 41 per cent of trials across Alberta by an average of 14 per cent. Pea yield was unaffected by inoculation in the remaining trials.
- in inoculated treatments on land with no history of legumes, the yield rose only slightly more often than on inoculated land that previously had a legume crop (45 per cent versus 38 per cent). However, the yield increase after inoculation was significantly larger (19 per cent vs.
  5 per cent) on land with no history of legumes.
- inoculation had a major effect on pea cultivars in 6 of 22 trials. Majoret pea responded the best to inoculation, while Baroness pea was the least responsive. From this study, it was estimated that approximately 80 per cent of N in the pea plant comes from nitrogen fixation.
- application of N fertilizer improved pea yield in 24 per cent of the 58 trials conducted with an average increase of 9 per cent. When spring soil test N to 12 inches (30 cm) was less than 18 lb/ac (20 kg N/ha), application of N fertilizer increased pea yield in one third of the trials by an average of 11 per cent. The modest benefits of rhizobia inoculation or starter N fertilizer in most trials, despite appreciable deficits between spring soil test N and accumulation of N by pea, was likely due to adequate nodulation of pea by naturally occurring rhizobia.
- generally, the effects of applied N fertilizer on protein concentration were small. Increases in protein concentration due to addition of N fertilizer were most frequent when soil test nitrate nitrogen (NO_3-N) was less than 18 lb N/ac (20 kg N/ha). In trials that showed significant benefit from applied N fertilizer, the average protein concentration increased significantly with the rate of N application from a 0.9% increase at 18 lb N/ac (20 kg N/ha) to a 2.9% increase at 54 lb N/ac (60 kg N/ha)

Nitrogen fertilizer response information table (Table 2) was developed for pea growers from the research results. The following observations were also noted:

- Pea benefits little from starter N. Starter N is only recommended when soil test N levels are less than 18 lb/ac in the 0 - 12 inch soil depth, in the Brown, Dark Brown and Thin Black Soil areas. Generally, nitrogen fertilizer is not required for pea grown on Black or Gray Wooded soils in central and northern Alberta. Frequently, most irrigated fields in southern Alberta have soil N levels greater than 40 lb N/ac and therefore do not require N.
- If soil test N levels are less than 18 lb N/ac (20 kg N/ ha), a small amount of N fertilizer should be either seed-placed or side banded at the time of seeding. N fertilizer could also be banded or broadcast and incorporated before seeding. Small amounts (< 20 lb N/ac) of **urea (46-0-0)** or **ammonium nitrate (34-0-0)** can be safely seed-placed, when seed bed moisture is good.
- Soil tests are important when choosing whether to apply fertilizer. Generally speaking, with the exception of beans, little or no additional N fertilizer is needed by most pulse crops. In fact, excess N fertilizer may reduce the amount of N fixed by a pulse crop and delay crop maturity. Mid-season N applications are normally not recommended except when inoculation has failed and there is an obvious N deficiency.

Phosphorus (P) response

Soil tests determine the amount of **phosphorus (P)** in the soil, and fertilizer recommendations are made in terms of **phosphate (P_2O_5)**. Fertilizer is also sold on the basis of per cent P_2O_5 in the fertilizer product. To convert P to P_2O_5, multiply by 2.3 (e.g. 10 lb/ac of P = 23 lb/ac of P_2O_5). Commercial granular phosphate fertilizer is generally sold as **monoammonium phosphate** and contains 11 to 12 per cent nitrogen and 51 to 55 per cent phosphate (P_2O_5).

To determine pea responsiveness to phosphate fertilizer, 52 field trials using triple superphosphate (TSP; 0-45-0) were completed over a wide range of soil types across

Table 1. Average increase in pea yield and protein concentration due to rhizobia inoculation and N fertilizer application in 58 trials conducted across a wide geographic area of Alberta, Canada.

