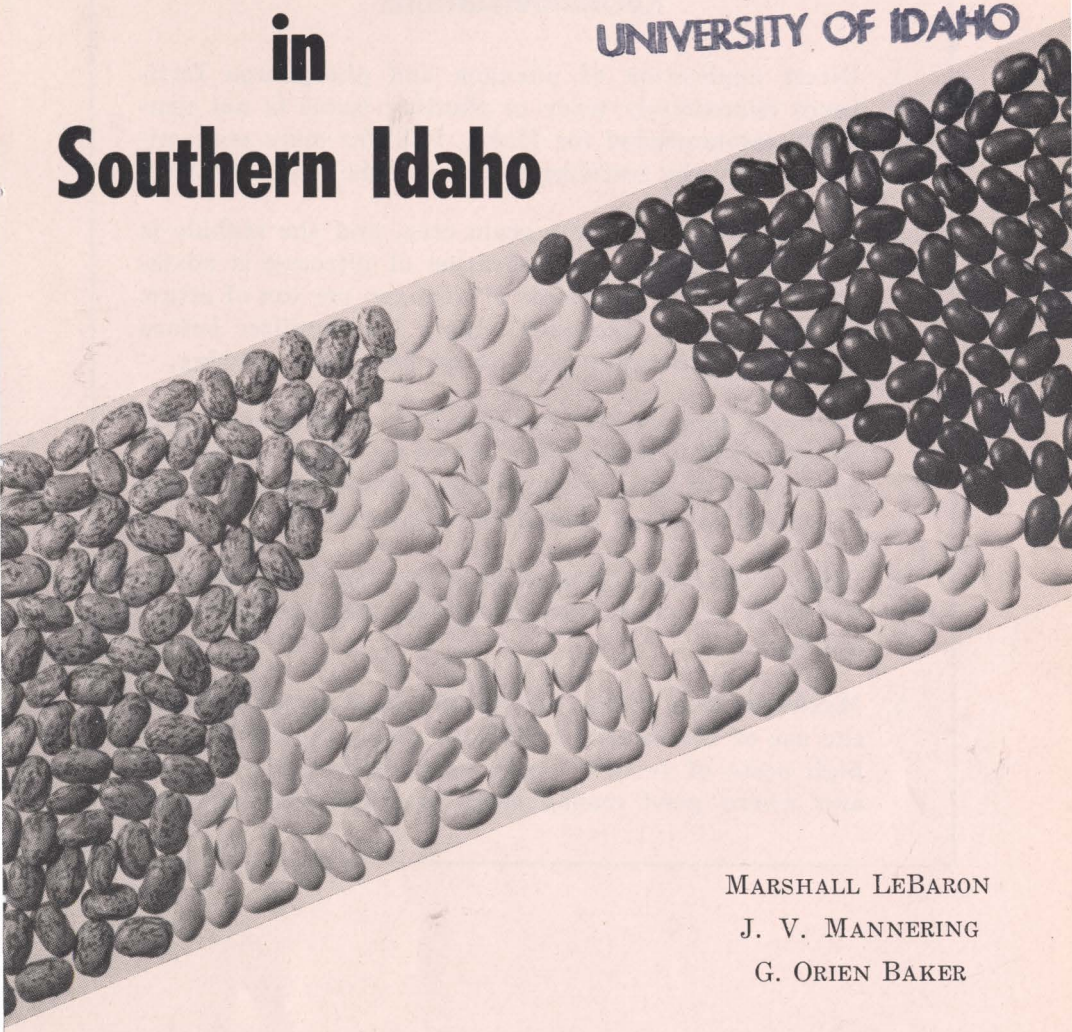
UNIVERSITY OF IDAHO
College of Agriculture

Bean Fertilization in Southern Idaho



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Recommendations

1. Direct application of nitrogen and phosphorus fertilizers immediately prior to planting beans is not generally recommended for Idaho. It is far more economical to apply the fertilizer to other crops in the rotation.

2. If beans are to follow a grain crop, and the stubble is not removed, then an application of nitrogen is advisable. Generally, 20 pounds of nitrogen per ton of straw turned under is adequate. Apply the fertilizer before plowing and irrigate prior to or just after plowing.

3. Barnyard manure will increase bean yields and should be applied if it is available. However, the fertilizer requirements of other crops in the rotation, such as sugar beets and potatoes, should be considered first.

4. Beans have not responded to applications of potash or the minor elements, iron, manganese, and zinc in southern Idaho.

5. Maximum bean yields can usually be expected without the use of commercial fertilizers where the soil is in a high state of fertility, with adequate organic matter, and where good management practices are followed.

