

Rate Effects for P and K Fertilizer in Soybean — Northwest

Soil Type: variable. All P & K treatments were applied and incorporated within three (3) dyas of planting.
 Planting Date: Downer 5/12, Moorhead & Shelly. 5/13, Thief River Falls & Callaway 5/14
 Row Width: 10 inch
 Weed Management: 5/16 - Preemerg: Zidua (2 oz/a) + Glyphosate/AMS or Sharpen; 6/13 Postemerg: Outlook
 Insecticide: None
 Experimental Design: Randomized complete block (RCB) 2 factor study with 4 replications.

Objective: To determine soybean response to P and K in Northwest Minnesota. Investigate a rate response to P and K in the high pH soils of NW MN. Evaluate the effectiveness of the air dried soil test used for determining K sufficiency for crops.

Results: The fertilizer response study was established in five of six soybean plot locations. One site had been fertilized in the fall of 2015 and was excluded. Four of the five sites were harvested for yield; the fifth site suffered water damage during the season and was abandoned due to poor plant development and unrepresentative yield expectations for the year. The study design was a RCB 2 factor study with 4 replications. Treatments are summarized as:

Trtmnt	P ₂ O ₅	K ₂ O	Site	Variety
	----- lbs -----			
1	0	0	SCN	AG0536
2	0	80	Non SCN	AG0835
3	80	0		
4	80	80		

No significant differences by treatment were detected at the F = 0.05 level; there was a significant response for P₂O₅ application at the F = 0.10 level (*P* = 0.0556).

Table 1. P & K Fertility Project in Northwest Minnesota: Analysis of Variance Table for Bushels/acre. 2016.

Source	DF	SS	MS	F	P
Rep	3	123.28	41.092	0.53	0.6644
Location	3	143.99	47.995	0.62	0.6067
P ₂ O ₅	1	299.81	299.806	3.86	0.0556
K ₂ O	1	18.49	18.486	0.24	0.6279
Location*P ₂ O ₅	3	9.89	3.298	0.04	0.9882
Location*K ₂ O	3	247.75	82.583	1.06	0.3738
Location*P ₂ O ₅ *K ₂ O	4	171.05	42.762	0.55	0.6993
Error	45	3492.46	77.610		
Total	63	4506.70			

Rate Effects for P and K Fertilizer in Soybean (continued) — Northwest

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The mean soybean yields by location and fertilizer treatments are summarized in Table 2. No statistical differences were found at any of the locations by treatment. When yields were calculated across all locations, grouped by main fertilizer component, no significant differences were found at the $F = 0.05$ level, however they were found for P_2O_5 at the $F = 0.10$ level (Table 3). Soils have been analyzed for P & K and were generally found to be adequate (Table 4) based on UMN Extension guidelines (See tables from Kaiser, et al.). The Callaway site was just above adequate for P based on the soil test, though the results would suggest there was a benefit from adding P_2O_5 at the site.

Table 2. Soybean yields summarized by fertilizer treatment and location for study located in NW MN. 2016.

Trtmnt	P_2O_5 --- lbs ---	K_2O	Location							
			Callaway		Downer		Shelly		Moorhead	
			bushels/acre							
1	0	0	52.5	A	62.4	A	61.0	A	61.5	A
2	0	80	62.8	A	60.7	A	59.3	A	60.3	A
3	80	0	61.6	A	70.1	A	66.8	A	66.1	A
4	80	80	61.7	A	60.3	A	64.7	A	63.6	A

Table 3. Soybean Yields (bu/acre) combined across all locations and grouped by main fertilizer component. 2016.

P_2O_5	Mean	$F = 0.05$	$F = 0.10$
80	64.4	A	A
0	60.1	A	B

K_2O	Mean	Homogeneous Groups
0	62.8	A
80	61.7	A

Table 52. Phosphate fertilizer suggestions for soybean production in Minnesota.

Expected Yield bu./acre		Phosphorus (P) Soil Test, ppm *				
		Bray: 0-5	6-10	11-15	16-20	21 +
	Olsen:	0-3	4-7	8-11	12-15	16 +
		---- P_2O_5 to apply (lb./acre) ----				
Less than 30		50	30	0	0	0
30-39		60	40	0	0	0
40-49		70	50	0	0	0
50-59		80	60	0	0	0
60 +		90	70	0	0	0

* Use one of the following equations if a phosphate suggestion for a specific soil test and a specific expected yield is desired.
 $P_{2O_5 rec} = [1.752 - (0.0836) (\text{Bray P, ppm})] (\text{Expected Yield})$
 $P_{2O_5 rec} = [1.752 - (0.1114) (\text{Olsen P, ppm})] (\text{Expected Yield})$

Table 53. Potash fertilizer suggestions for soybean production in Minnesota.

Expected Yield bu./acre		Potassium (K) Soil Test, ppm *				
		0-40	41-80	81-120	121-160	161 +
		---- K_2O to apply (lb./acre) ----				
Less than 30		55	30	15	0	0
30-39		65	40	20	0	0
40-49		80	50	20	0	0
50-59		100	60	30	0	0
60 +		110	70	30	0	0

* Use the following equation if a potash suggestion for a specific soil test and a specific expected yield is desired.
 $K_{2O rec} = [2.2 - (0.0183) (\text{Soil Test K, ppm})] (\text{Expected Yield})$

Table 4. Soil Test for P and K from NW MN plot sites. 2016.

Location	Bray P (mg/kg soil)	Olsen P (mg/kg soil)	NH_4OAc-K (mg/kg soil)
Shelly	28 / 27	21	219 / 223
Downer	59	38 / 37	193
Callaway	15	9	165
Moorhead	27	24	315

Source:

Kaiser, D., J. Lamb, and R. Eliason. 2011. Fertilizer Guidelines for Agronomic Crops in Minnesota. UMN Extension BU-06240-S, 44 pp.

For Additional Information:
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