Trial Code	Legume history	Soil NO_3-N to 30 cm (kg ha^{-1})	Mean Seed Yield (kg ha^{-1})	Yield Response to Inoculation (% increase)	Yield Response to N Fertilizer[x] (% increase)	Protein Conc. (g kg^{-1})	Protein Response to Inoculation (% increase)	Protein Response to N Fertilizer (% increase)
Dark Brown Soil Zone								
Barons 95	No	7	2854	3.8 PC[y]	9.7 **	19.0	0.9 PC	4.1 **
Strathmore 95	No	29	5691	-4.4 PC	-0.1	19.0	-1.9 PC	-0.6
Chin 96	No	15	2331	3.2 PC	17.6 **	17.2	3.9 PC	1.0
Claresholm 96	No	6	3697	18.9 PC	11.0 **	19.7	3.8 PC	-1.0 *
Strathmore 96	No	3	5488	-3.3 PC	1.0	21.3	0.0 PC	-0.1
Claresholm 97	No	22	3013	13.5 **	-6.4	21.3	7.1 **	0.6
Wilson 98	No	7	4403	39.8 **	0.5	19.9	8.6 **	-0.9
Thin Black Soil Zone								
Beiseker 95	No	24	3769	-16.5 PC	-14.2 **	18.4	-5.8 PC	-3.4 **
High River 95	No	24	4600	-3.6 PC	8.0	16.9	-3.8 PC	1.0
Irricana 95	No	40	2166	-3.2 PC	4.5	17.3	-4.0 PC	-6.3 **
Pincher Creek 95	No	71	3451	-5.2 PC	20.0 **	20.0	-3.9 PC	0.0
Beiseker 96	No	15	4674	0.8 PC	3.0	22.1	-0.7 PC	0.7 **
High River 96	No	12	4016	2.5 PC	0.3	20.3	0.4 PC	-0.8
Irricana 96	No	40	3636	7.9 PC	-1.1	19.5	2.4 PC	-3.0 **
Pincher Creek 96	No	20	2397	-3.8 PC	2.4	21.7	-0.2 PC	1.1 **
Beiseker 97	No	23	4713	-1.7	3.0	21.9	2.2	-1.1
High River 97	No	24	3747	11.5 **	7.7 **	20.3	3.5 **	-1.4
Irricana 97	No	15	4561	1.2	3.8 *	21.3	0.7 *	0.8 **
Beiseker 98	No	24	3563	-2.5	7.2 **	21.1	-0.3	0.6
Irricana 98	No	34	3855	9.0 **	-3.1	19.9	5.2 **	-2.8 **
Black Soil Zone								
Ellerslie 95	No	104	4556	0.9 PC	2.7	19.0	-0.7 PC	-0.6
Lacombe 95	Unknown	NDz	3736	-7.8 PC	1.6	20.5	0.6 PC	0.8
Olds 95	Yes	68	3997	1.8 PC	8.2	22.6	-0.8 PC	-0.5
Red Deer 95	No	57	5632	-0.1 PC	5.2 **	18.1	-7.4 PC	0.6
Vegreville 95	No	20	4116	-4.4 PC	4.2	21.4	-1.4 PC	-1.5 *
Viking 95	No	117	3199	-5.4 PC	4.5	21.0	0.0 PC	2.1 **
Ellerslie 96	No	42	6753	-1.0 PC	1.0	21.3	-0.7 PC	0.4
Olds 96	No	42	5522	1.2 PC	1.1	22.1	0.0 PC	0.6
Ponoka 96	No	77	5642	9.8 PC	3.5	24.6	-3.4 PC	-0.7
Red Deer 96	Yes	26	2169	-1.1 PC	-7.5	20.9	1.3 PC	-3.1 **
Ryley 96	No	ND	2477	0.6 PC	-2.4	21.8	-0.8 PC	2.3 **
Ellerslie 97	No	24	4999	-2.6	-1.3	21.4	-2.1 **	0.1
Olds 97	No	33	6688	-0.8	-2.9	20.9	2.1	-0.5
Red Deer 97	Yes	18	5779	-7.2	-3.0	20.1	2.7 *	-0.3
Vegreville 97	Yes	71	3895	5.5 **	4.1	20.3	0.3	0.2
Devon 98	No	15	3628	19.0 **	-4.7 *	20.6	3.7 **	-1.3 **
Ellerslie 98	No	42	5082	3.4	-2.1	21.4	0.8 *	-0.3
Red Deer 98	Yes	31	3437	-0.5	5.4 **	21.2	0.2	0.5
Vegreville 98	Yes	ND	3047	-0.1	0.8	21.8	-0.3	-1.1 *

[z] Not determined. [y] Possible cross-contamination of inoculant between treatments. [x] 20, 40 and 60 kg N ha^{-1} compared to 0 kg N ha^{-1}.
* $P<0.05$, ** $P<0.01$ (planned F tests).

