Journal of Advances in Developmental Research 2 (1) 2011 : 42-46

Research Article
Available online at www.journal-advances-developmental-research.com
Journal of Advances in Developmental Research
ISSN: 0976-4704 (Print), e-ISSN: 0976-4844 (Online)
J.Adv.Dev.Res. Volume 2, No.1, June 2011

Effect of Integrated Use of Fertilizer P, FYM and Biofertilizers on Soil Properties and Productivity of Soybean – Wheat Crop Sequence

S.K. Dadhich[*1] , L.L. Somani[2] and Deepti Shilpkar[3]

[*1] Corresponding author, Krishi Vigyan Kendra, Maharana Pratap University of Agriculture and Technology, Sirohi, Rajasthan, Email- drskd2001@yahoo.com
[2]Professor, Ex Director Residential Instructions, Maharana Pratap University of Agriculture Technology, Udaipur, Rajasthan
[3]Department of Botany, Jai Narayan Vyas University, Jodhpur, Rajasthan

Abstract

A field experiment was conducted at Udaipur to study the direct effect of fertilizer P, FYM and biofertilizers alone and in combinations on soybean and their residual effect on subsequent wheat. Application of increasing levels of P, FYM and biofertilizers significantly enhanced the seed/grain yield of soybean and subsequent wheat. A supplementation of P to the extent of 20 kg and 10 kg P_2O_5 in soybean and wheat respectively is possible by judiciously integrating P levels, FYM and biofertilizers. Increasing P levels, FYM and biofertilizers significantly increased N, P and K uptake by soybean while integrated use of P levels and FYM as well as P levels and biofertilizers significantly enhanced N and P uptake by soybean. Application of FYM significantly increased the organic carbon, CEC, available N, P and K content and significantly decreased the bulk density of soil after wheat harvest. Application of P resulted in significant improvement in organic carbon, CEC, available N and P while biofertilizers inoculation significantly improved available P status of soil after harvest of wheat.

Key words: P levels, FYM, Biofertilizers, Inoculation, Nutrient uptake

Introduction

Modern agricultural practices have emphasized the widespread use of fertilizer and this approach has certainly increased grain yields in many countries in the last three decades. However, long term use of chemical fertilizers also led to a decline in crop yields and soil fertility in the intensive cropping system. There is evidence that over fertilization has increased the concentration of many plant nutrients in both surface and ground water, which has created a potential health hazard. This has in turn paved the way for integrated plant nutrition involving judicious and integrated use of chemical/synthetic sources of nutrients alongwith biofertilizers in addition to nutrient recycling through use of organic manures, green manuring and biodegradable wastes, etc. Biofertilizers offer a cheaper low capital intensive and ecofriendly route to boosting farm productivity depending upon their activity of mobilizing different nutrients. Integrated Nutrient Management (INM) holds great promise in meeting the growing nutrient demands of intensive agriculture and maintaining the crop productivity at higher levels with overall improvement in the quality of resource base.

Soybean is a highly exhaustive crop and require higher amount of nutrients particularly P

for its optimum production[1]. Soybean-wheat cropping system is an important crop sequence. Considering these facts and paucity of findings on these aspects in the typical edapho-ecological conditions, the present investigation was undertaken.

Experimental

A field experiment was conducted during 2001-02 and 2002-03 at Rajasthan College of Agriculture, Udaipur. The zone has typical subtropical, sub-humid climate with mild winter, moderate summer and high humidity during July – September. The soil of experimental field was clay loam in texture, alkaline in reaction (pH 7.8) having bulk density 1.54 Mg m^{-3} CEC was 20.21 cmol (P^+) kg^{-1} and it was medium in organic carbon 0.70 per cent, available N 270.4 kg ha^{-1} and available P 7.64 kg ha^{-1} and high in available K 372.8 kg ha^{-1}. The DTPA extractable metallic cations viz. Zn, Cu, Mn and Fe of the soil were 2.51, 2.18, 11.45, 9.69 mg kg^{-1}, respectively.

A total of 32 treatments combinations comprising of four levels of P (0, 8.73, 13.10 and 17.47 P kg ha^{-1}), two levels of FYM (0 and 10 t ha^{-1}) and four biofertilizers [No inoculation, Phosphate Solubilizing bacteria (PSB) Vesicular Arbuscular Mycorrhiza (VAM) and PSB + VAM] were replicated thrice under spilt plot design. Seeds were inoculated with *Bacillus megatherium* var. phosphaticum for PSB. Inoculum of VAM, *Glomus fasciculatum* was drilled below seeds in soil. Soybean var. JS-335 was taken as a test crop to observe direct effect of the treatments and wheat var. Raj 3765 was taken to observe residual effect. A uniform application of 30 kg N ha^{-1} was common to all treatments for soybean alongwith seed inoculation with *Rhizobium* while recommended dose of N @ 90 kg ha^{-1} was used for wheat.

