Pak. Jour. Agri. Sci.
23 (3-4) 163, 1986

COMPARISON OF BULK AND SPLIT APPLICATION OF PHOSPHORUS ON THE YIELD AND QUALITY OF BERSEEM FODDER

M. Aslam and H. M. Bhatti*

Depatment of Soil Science, University of Agriculture, Faisalabad
*Agricultural Chemist (Soils), Ayub Agricultural Research, Institute, Faisalabad

To compare the effect on yield and quality of berseem fodder of the application of phosphorus applied whole bulk at sowing against its split use made at sowing and after first and second cuttings, a field trial was conducted for three years from 1975 to 1978 on a laomy soil in Ayub Agricultural Research Institute, Faisalabad. Doses of phosphorus were 67, 135 and 202 kg P_2O_5 ha^{-1} ha. Fodder yield as well as the protein content were increased with the increased level of phosphorus. Application of 202 kg of P_2O_5/ha produced significantly higher yield than those obtained from 67kg of P_2O_5ha^{-1} and control, the latter resulted in the lowest yield of berseem fodder. Bulk application made at the time of sowing and the splited use done at different stages, i.e. at sowing, first and second cuttings, both were found to be equally effective, and statistically similar.

INTRODUCTION

Berseem (*Trifolium alexandrium*-L) is the prime fodder crop for both milch and draught animals in the country. Besides being a highly paletable feed its nutritional value is well recognised. Over and above these qualities the crop being a legume plays an important role in enriching the soil through the fixation of atmospheric nitrogen, therefore its role in the crop rotation system is quite significant (Gill, 1967). Among the fodder crops its duration of fodder supply is the longest which has made it a highly popular fodder, consequently it is sown on a very large area in the Punjab. Due to good nodulation of the crop in the congenial environment of our soils its requirements for nitrogen are just nominal and that also only in the early stages, while its needs for phosphorus are more pronounced (Wahhab, 1960 and Sarwar, 1976).

Dry matter yield of various legumes including berseem was considerably

increased by the application of phosphatic fertilizers (Lawton *et al.* 1954). Sabir (1968) and Rashid (1969) found that yield as well as nitrogen and phosphorus contents of legumes were significantly increased by phosphorus application. Shahani *et al.* (1971) found that berseem seed and fodder yield was increased with the increasing rates of phosphorus. Wahhab (1960) argued that our soils being generally of sandy loam to clay loam texture may permit the downward movement of surface applied phosphorus with irrigation water to a depth of few centimeter.

It is likely, that split application of phosphorus may be efficiently utilized by the developed root system of crop as compared to the total application at sowing which has more chances of fixation in the soil. Khan and Bhatti, (1971) used the phosphorus; all the quantity at the time of sowing and in splits, and concluded that total application of phosphorus fertilizer at the time of sowing to berseem crop was the most effective method for getting maximum yield. Mian and Bakhsh (1980) carried out a field experiment on sandy clay loam soil to assess the effect of phosphorus on berseem. They applied phosphorus fertilizer at sowing and in two equal splits, and concluded that the fodder yield was increased by the application of phosphorus and the fertilizer applied in either way proved equally effective. To gain as much as possible from the costly input it is considered adviseable to further investigate the problem for the soil type mainly prevelant in Faisalabad area so that the efficiency of applied phosphorus could be enhanced.

MATERIALS AND METHODS

The field trial was carried out in a loam soil at Ayub Agricultural Research Institute, Faisalabad for three consecutive years, 1975 to 1978. Phosphorus as single superphosphate at the rates of 67, 135, 202 kg ha^{-1} was applied as bulk and in split doses. The net plot size as was 13 x 3.5 meter. The treatments were:

T_1 Control
T_2 67 kg of P_2O_5 ha^{-1} at sowing
T_3 135 kg of P_2O_5 ha^{-1} at sowing
T_4 202 kg of P_2O_5 ha^{-1} at sowing
T_5 34 kg of P_2O_5 ha^{-1} at sowing + 16.5 kg P_2O_5 ha^{-1} at Ist + 16.5 kg P_2O_5 ha^{-1} at 2nd cutting.
T_6 67 kg of P_2O_5 ha^{-1} at sowing + 34 kg P_2O_5 ha^{-1} at Ist + 34 kg of P_2O_5 ha^{-1} at 2nd cutting.

T_7 101 kg of P_2O_5ha^{-1} at sowing + 51 kg of P_2O_5 ha^{-1} at 1st cutting + 51 kg of P_2O_5 ha^{-1} at 2nd cutting.

The fertilizer at sowing was applied by broadcast method and mixed well in the soil, whereas for split application fertilizer was broadcasted after taking the respective cuttings, irrigation was applied immediately thereafter. The trials were laid out in randomised complete block design with four replications. Analysis of soil (U.S. Salinity Lab. Staff, 1954) was down before the sowing of the crop and the data are given in Table 1.