Table 1. (cont'd) **Average increase in pea yield and protein concentration due to rhizobia inoculation and N fertilizer application in 58 trials conducted across a wide geographic area of Alberta, Canada.**

Trial Code	Legume history	Soil NO_3-N to 30 cm (kg ha^{-1})	Mean Seed Yield (kg ha^{-1})	Yield Response to Inoculation (% increase)	Yield Response to N Fertilizer[x] (% increase)	Protein Conc. (g kg^{-1})	Protein Response to Inoculation (% increase)	Protein Response to N Fertilizer (% increase)
				Gray Soil Zone				
Barrhead 95	Unknown	77	3709	-0.9 [PC]	11.2 **	22.3	0.0 [PC]	-0.9
Beaverlodge 95	No	106	7631	0.1 [PC]	-0.6	20.2	0.3 [PC]	0.4
Fahler 95	Unknown	25	5073	-12.5 [PC]	1.2	17.6	-8.0 [PC]	-2.5 **
Grimshaw 95	Unknown	41	2087	-0.8 [PC]	-1.5	18.3	-0.6 [PC]	-0.8
Barrhead 96	Unknown	31	4752	0.3 [PC]	4.5 **	20.9	-1.3 [PC]	1.2 *
Beaverlodge 96	No	26	1994	14.7 [PC]	1.7	20.9	-0.5 [PC]	0.4
Fairview 96	Unknown	30	2972	-0.8 [PC]	-3.1	20.6	0.1 [PC]	0.4
Rycroft 96	Unknown	53	1791	-3.4 [PC]	1.0	18.7	1.2 [PC]	-2.9 **
Fairview 97	Unknown	52	3059	21.2 **	10.3 **	21.2	-0.5	0.3
Wanham 97	Unknown	44	3829	-4.1	2.9	20.9	0.3	0.1
Fairview 98	Unknown	31	763	-4.2	-3.2	19.0	6.7 **	-3.2 **
				Irrigated trials, Brown and Dark Brown Soil Zones				
Bow Island 95	Yes	43	6613	-4.5 [PC]	-1.0	20.1	-1.4 [PC]	1.8
Bow Island 96	Yes	22	5202	-2.1 [PC]	3.0	20.1	0.2 [PC]	0.1
Lethbridge 96	Yes	97	5530	3.4 [PC]	5.0	21.0	0.3 [PC]	2.0 *
Picture Butte 96	Yes	40	5532	2.7 [PC]	-0.7	17.7	-2.5 [PC]	0.4
Bow Island 97	Yes	62	5229	-0.5	0.9	20.6	0.8	-0.1
Lethbridge 97	Yes	75	5967	5.0 *	6.6 **	19.0	0.7	2.0 **
Bow Island 98	Yes	40	4409	4.7 *	3.4	21.4	-0.8 *	0.9
Lethbridge 98	Yes	31	5299	0.2	2.8	19.0	0.0	0.6

[z] Not determined. [y] Possible cross-contamination of inoculant between treatments. [x] 20, 40 and 60 kg N ha^{-1} compared to 0 kg N ha^{-1}.
* $P<0.05$, ** $P<0.01$ (planned F tests).

Table 2. Nitrogen fertilizer recommendations for pea in the various soil zones of Alberta.

Soil Test N (0-12 inch depth; 0-30 cm)	Soil Test N (0-12 inch depth; 0-30 cm)	Brown and Dark Brown	Thin Black	Black & Gray Wooded	Irrigated
(lb/ac)	(ppm)	Recommended N (lb/ac)			
0-8	0-2	20	25	10*	30
8-16	2-4	15	20	0	20
16-24	4-6	10	15	0	10
24-32	>6	0	10	0	0

* At very low soil test N levels, 10 lb of N/ac could be applied to ensure N deficiency does not occur before N fixation begins.

Alberta. Five rates of 0, 14, 27, 41 and 54 lb P_2O_5/ac (0, 15, 30, 45 and 60 kg P_2O_5/ha) were placed with the seed or band applied before seeding Carneval pea. Table 3 shows the research site locations, mean yield and mean protein of all treatments, per cent yield and protein increase from using phosphate fertilizer.

The trials showed:

- applying phosphate significantly increased pea seed yield at 19 of 52 sites. The average increase in seed yield from a phosphate application was 7 per cent.
- the average yield benefit was similar in the Thin Black, Black and Gray Wooded soil zones, but was negligible in the Dark Brown soil zone and in irrigated trials.

Table 3. Effect of TSP application on seed yield, protein concentration and P concentration of pea in 52 trials conducted across a wide geographic area of Alberta, Canada.