Bean Fertilization in Southern Idaho

MARSHALL LEBARON, J. V. MANNERING, AND G. ORIEN BAKER*

PRIOR to 1947 very little information was available on the fertilization of dry beans in Idaho. Generally beans were grown at the end of the crop rotation cycle, which included a legume forage crop, and in many cases were grown continuously for several years before replanting to a legume. The yield of bean seed was gradually declining. Reports from the new land in the Columbia Basin of Washington were showing yield increases from the use of nitrogen fertilizer. Several individual growers in Idaho had in the past reported the use of fertilizers on beans with varying degrees of success. So it seemed advisable to investigate more thoroughly the use of fertilizers on beans.

During the period 1947 through 1954, fertilizer trials were located in the Twin Falls area to determine the influence of nitrogen, phosphorus, potash, and the minor elements — iron, manganese, and zinc—on bean yields. The fertilizer for these trials was broadcast and worked into the soil prior to planting. While the yield response varied considerably, the major differences could be attributed to factors other than fertilizer—such as soil variability, irrigation, stand and disease. The results, however, indicated that it was not profitable to apply fertilizers to dry beans.

The negative results of the early trials seemed to suggest that the beans might not be able to efficiently utilize the fertilizer applied by the broadcast method. Starting in 1955, the fertilizers were applied by sidedressing the row after planting to determine if this placement would result in a response. The results are given in the following sections.

Residual Influence of Phosphate Fertilizer

Great Northern 123 beans were planted on the residual phosphate plots at the Twin Falls Branch Experiment Station. The phosphate fertilizer was applied in 1951 when the plots were seeded to alfalfa with barley as a companion crop. All of the alfalfa was removed as hay except the final or third cutting in 1954, which was plowed under as a green manure crop. Nitrogen was applied to one-half of each plot at the rate of 33 pounds per acre in the spring of 1955. As might be expected after plowing under alfalfa, the addition of nitrogen did not significantly[1] increase the bean yield.

The residual effect of the different rates of phosphate applied in 1951 on bean yields in 1955 is shown in Table 1.

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[1] The term "significant" as used here, is to designate that any difference in yield is the result of the fertilizer treatment and not due to such factors as soil variability, stand, disease, etc.

Table 1.—Residual effect of phosphate fertilizer applied in 1951 on yield of beans in 1955—Twin Falls Branch Experiment Station.

1951 treatment P_2O_5 lbs./A.	Bean yield cwt./A.
0	28.6
60	30.1
120	29.3
240	31.4
480	32.5
L.S.D. 5%[2]	2.6

[2] L.S.D. (Least Significant Difference)—The yield increases between treatments from the use of fertilizer should be equal to or greater than the figure given to be considered a significant increase.

The 240- and 480-pound rates of phosphate resulted in significant yield increases. These results show that where heavier rates of phosphate fertilizer were applied to alfalfa there was a residual effect, as measured by increased yield of beans, from the phosphate applied 5 years previously.

Fertilizer Studies with Nitrogen, Phosphate, and Potash

An experiment which included nitrogen, phosphorus and potash was located on the Ernest Emerson farm near Kimberly in 1955. While no soil tests were taken, the past cropping history indicated that the experimental site was in an extremely low state of fertility. The results are given in Table 2.

Table 2.—The influence of nitrogen and phosphorus fertilizers on the yield of beans.

Fertilizer treatments lbs./A.	Emerson farm Contender beans Yield cwt./A.	Kruger farm Black Valentine beans Yield cwt./A.
0-N	19.4	17.8
40-N	22.2	18.8
80-N	23.7	19.1
0-P_2O_5	19.1	18.3
60-P_2O_5	22.8	18.8
120-P_2O_5	23.3	18.6
L.S.D. 5%	1.4	1.1

The 40-pound rate of nitrogen significantly increased the yields of Contender beans over the check and the 80-pound rate over the 40-pound rate. Sixty pounds of P_2O_5 significantly increased the yields over the check, but the 120-pound rate was no better than the lighter rate. The addition of potash did not affect the yields.

A similar fertilizer trial was located on the Henry Kruger farm near Kimberly in 1956. Soil tests gave the following results:

pH	8.0
Total Nitrogen	0.11%
CO_2 soluble P_2O_5	10.7 lbs./A.

Only the 80-pound application of nitrogen significantly increased the yield of Black Valentine beans over the check as shown in Table 2. However, it is questionable whether the increased yield would pay the cost of the fertilizer. The application of phosphorus and potash did not increase the yield.

Fertilizer Studies with Nitrogen and Phosphate

Fertilizer experiments were established in Jerome County on the Johanson farm (4 miles N.W. of Jerome) and on the Lutz farm (5 miles S.W. of Jerome) in 1957. These locations were chosen because the past history of the fields indicated that a fertilizer response might be expected. The results of the soil tests are given in Table 3.