Results and Discussion

Crop yield

Application of phosphorus levels, FYM and biofertilizers to soybean significantly increased seed yield of soybean and their residual effect significantly enhanced grain yield of subsequent wheat (Table 1). Among biofertilizers, dual inoculation of PSB + VAM found significantly better than their singular inoculation. The greater yield response due to dual inoculation of VAM fungus and PSB than with PSB alone can be attributed to the activity of the VAM fungus in transporting extra phosphorus solubilized by PSB from and beyond the root zone into the plant roots which in the absence of VAM hyphae gets refixed by soil constituents during the course of slower diffusion towards plant roots. Interaction effect of phosphorus levels, FYM and biofertilizers was found significant in increasing seed yield of soybean. These effects can be attributed to increased nutrients contents in soil followed by their increased uptake by plants due to greater availability of

Table 1. Effect of phosphorus levels, FYM and biofertilizers on seed / grain yield of soybean and subsequent wheat

Treatments	Seed yield of soybean (t ha^{-1})		Grain yield of wheat (t ha^{-1})	
	2001	2002	2001	2002
P Levels (kg P_2O_5 ha^{-1})				
0	1.22	1.48	3.45	4.48
20	1.63	1.90	4.24	5.27
30	1.90	2.19	4.77	5.81
40	2.25	2.49	5.26	6.31
CD at 5%	0.044	0.048	0.1383	0.1309
FYM (t ha^{-1})				
0	1.48	1.75	3.94	4.96
10	2.09	2.29	4.92	5.92
SEm±	0.010	0.011	0.322	0.30
CD at 5%	0.31	0.34	0.978	0.926
Biofertilizers				
No Inoculation	1.50	1.77	3.98	5.00
PSB	1.72	1.99	4.43	5.47
VAM	1.791	2.06	4.47	5.51
PSB+ VAM	1.99	2.25	4.84	5.87
CD at 5%	0.056	0.049	0.1573	0.1677

Table 2. Effect of phosphorus levels, FYM and biofertilizers on N, P and K uptake (kg ha^{-1}) by soybean

Treatments	N uptake		P uptake		K uptake	
	2001	2002	2001	2002	2001	2002
P Levels (kg P_2O_5 ha^{-1})						
0	96.0	143.0	12.0	13.0	44.5	48.0
20	135.3	168.6	15.6	17.3	62.3	64.5
30	167.1	175.4	18.4	20.0	73.9	75.9
40	205.1	196.7	22.6	24.1	88.1	87.0
CD at 5%	5.93	5.59	0.56	0.48	4.63	4.19
FYM (t ha^{-1})						
0	120.2	140.1	14.0	15.8	53.3	55.6
10	181.6	201.5	19.8	21.4	81.1	82.2
CD at 5%	4.19	3.95	0.40	0.34	3.27	2.96
Biofertilizers						
No Inoculation	124.4	143.0	14.1	15.8	57.4	60.1
PSB	147.6	168.2	16.6	18.3	65.7	67.6
VAM	155.4	175.4	17.3	19.0	68.9	70.5
PSB+ VAM	176.1	196.7	19.7	21.4	76.7	77.5
CD at 5%	5.89	8.98	0.62	0.60	4.09	4.30

nutrients through organic, inorganic and biological sources by enhancing the cambial activity of root hairs, root proliferation and cell development in the root surface areas resulting in higher growth and yield.

Nutrient uptake

Application of increasing levels of P, FYM and biofertilizers significantly increased the uptake of N, P and K by soybean (Table 2). Combined use of P levels and FYM and P levels and biofertilizers also recorded significantly higher N and P uptake by soybean and the combined use of residual P levels and FYM significantly increased the uptake of P by subsequent wheat. The increased uptake of these nutrients was due to increased supply of nutrients which enhanced proliferation of root system under balanced nutrient application which in turn facilitated better absorption of water and nutrients alongwith improved soil physical environment.

Improvement in uptake of nutrients due to combined use of P and biofertilizers is attributed to significantly improved P availability which played a pivotal role in development of roots, their proliferation and improvement in their functional activities. This in turn induced higher N_2-fixation besides higher extraction of nutrients from soil environment.

Soil Properties

The bulk density of soil decreased significantly with the application of FYM (Table 3). This may be attributed to improvement in soil structure.