Trial Code	Soil test P[z] (kg P ha^{-1})	Yield		Protein concentration	
		Mean (kg ha^{-1})	Increase	Mean (g kg^{-1})	TSP benefit[x] (%)
		Dark Brown Soil Zone			
Barons 95	23	2614	9 *	17.4	-0.2
Strathmore 95	42	5399	-4	17.9	-0.0
Chin 96	2	2371	0	16.0	0.7
Claresholm 96	9	4637	5	19.5	2.0 *
Strathmore 96	18	5691	6	20.3	-0.1
Claresholm 97	57	3192	2	21.1	-0.2
Wilson 98	20	5177	3	19.8	0.7 *
Average	24	4154	3	18.9	0.4
		Thin Black Soil Zone			
Beiseker 95	29	3872	26 ***	17.5	2.0 *
Irricana 95	11	1797	8 **	16.1	-2.6
Beiseker 96	66	4694	7	ND	ND
High River 96	17	3932	2	19.4	0.4
Irricana 96	26	4204	27 ***	ND	ND
Pincher Creek 96	9	2026	20 **	20.6	-1.4
Beiseker 97	51	4548	-4	21.0	1.6 **
High River 97	35	3919	2	19.7	0.3
Irricana 97	26	4742	5	20.6	1.3
Beiseker 98	24	4594	7	19.9	-0.5
Irricana 98	14	4489	15 ***	19.0	1.8 **
Average	28	3893	10	19.3	0.3
		Black Soil Zone			
Ellerslie 95	3	4503	22 *	17.8	0.3
Olds 95	53	4357	1	21.3	0.4
Red Deer 95	18	5234	13 ***	15.8	1.1
Vegreville 95	20	4557	4	20.1	-0.3
Viking 95	ND[y]	3566	5	19.7	0.4
Ellerslie 96	4	7146	17 ***	19.6	-0.7
Olds 96	20	5801	-12 ***	ND	ND
Ponoka 96	ND	6805	7 *	20.6	-0.0
Red Deer 96	7	3193	16 **	ND	ND
Rycroft 96	ND	3090	16 *	20.2	-0.6
Ellerslie 97	16	5583	2	19.3	0.2
Olds 97	32	6837	7	19.2	-0.7
Red Deer 97	7	7019	12 ***	18.5	-1.6 ***
Vegreville 97	36	4179	2	18.9	-0.2
Devon 98	22	4302	6	19.7	-0.2
Ellerslie 98	56	5284	1	19.6	-0.1
Red Deer 98	11	3547	16 ***	20.0	1.2
Vegreville 98	ND	3472	9 *	19.9	1.1
Average	22	4915	8	19.4	0.0

[z] Modified Kelowna method (Ashworth and Mrazek, 1995).
[y] Not determined.
[x] TSP benefit = average yield increase of all TSP-amended treatments relative to non-P-fertilized control; statistical significance (*P<0.1, **P<0.05, ***P<0.01) based on contrasts.

Table 3. (cont'd) Effect of TSP application on seed yield, protein concentration and P concentration of pea in 52 trials conducted across a wide geographic area of Alberta, Canada.

Trial Code	Soil test P[z] (kg P ha^{-1})	Yield		Protein concentration	
		Mean (kg ha^{-1})	Increase	Mean (g kg^{-1})	TSP benefit[x] (%)
Gray Soil Zone					
Barrhead 95	9	3284	-4	21.1	1.0
Beaverlodge 95	18	7839	1	18.9	1.2
Barrhead 96	13	5062	5	18.6	-1.5
Beaverlodge 96	9	2471	33 **	20.0	3.4 *
Rycroft 96	7	1535	6	18.0	1.5
Fairview 97	7	3373	13 *	20.7	-1.1
Wanham 97	7	3309	17 **	19.3	1.3
Fairview 98	22	631	-4	19.7	0.8
Average	11	3438	8	19.5	0.8
Irrigated trial in Brown and Dark Brown Soil Zone					
Bow Island 95	50	6938	5	19.0	-0.5
Lethbridge 95	37	3013	11 *	15.9	-1.2
Bow Island 96	49	6331	-1	19.5	0.8
Lethbridge 96	31	5098	14	18.9	1.0
Bow Island 97	46	4986	-1	19.4	-0.1
Lethbridge 97	82	4512	-7	17.4	-2.3
Bow Island 98	55	3884	-1	20.3	0.3
Lethbridge 98	55	5263	0	17.7	-3.3 ***
Average	51	5003	2	18.5	-0.7
All Sites	27	4383	7	19.2	0.2

[z] Modified Kelowna method (Ashworth and Mrazek, 1995).
[y] Not determined.
[x] TSP benefit = average yield increase of all TSP-amended treatments relative to non-P-fertilized control; statistical significance (*P<0.1, **P<0.05, ***P<0.01) based on contrasts.

