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RESEARCH ARTICLE

Influence of phosphorus enriched biogas spent slurry (BSS) on growth and yield of sunflower (*Helianthus annuus*)

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SUMMARY

A field experiment was conducted during 2006-2007 at Main Agricultural Research Station (MARS), Dharwad, to study the influence biogas spent slurry enriched with phosphorus using rock phosphate and phosphate solubilizing bacterial cultures in black clayey soil. Significantly highest was plant height recorded for the treatment 100 per cent recommended dose of fertilizers and normal BSS (124.07cm) followed by 75 per cent RDF and 25 per cent P-enriched BSS. The stem girth and head diameter were found to be significantly different for the P-enriched BSS, where PSB-D1 performed better than TNAU-2. The yield attributes *viz*., head weight, thousand seed weight and grain yield were significant in the same treatment enriched with PSB-D1. A matching trend was observed with respect to shoot N and P concentration. Similarly, the population of rhizosphere microflora *viz*., bacteria, fungi, actinomycetes, free living nitrogen fixers and phosphate solubilizers were found to be highest at flowering stage and thereafter decreased at harvest.

Key Words : Sunflower, BSS, Enrichment, P-solubilizers, Yield

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The addition of organic matter to the soil had long been recognized as an essential component in maintenance of soil health for sustainable crop production. Maintenance of soil fertility, release of nutrients to the plants over the growing season, improvement of water holding capacity, cation exchange capacity and resistance to soil erosion are some of the properties of organic matter in soil. Biogas spent slurry (BSS), a product obtained from biogas plants, is one among the various organic inputs used as fertilizer in crop production (Shankarappa and Geeta, 2001; Geeta *et al.,* 2004). BSS contain both macro and micro nutrients in appreciable quantities that promote plant growth and also improve physical, chemical and biological properties of soil, which in turn contribute to increased productivity (Shyam and Sreenivasa, 1998).

The nutrient status of various organic inputs may be deficient in major nutrient, phosphorus. To overcome this, several workers have tried to enrich P in FYM (Bajpai and Sundara Rao, 1971), in compost (Rasal *et al*., 2002), in BSS (Shankarappa and Geeta, 2001; Geeta *et al.,* 2002) and other organic amendments. The performance of BSS in crop production had been documented for few crops. The manurial value of BSS composted with mango leaves, wheat straw and rock phosphate was evaluated on wheat crop (Pathak *et al.,* 1992). The application of BSS along with inoculation of nitrogen fixers enhanced growth and yield of maize (Sreenivasa and Geeta, 2000). Application of BSS with *Azospirillum* inoculation had reduced the fertilizer nitrogen requirement by 25 per cent in potato

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(Shankarappa and Geeta, 2001) and substitution of P enriched BSS up to 50 per cent with chemical P had performed at par with recommended dose of fertilizer P with respect to growth and yield of sunflower (Geeta *et al.,* 2004).

A farmer friendly technology for enrichment of P in BSS was developed (Geeta *et al.*, 2003) using rock phosphate and P-solubilizers. This P enriched BSS had available P content up to 1.70 per cent. Hence, in the present investigation, influence of enriched BSS on growth and yield of sunflower, its effect on nutrient content and rhizosphere microflora was attempted in black clayey soil under rain fed condition.

MATERIALS AND METHODS

A field experiment was conducted to study the influence of P-enriched biogas spent slurry on growth and yield attributes of sunflower and its effect on shoot N and P concentration and rhizosphere microflora in black clayey soil at Main Agricultural Research Station, Dharwad, Karnataka, during 2006-2007. The soil of the experimental plot was clayey in texture (64.63% clay, 13.12% sand and 22.25% silt) with bulk density of 1.27 g/cc, alkaline in reaction (pH 7.3), low in organic carbon (0.49%), available nitrogen (240 kg/ha), and phosphorus (16 kg/ha) and available potassium (330 kg/ha). The experiment was laid out in randomized block design with eight treatments with varying levels of recommended dose of fertilizers and P-enriched BSS with rock phosphate and phosphate solubilizing bacterial cultures (PSB-D1 and TNAU-2) individually. All the eight treatments were laid out in three replications with a net plot size of $10m^2$.

The P-enriched BSS was obtained by using rock phosphate and two efficient P-solubilizing bacteria namely PSB-D1 and TNAU-2. In two polythene lined pits, about 100l of BSS was poured and amended with 2.5 kg of rock phosphate to each pit and inoculated with 500g of either PSB-D1 or TNAU-2. This was allowed for enrichment for 45 days under ambient conditions. The P-enriched BSS had available P content of about 1.50 per cent over normal BSS (0.50% P).