Table 1. *Analysis of the soil before the sowing of berseem crop :*

Determination	Depth					
	0-15 cm			15-30 cm		
	1975-76	1976-77	1977-78	1975-76	1276-77	1977-78
T.S.S. (%age)	0.20	0.18	0,19	0.17	0.16	0.18
CO_3 (me l^{-1})	NIL	NIL	NIL	NIL	NIL	NIL
HCO_3 (me l^{-1})	1.30	1.20	1.29	1.28	1.10	1.10
Cl (me/l^{-1})	0.5	0.40	0.45	0.34	0.35	0.30
SO_4 (me l^{-1})	0.42	0.40	0.31	0.25	0.30	0.60
Av. F (ppm)	6.7	5.9	5.1	3.4	3.2	2.5
Av.K (ppm)	220	245	240	230	210	190
Ca + Mg(me l^{-1})	1.2	0.9	1.1	1.05	0.7	1.0
Organic matter (% age)	0.65	0.72	0.75	0.44	0.40	0.52
pH	7.8	7.9	7.9	7.9	8.0	7.8
Texture	loam	loam	loam	loam	loam	loam

Sowing were done during the period from last week of september to first week of October each year, and 4 to 5 cuttings of fresh fodder were taken upto the Ist week of April each year and then the crop was left for seed. Protein content of the fodder was determined for the two years i.e. 1976-77 and 1977-78 (Jackson, 1960). The data of fresh fodder yield and protein content were subjected to statistical analysis using LSD method of statistical analysis.

RESULTS AND DISCUSSIONS

Yield of berseem fodder (1975-78).

The data in Table 2 clearly indicated the beneficial effect of phosphorus

on the yield of berseem fodder. The phosphorus application had significantly increased the fodder yield over control. Yield was also increased with the increasing levels of phosphorus application.

Table 2. *Yield of berseem fodder (tons ha^{-1}) as affected by phosphorus use in bulk and split applications :*

Treatment	1975-76 Av.of 5 cutting	1976-77 Av.of 4 cutting	1977-78 Av.of 5 cutting	Av. yield	%increase over control
T 1.	47.65	48.44	57.07	51.05 d	—
T 2.	81.06	71.10	88.08	80.08 bc	56.86
T 3.	84.22	78.13	91.93	84.76 b	66.03
T 4.	91.23	87.50	91.69	90.14 a	76.57
T 5.	79.64	67.19	87.27	78.04 c	52.87
T 6.	88.61	78.13	93.16	86.63 ab	69.69
T 7.	88.36	82.04	95.99	89.13 a	74.59
Cd_1	10.22	7.35	7.25	3.97 ton ha^{-1}	
Cd_2	14.00	9.90	9.93	5.29 ton ha^{-1}	

Means followed by the same letters are statistically alike at 5% probability level.

So for as influence of the times of application of phosphorus is concerned both bulk application at sowing and split applications at sowing combined with their use at Ist and 2nd cuttings were equally effective and efficient.

Solo phosphorus application @ 202 kg P_2O_5 ha^{-1} at sowing produced 270.42 tons ha^{-1} of green berseem fodder as compared to the split application of the similar dose and in that case the yield was 274.6 tons ha^{-1} indicating that both the times of phosphorus application were statistically equally effective in enhancing berseem fodder yield. Such findings were also reported by Mian and Bakhsh (1980), but these results are not in agreement with those reported by Khan and Bhatti (1971).

When the influences of treatments were compared on the basis of overall yield pooled for the three years, it was seen that the maximum averaged yield was produced by the treatment No. 4. It was very closely followed by the treatment No. 7. Yields from both the treatments were statistically equal. Dose of

67 kg P_2O_5ha^{-1} produced significantly lower yield as compared to the application of 202 kg P_2O_5ha^{-1}. The applications of phosphorus @ of 67 to 202 kg ha^{-1}caused very significant increases in fodder yields ranging from 52.87% to 76.57% over control. Statistically the lowest yield was produced by the control treatment. Similar results had been reported by Wahhab (1960), Sabir (1968) and Shahani *et al.* (1971). The intermidiary doses of phosphorus (135 kg P_2O_5 ha^{-1}) ranked in between the lowest and the highest doses. From the data it was quite clear that when the counterpart doses were compared the times of application of phosphatic fertilizer did not result in significant differences. It can therefore be concluded that the use of phosphorus to berseem may it be applied in bulk from or in splitted doses upto 2nd cutting is of equal importance.

Protein contents of berseem fodder :

Berseem fodder samples were analysed for the two years (1976-77 and 1977-78) for crude protein and the data are presented in Table 3.