- of the 31 trials with soil test P (modified Kelowna method) levels of less than 27 lb P/ac (30 kg P/ha) to 6 inches (15 cm), 52 per cent had a significant yield increase due to the application of phosphate, while only 1 of 17 trials with soil test P levels of more than 27 lb P/ac (30 kg P/ha) had a significant yield increase. Application of 27 lb P_2O_5/ac (30 kg P_2O_5/ha) was enough to get close to maximum yields in trials with soil test P levels of less than 27 lb P/ac.
- Phosphate placement had no effect on pea yields. There was no difference in pea yield between seed-placed and banded P. The minimal impact of seed placement on yield in this study was likely due to the less damaging effects to seedling growth of 0-45-0 than of the more commonly used source of P, monoammonium phosphate (MAP). Seed protein and P concentrations were not strongly affected by phosphate fertilizer application.

Phosphorus soil tests and fertilizer recommendations developed for pea in Alberta are fairly effective in predicting when a crop will respond to P fertilizer application. Soils that have accumulated fertilizer P over the years may still test deficient in plant-available P, particularly on high pH calcareous soils. Yet, crops grown on this land may not respond to added P fertilizer. This situation occurs most frequently in the Brown and Dark Brown soil areas of Alberta.

Table 4 shows phosphate fertilizer recommendations for pea in Alberta. P fertilizer does not have a strong effect on pea. Results from this project suggest that pea is most responsive to P fertilizer when soil P levels are less than 27 lb P/ac. Above this level, there is relatively little chance P fertilizer will have any effect. When soil test P levels are medium and significant P fertilizer was applied in the past 10 to 20 years, an annual maintenance application of phosphate fertilizer can be used to meet crop requirements and replenish soil P that is removed.

Table 4. Phosphate fertilizer recommendations for pea based on the Kelowna method, for each major soil zone in Alberta.

Soil Test P (0-6 inches; 0-15 cm)		Brown and Dark Brown	Thin Black and Black	Gray Wooded	Irrigated
(lb/ac)	(ppm)	Recommended P_2O_5 (lb/ac)			
0-10	0-5	30	40	30	40
10-20	5-10	20	30	25	30
20-30	10-15	15	20	20	20
30-40	15-20	15 *	15 *	15 *	15 *
40-50	20-25	15 *	15 *	15 *	15 *
50-60	25-30	15 *	15 *	15 *	15 *
>60	30-35	0	0	0	0

* This rate is a maintenance application of P. Probability of pea response is estimated to be <25 %.

Potassium and sulfur response

The availability of potassium (K) or sulfur (S) did not seem to be a significant factor in these trials. Adding K and S fertilizer increased yield significantly in only 3 of 44 trials. There did not seem to be a correlation between the response to K and S additions and soil test levels. However, recommendations were developed with general guidelines for when K and S fertilizers may be required.

Potassium (K)

The K soil test determines the amount of **potassium** in the soil, and fertilizer recommendations are made in terms of **potassium oxide (K_20).** Fertilizer is sold on the basis of per cent K_2O in the fertilizer product. The most common commercial potassium fertilizer sold is **potassium chloride (KCl)** and is often referred to as **muriate of potash**.

Pea takes up relatively large amounts of K. However, only 20 per cent of the K is in the seed, while the remaining K, contained in the leaves and stems, is returned to the soil. Many prairie soils have K levels in the range of 400 to over 1,000 lb/ac. Generally, K fertilizer is ineffective on pea when soil test levels are more than 300 lb/ac. K fertilizer may be needed on fields that test less than 300 lb/ac, or on sandy soils or intensively cropped fields.

Potassium is less mobile in soil than nitrate-nitrogen, but more mobile than phosphate fertilizer. Potassium fertilizers are more efficient when seed-placed or banded. However, even small amounts of seed-placed potassium with pea may reduce germination and emergence. Therefore, if potassium is required, banding may be the better placement method. Table 5 gives generalized K fertilizer recommendations for pea grown on various soil types in Alberta.

Table 5. General potassium fertilizer recommendations for pea using a 0.1N NH_4OAc (ammonium acetate) solution to extract K, in the various soil zones of Alberta.