The sunflower hybrid seeds(KHSB-1),were treated with *Azospirillum* and sown at a spacing of 60cmx30cm. The recommended dose of fertilizers *viz.,* 35:50:35 kg N, P_2O_5 and K_2O, per hectare were provided in the form of urea, single super phosphate and muriate of potash, respectively. The recommended dose of P was alone substituted with P-enriched BSS as per the treatments. The fertilizer doses were applied in the furrows at the time of sowing. The recommended dose of FYM @ 7.5 tons per hectare, P enriched BSS and BSS alone as per the treatments were applied two days before sowing. The shoot N and P concentrations were estimated by following standard procedures.

The experimental plots were kept weed free by manual weeding and sprayed one time with monocrotophos (36 SL) @ 0.05% to control *Helicoverpa* caterpillar at 45 days after sowing (DAS). The observations on growth parameters were recorded at peak flowering stage and yield attributes were recorded after harvest. The rhizosphere microflora *viz.,* total bacteria, total fungi, total actinomycetes, free living nitrogen fixers and P-solubilizers were recorded at peak flowering and at harvest stage by following standard plate count method.

RESULTS AND DISCUSSION

The effect of P-enriched BSS alone or in combination with recommended dose of chemical fertilizers had influenced in better growth parameters of sunflower such as plant height, stem girth and head diameter at flowering stage. These combinations showed identical growth pattern when compared to the treatment that received 100 per cent recommended dose of chemical fertilizer (Table 1). The significantly highest plant height recorded for the treatment 100 per cent recommended dose of fertilizers and normal BSS

Table 1: Influence of enriched biogas spent slurry on growth parameters of sunflower at flowering stage

Treatments	P- solubilizers								
	Plant height(cm)			Stem girth(cm)			Head diameter (cm)		
	PSB-D1	TNAU-2	Mean	PSB-D1	TNAU-2	Mean	PSB-D1	TNAU-2	Mean
100% RDF + BSS	124.73	123.40	124.07	1.11	1.13	1.12	13.60	13.30	13.45
100% RDF	118.20	117.80	118.00	0.98	1.02	1.00	12.80	12.85	12.83
75% RDF	114.53	113.23	113.88	0.92	0.92	0.92	12.85	12.40	12.63
50% RDF	109.80	108.00	108.90	0.92	0.94	0.93	11.30	11.20	11.25
100% P-enriched BSS	114.07	98.00	106.03	1.07	1.02	1.04	10.50	10.55	10.53
50% RDF + 50% P- enriched BSS	117.67	102.00	109.83	0.98	1.04	1.01	11.50	11.00	11.25
75% RDF + 25% P-enriched BSS	116.87	114.00	115.43	1.07	1.12	1.10	13.05	12.70	12.88
25% RDF + 75% P-enriched BSS	109.53	96.00	102.77	0.96	1.02	0.99	11.20	10.40	10.80
Mean	115.68	109.05		1.00	1.03		12.10	11.80	
Source	S.Em±	CD (P=0.05)		S.Em±	CD (P=0.05)		S.Em±	CD (P=0.05)	
Treatments (A)	1.33	3.84		0.02	NS		0.12	NS	
P-solubilizers (B)	2.66	7.68		0.04	0.12		0.23	0.67	
Interaction (A x B)	3.76	NS		0.06	NS		0.33	NS	

Legend: NS: Non -significant

(124.07 cm) was followed by 75 per cent RDF and 25 per cent P-enriched BSS. Among the P-solubilizers, PSB-D1 (115.68 cm) was found to be superior over TNAU-2. The interaction of treatments and P-so lubilizers although were not significant but resulted in superior plant height with 100 per cent RDF and normal BSS (124.73 cm) followed by 50 per cent RDF and 50 per cent P-enriched BSS (117.67 cm). The stem girth and head diameter were found to be significantly different for the P-enriched BSS, where PSB-D1 performed better than TNAU-2, while the different treatments and their interaction were found to be at par with each other. The superior growth factors observed in the treatments was perhaps due to enhanced and continuous availability of solubilized phosphorus for the plant uptake (Krasilnikov, 1961).