The crude protein of the fodder was increased not only by the application of phosphatic fertilizers but also with the increase in phosphorus doses. The maximum over all protein content of fodder (average for two years pooled data including all the cuttings) were observed to the treatment where 202kg of P_2O_5ha^{-1} was applied at sowing followed by the same amounts of phosphorus in split application (12.88%). The other treatments in the order of merit were treatment No. 3 and treatment No. 6 where the pooled and averaged protein contents were 12.6% and 11.50% respectively. In fodder obtained from the control, the protein contents were even less than half of that from the best treatment. The protein content data indicated that generally bulk application of phosphorus caused more enrichment of the fodder than the treatment where same amount of phosphorus had been applied in split fractions. It may be noted that the use of phosphorus not only greatly enhanced the yields of berseem fodder but it also very materially improved the fodder nutritionally. The fact has also been noted by Sabir (1968), Rashid (1969) and Mian and Bukhsh (1980).

The further examination of data indicated that there had been consfieuous effects of the year of crop production on the protein contents of the fodder, the produce of the later year, generally contained more overall polled and average quantity of crude protein. Total protein harvested during each year through various treatments was presented in Table 3. Despite the year-wise differences in various treatments, the overall protein contents in the produce

Table 3. *Protein contents (%) berseem fodder as affected by phosphorus applicatton in bulk and split form.*

Treat-ment	1st cutting		2nu cutting		3rd cutting		4th cutting		5th cutting		Average		Overall Av.	
	1976-77	1977-78	1976-77	1977-78	1976-77	1977-78	1976-77	1977-78	1976-77	1977-78	1976-77	1977-78		
T_1	5.15	8.75	5.82	7.61	4.27	7.44	4.28	8.74	—	9.89	4.88	8.49	6.69	c
T_2	13.22	10.88	10.43	11.89	8.49	11.82	10.67	12.50	—	13.05	10.70	12.03	11.37	b
T_3	15.03	11.99	12.12	12.54	10.24	12.78	12.51	13.47	—	13.22	12.47	12.80	12.64	ab
T_4	18.69	12.07	14.14	12.79	12.21	13.39	14.30	14.71	—	14.18	14.91	13.43	14.17	a
T_5	14.92	10.33	9.10	10.23	7.48	11.45	9.76	12.79	—	13.03	10.31	11.71	11.01	b
T_6	15.46	11.82	7.92	12.69	7.39	12.96	8.62	14.54	—	13.74	9.85	13.15	11.50	b
T_7	16.07	12.00	10.19	12.86	10.27	13.21	10.84	15.07	—	15.20	12.09	13.67	12.87	ab
	98.54	77.84	70.20	81.31	60.34	83.05	70.98	91.82	—	92.31	75.21	85.28		
												Cd_1	72.46	
												Cd_2	2.91	

Mean followed by same letters are statistically equal at 5% level of probability.

of the later year were higher which could be due either to the season's effect or better activity of symbiotic bacteria which might had established better,

REFERENCES

Gill, M.A. 1967. Effect of phosphorus fertilizer on soil and leguminous crops. M.Sc. thesis, WPAU. Lyp.

Jackson, M.L. 1960. Soil Chemical Analysis. Prentice Hall Inc. Englewood Cliffs. N. York.

Khan, M.A and M.A. Bhatti. 1971. Effect of time of application of N and P (30-75) on the yield of berseem crop under irrigated conditions. J. Agri. Res. 9 : 120-123.

Lawton, K., M.B. Leson and B. Kawin. 1954. Effect of rate and placement of superphosphate on the yield and phosphorus absorption of legume hay. Soil Sci. Soc. Amer Proc. 18 : 428-432.

Mian, M.A. and M. Bakhsh. 1980. Role of Starter nitrogen and time of phosphate applicaton in miximizing berseem production. Pak. J. Agri. Sci. 17 : 1-6.

Rashid, A. 1969. Effect of phosphorus and molybdenum application to berseem on the yield of J/1 Maize. M.Sc. thesis WPAU- Lyp.

Sabir, A. 1968. Effect of differnt sources of phosphorus on the fixation of nitrogen by legumes. M.Sc. thesis WPAU. Lyp.

Sarwar, M. 1976. Effect of phosphorus and starter nitrogen on berseem as influenced by the time of application. M.Sc. thesis UA. Lyp.

Shahani, M.N., K.N. Singh and S.B. Roy 1971. Response of berseem to basic slag, rockphosphate and superphosphate in acid soils. Ind. J. Agri. Sci. 41 : 559-563.

U.S. Salinity Lab. Staff. 1954. Diagnosis and Improvement of Saline and Alkali Soils. USDA. Hand Book 60.

Wahhab, A. 1960. Effect of Rate and placement of some phosphatic fertilizers on the yield and phosphorus absorption by some legumes. Fifty years of Agri. Ed. and Res. at Pb. Agri. College and Res. Instt. Lyp. II : 17-18.