Table 3.—Soil test results for experimental areas.

	Johanson	Lutz
pH	7.7	8.3
Organic Matter—%	1.52	1.24
Total Nitrogen—%	0.10	0.07
CO_2 soluble P_2O_5—lbs./A.	23.5	13.8
$NaHCO_2$ soluble P_2O_5—lbs./A.	42.6	36.8

Nitrogen and phosphorus were applied by two methods:

(1) broadcasting and working into the soil prior to seeding.

(2) sidedressing the fertilizer after seeding.

The results, Table 4, show that the commercial fertilizer did not significantly increase the yield of beans and that the method of applications did not have any effect on yield.

Table 4.—Effect of commercial fertilizers and methods of application on yield of beans—1957.

Treatments lbs./A. N-P_2O_5	Methods of fertilizer application	Johanson Yield cwt./A.	Yield cwt./A. Lutz
0-0		31.0	26.5
40-0	Broadcast	29.0	24.1
40-80	"	30.5	25.7
80-0	"	27.3	22.8
80-80	"	26.4	26.7
Aver. yield-cwt./A.		28.3	24.8
40-0	Sidedress	28.8	26.4
40-80	"	28.1	27.9
80-0	"	33.1	25.5
80-80	"	33.3	24.1
Aver. yield-cwt./A.		30.8	26.0
L.S.D. 5%		2.36	2.36

Influence of Crop Rotations and Management Practices

It is known that crop rotations and management practices have an effect on the yield of beans. This was further demonstrated at the Twin Falls Branch Experiment Station where Great Northern beans were planted following two different management practices.

1. Three years of row crop (beans), and 1 year of barley. Seven tons of barnyard manure was applied to half the plots with the other half not treated.
2. One year of barley and 3 years of alfalfa.

Beans were then planted on all plots. The yield from the plots receiving 7 tons of barnyard manure following beans and barley was equal to the yield following 3 years of alfalfa. These two treatments gave yields significantly greater than where beans followed 3 years of row crop (beans) and 1 year of barley without manure. The plots plowed out of alfalfa had the best soil tilth and greater water penetration. Furthermore, the weed problem was not as great as with the other two cropping sequences.

In another trial, Pinto beans were grown continuously for 4 years on the same land with and without a winter cover crop. Rye was used as the cover crop and was fertilized with nitrogen at the rate of 100 pounds per acre at planting time. The bean yields for the 4 years are given in Table 5.

Table 5—Influence of using a winter green-manure crop, rye and nitrogen fertilizer, on the yield of Pinto beans grown each year on the same land —1955-1958.

	Yield cwt./A.				
Treatment	1955	1956	1957	1958	Average
Continuous beans	2370	2489	2040	2470	2342
Continuous beans with rye and nitrogen fertilizer	2303	2476	2200	2820	2450

Planting rye in late summer after bean harvest, fertilizing with 100 pounds of nitrogen per acre and plowing under as a green manure crop in the spring prior to planting beans resulted in no increase in bean yields the first two years. The results indicate that there is a cumulative effect from such a practice on the same land over a number of years. The last two years there was a yield increase with the greatest increase occurring the fourth year. Further investigation should be made on the use of winter cover crops.

Influence of Trace Elements on Beans

Preliminary trials with the trace elements, iron, manganese and zinc, applied to the soil and used as foliar sprays have not resulted in increased plant vigor or yields. Chlorosis of the leaves in scattered areas in recent years indicates a need for additional work with trace elements.

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Fertilizer Studies with Nitrogen and Phosphate

Fertilizer experiments were established in Jerome County on the Johanson farm (4 miles N.W. of Jerome) and on the Lutz farm (5 miles S.W. of Jerome) in 1957. These locations were chosen because the past history of the fields indicated that a fertilizer response might be expected. The results of the soil tests are given in Table 3.

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Summary

The results of fertilizer trials with beans have shown little consistent response to the direct application of nitrogen and phosphorus and no response to potash fertilizer. In only one trial was there a significant profitable response to nitrogen and phosphorus. This occurred in a field extremely low in fertility. In one trial, 80 pounds of nitrogen resulted in a significant increase in yield over no nitrogen, but the increase was not large enough to be profitable.

Applications of phosphate fertilizer at 250 pounds or more of available P_2O_5 per acre to alfalfa at the beginning of its cropping cycle resulted in significant increases in bean yields the fifth year after the phosphate was applied.

It is generally concluded that where good soil management is practiced (use of crop rotations which include leguminous crops and adequate fertilization of all other crops in the rotation) the application of nitrogen, phosphorus and potash to field and snap beans in southern Idaho is not profitable. Where the fertility level of the soil is very low it may be possible to obtain a profitable response from the use of nitrogen and phosphorus but not from the use of potash.