The yield parameters as influenced by 100 per cent RDF and different combinations of RDF and P- enriched BSS indicated significant differences for head weight per plot and 1000 seed weight. P- Enriched BSS with PSB-D1 (1238.54 g and 65.17 g) showed significantly highest head weight and 1000 seed weight, respectively over TNAU-2 (Table 2). The grain yield per plot, and shoot N were observed to be significantly superior with the individual treatments 100 per cent RDF + 7.5 tons per hectare normal BSS and P solubilizer PSB-D1 compared to their respective counterparts and their interactions. The shoot P was highest in P enriched BSS with PSB-D1. Bajpai and Sundar Rao (1971) reported increased P-uptake in wheat and cowpea when phosphobacteria was inoculated with FYM and rock phosphate.

With regards to rhizosphere microflora at flowering stage, it was observed that TNAU-2 enriched BSS had resulted in significantly highest total bacteria per gram of soil (40.50×10^6 CFU/ g) while the total fungi (20.00×10^4 CFU/ g), actinomycetes (9.83×10^3 CFU/ g), free living nitrogen fixers (15.42×10^3 CFU/ g), and phosphate solubilizers (11.46×10^4 CFU/ g), were significantly highest in the rhizosphere soil amended with UAS-D1 enriched BSS. The interaction effects showed better proliferation of bacteria with the treatment 50 per cent RDF alone and all other microflora were found to be better colonized in the rhizosphere of the treatment 100 per cent P enriched BSS for both PSB -D1 and TNAU-2(Table 3).

The rhizosphere microflora at harvest stage indicated a significantly better survival of the rhizosphere microflora with the individual treatment UAS-D1 when compared to TNAU-2 (Table 4) and other main treatments and their interaction with P enriched BSS did not show significant differences with respect to all the microflora analyzed. The microflora of the rhizosphere showed highest bacteria followed by fungi, P solubilizers, N_2 fixers and actinomycetes in the decreasing order in rhizosphere soil of sunflower. Pathak *et al*. (1992) observed that addition of NSS alone or in combination with absorbent and MRP resulted in a significant build up of soil fertility. The population declined gradually at harvest from peak flowering stage for all the organisms studied in the experiment and the decline in the population at the time of harvest, probably due to complete mineralization of organic matter added to the soil.

REFERENCES

Bajpai, P. D. and Sundara Rao, W. V. B. (1971). Phosphate solubilizing bacteria. III. Soil inoculation with phosphate solubilizing bacteria. *Soil Sci. Plant Nutri.*, **17**:46-53.

Geeta, G.S., Gurumurthy, S.B. and Shankarappa, T.H. (2003). Enrichment of biogas spent slurry with phosphorus. In: 44th AMI Conference on Microbes and Human Sustenance, held at UAS, Dharwad (KARNATAKA) INDIA. 12-14 Nov. 2003,23p.

Geeta, G.S. Gurumurthy, S.B. and Shankarappa, T.H. (2004). Enrichment of biogas spent slurry with phosphorus. In: 45th AMI Conference, held at the Division of Microbiology, NDRI, Karnal (HARYANA) INDIA 23-25Nov. 2004,30pp.

Krasilnikov, M. (1961). The role of soil bacteria in plant nutrition. *J. Gen. Appl. Microbiol*., **7**:128-144.

Pathak, H., Kushwaha, J.S. and Jain M.C. (1992). Evaluation of manorial value of biogas spent slurry composted with dry mango leaves, wheat straw and rock phosphate on wheat crop. *J. Indian Soc. Soil Sci*., **40**:753-757.

Rasal, P.H., Jadhav, B.R., Nazirkar, R. B., Kalbhor, H. B. and Pawar, K. B. (2002). Role of phosphocompost and their efficacy in groundnut-wheat cropping system and soil health. *J. Maharastra Agric. Univ.,* **27**:156-160.

Shankarappa, T.H. and Geeta, G.S. (2001). Use of biogas spent slurry as N-fertilizer for potato. In: AMI Conference on Microbial Technology-Millennium's new vision, held at the Gulburga University, Gulburga (KARNATAKA) INDIA 09-11, Nov. 2001.111pp.

Shyam, M. and Sreenivasa, M. N. (1998). Research digest on use of biogas spent slurry. Technical Bulletin, CIAE, ICAR, Bhopal (M.P.) INDIA.

Sreenivasa, M. N. and Geeta, G. S. (2000). Influence of biodigested slurry in conjunction with *Azospirillum* on growth and yield of maize. In: 41st AMI Conference held at the Birla Institute of Scientific Research, Jaipur (RAJASTHAN) INDIA 25-27, Nov. 2000.162pp.

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