Soil K (0-6 in; 0-15 cm)		Brown	Dark Brown	Thin Black	Black	Gray Wooded	Irrigation
(lb/ac)	(ppm)	Recommended K_2O (lb/ac)					
0-25	0-12.5	130	135	135	140	140	150
25-50	12.5-25	115	120	125	130	130	135
50-75	25-37.5	105	115	115	120	120	125
75-100	37.5-50	95	100	100	105	105	115
100-125	50-62.5	80	90	90	95	95	100
125-150	62.5-75	70	80	80	85	85	90
150-175	75-87.5	60	65	65	70	70	80
175-200	87.5-100	45	55	55	60	60	65
200-225	100-112.5	35	45	45	50	50	55
225-250	112.5-125	25	30	30	35	35	45
250-275	125-137.5	20	20	20	25	25	30
275-300	137.5-150	20	20	20	20	20	20
>300	>150	0	0	0	0	0	0

Sulfur (S)

Pea has a moderate requirement for S. Sulfur levels are generally adequate in the Brown and Dark Brown soil zones; however, some soil types are occasionally low in sulfur. Much of the sulfur in the topsoil is contained in the soil organic matter and is slowly released as **sulfate-sulfur (SO_4-S)**, the form a pea crop needs. Sulfate-sulfur is similar to nitrate-nitrogen in that it is very mobile in soil. Irrigation water contains substantial amounts of sulfate-sulfur. Although amounts in the water vary over time, 12 inches of irrigation water will add approximately 30 lb/ac of sulfate-sulfur into the soil. Therefore, pea crops rarely require S when grown on irrigated land.

Sulfate sulfur can be highly variable across fields. When a field is uniformly low in S, a soil test is very useful to estimate S fertilizer needs. However, if 10 to 20 per cent of a field is low in S, it can be difficult to identify these low S areas without intensive soil sampling.

Table 6. Sulfate-sulfur fertilizer recommendations for pea in different soil zones of Alberta.

Soil Test S Level (0-6 + 6-12 in) (0-15 + 15-30 cm)		Brown, Dark Brown	Thin Black, Black and Gray Wooded	Irrigation
(lb/ac)	(ppm)	Recommended Sulfate-Sulfur (lb/ac)		
0-5	0-2.5	15	25	20
5-10	2.5-5	10	20	15
10-15	5-7.5	5	15	10
15-20	7.5-10	5	10	5
20-25	10-12.5	0	5	0
>25	>12.5	0	0	0

Table 6 can be used as a guide to determine if sulfur fertilizer is required for growing pea in Alberta. If more than 10 to 15 per cent of a field is S deficient, it may be cost-effective to apply S fertilizer to the entire field.

Summary

- given the uncertainty of naturally occurring levels of rhizobia in soil and the responsiveness of the many pea cultivars available to growers, rhizobia inoculation is strongly recommended. Rhizobia inoculation represents a cost-effective means of ensuring maximum pea yields. However, the frequency and magnitude of inoculation benefits are likely to be less than 50 per cent, especially in fields that have regularly grown a pea crop.
- the benefits from applying starter N with pea are infrequent and usually small. Generally, starter N is only recommended when soil test N levels are less than 18 lb N /ac in the 0 to 12 inch soil depth in the Brown, Dark Brown and Thin Black soil areas of Alberta. Starter N is normally not recommended in the Black and Gray Wooded soil areas of Alberta. Nitrogen fertilizer recommendations are summarized in Table 2.
- P fertilizer is not particularly effective on pea. Results from this project suggest that P fertilizer works best when soil P levels are <27 lb P/ac. Above this level, it is unlikely pea will respond to P fertilizer. Phosphate fertilizer recommendations are summarized in Table 4.
- potassium and sulfur were not found to be major factors on pea yield. Adding K and S fertilizer resulted in significant yield increases in only 3 of 44 trials. No relationship was seen between the response to K and S additions and soil test levels. General recommendations and guidelines were developed for pea with K in Table 5 and S fertilizers in Table 6.

For more detailed information on this project, refer to:

McKenzie, R.H., A.B. Middleton, E.D. Solberg, J. DeMulder, N. Flore, G.W. Clayton and E. Bremer. 2001. "Response of pea to rhizobia inoculation and starter nitrogen in Alberta." Can. J. Plant Sci. 81: 637-643

McKenzie, R.H., A.B. Middleton, E.D. Solberg, J. DeMulder, N. Flore, G.W. Clayton and E. Bremer. 2001. "Response of pea to rate and placement of phosphate fertilizer in Alberta." Can. J. Plant Sci 81: 645-649

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