Organic carbon content and CEC of soil after harvest of wheat increased significantly with increasing levels of P application and incorporation of FYM (Table 3). The increased organic carbon and CEC of soil may be due to enhanced root growth leading to accumulation of more root residues in the soil as reported earlier[2].

Application of P levels significantly improved available N and P content of soil while inoculation of biofertilizers resulted in significant increase in available P content of soil after harvest of wheat (Table 3). Significant build up of the soil available N could be attributed to increased activity of nitrogen fixing rhizobia thereby resulting in higher accumulation of N in the soil[3]. P status of soil improved due to partial recovery of applied P by crops and that due to biofertilizers may be ascribed to increased solubility of unavailable native soil phosphate with exotic strains of PSB besides extraction of P from deeper layers by VAM hyphae.

Application of FYM (Table 3) resulted in significant buildup of soil P after wheat harvest. This is attributable to the additional supply of P through FYM in combination with direct supply

Table 3. Effect of phosphorus levels, FYM and biofertilizers on some soil properties after harvest of wheat

Treatments	Bulk density(g/cc)		Organic carbon (%)		CEC[cmol (P+) kg-1]		N (kg / ha)		P_2O_5(kg / ha)		K_2O(kg / ha)	
	2001-02	2002-03	2001-02	2002-03	2001-02	2002-03	2001-02	2002-03	2001-02	2002-03	2001-02	2002-03
P Levels (kg P_2O_5 ha^{-1})												
0	1.47	1.47	0.66	0.67	20.15	20.28	272.58	268.32	14.05	13.99	335.85	303.21
20	1.47	1.47	0.75	0.78	21.17	21.59	281.38	276.99	18.26	18.68	341.16	308.33
30	1.46	1.46	0.80	0.82	21.90	22.36	287.12	282.77	20.36	18.87	345.07	311.57
40	1.45	1.45	0.85	0.90	22.18	22.83	290.20	285.57	21.50	20.02	348.28	314.39
SEm±	0.004	0.005	0.013	0.031	0.151	0.483	4.16	2.30	0.17	0.23	2.97	3.23
CD at 5%	NS	NS	0.040	0.094	0.460	1.465	12.62	6.97	0.52	0.69	NS	NS
FYM (t ha^{-1})												
0	1.49	1.49	0.67	0.70	19.79	20.22	268.91	264.69	17.80	17.11	336.00	303.52
10	1.44	1.44	0.87	0.89	22.91	23.31	296.72	292.13	19.29	18.68	349.18	315.23
SEm±	0.003	0.004	0.009	0.022	0.107	0.341	2.94	1.63	0.12	0.16	2.10	2.28
CD at 5%	0.010	0.011	0.028	0.066	0.325	1.036	8.92	4.93	0.37	0.49	6.37	6.92
Biofertilizers												
No Inoculation	1.47	1.46	0.74	0.77	21.15	21.57	281.73	275.00	17.75	16.75	341.26	308.05
PSB	1.46	1.46	0.76	0.79	21.28	21.66	282.69	278.18	18.24	17.71	342.60	309.39
VAM	1.46	1.46	0.77	0.80	21.45	21.89	282.92	278.41	18.71	18.18	342.88	309.67
PSB+ VAM	1.46	1.46	0.79	0.82	21.53	21.94	282.94	282.65	19.47	18.93	343.61	310.40
SEm±	0.005	0.006	0.014	0.020	0.143	0.287	5.17	2.32	0.21	0.28	3.69	4.10
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	0.62	0.79	NS	NS

through P fertilizers. FYM releases organic acids which also solubilise less soluble forms of P in the soil, besides minimizing fixation of applied P by soil constituents

It can be concluded from the results of this experiment that integrated use of P, FYM with dual inoculation of biofertilizers can supplement P requirement to the extent of P_2O_5 equivalent to 20 kg ha^{-1} for soybean and 10 kg ha^{-1} for subsequent wheat.

References

1. Wadodkar MR, Sehgal JL and Challa O. 1996. Soil site suitability for soybean in Vidharbha region. *Agropedology,* 6: 95-101.
2. Singh RD and Chauhan VS. 2002. Impact of inorganic fertilizers and organic manures on soil productivity under wheat-ragi system. *Journal of the Indian Society of Soil Science,* 50: 62-63.
3. Parmar DK, Sharma PK and Sharma TR. 1998. Integrated nutrient supply system for 'DPP68' vegetable pea (*Pisum sativum* var. arvense) in dry temperature zone of H.P. *Indian Journal of Agricultural Sciences,* 68 : 84-86.