Agric. Sci. Digest., 38 (1) 2018 : 22-26
Print ISSN:0253-150X / Online ISSN:0976-0547

AGRICULTURAL RESEARCH COMMUNICATION CENTRE
www.arccjournals.com

Effect of nutrient supply system on biometry and rhizosphere microflora of soybean, pigeon pea and sorghum

M.S. Girme and D.H. Sarnobat*
Agriculture College, Latur,
Marathwada Agriculture University, Parbhani-431 402, Maharashtra, India.
Received: 12-12-2016 Accepted: 18-12-2017 DOI: 10.18805/ag.D-4516

ABSTRACT

A field experiment was conducted at farm of Agriculture College, Latur (Maharashtra) to study the Effect of Nutrient Supply System on Biometry i.e. Plant height, functional leaves, grain yield and straw yield of soybean, pigeon pea and Sorghum as well as to study the azotobactor,phosphate solubilizing bacteria , fungi, actinomycetes and total microorganism in the rhizosphere microflora of soybean, pigeon pea and sorghum. The experiment was laid out in randomized block design with seven treatments combinations replicated two time. The treatments were - T1-organic (100% R.D.F.) ,T2-inorganic nutrient supply system.(Rhizobium + PSB + Azotobactor + FYM), T3—Integrated nutrient supply system. (50% R.D.F. +50% FYM + Rhizobium PSB + Azotobactor), T4- maximum yield nutrient supply system. T5- biodyamics or ecofriendly nutrient supply system.. T6- natural (No fertilizer) ,T7-fallow . The fertilizer were applied as a basal dose as per the treatments. The observation on growth i.e. height of plant and number of functional leaves and yield were recorded by using five randomly selected plants of soybean,pigeon pea and sorghum in each treatment plot. The selected plants were labelled and all subsequent biometric observations were recorded on labelled plants during the course of investigation.The judicious use of biofertilizers like rhizobium, azotobactor ,phosohate solubilizing bacteria with organic manures helped in building up of soil microflora .It also helped to augment the availabity of nutrient that could be easily assimilated by plants. The results revealed that the maximum yield nutrient supply system (MYNSS) is significantly superior to other system and it was at par with integrated nutrient supply system.

Key words: Actinomycetes, Azotobactor, Biometry, Fungi, Functional leaves, Microflora, Nutrient supply system, Phosphate Solubilizing Bacteria, Plant height, Total microorganism, Yield.

INTRODUCTION

Soybean [*Glycin max.* (L).Merril] is an important pulse and oilseed crop containing 43.2 per cent proteins, 19.5 per cent oil. (SOPA 2016). .The total yield of soybean in Maharashtra was 35.80 millilion tons during the year 2016 and productivity 1102 kg per acre. (SOPA 2016). Among the pulses, Pigeonpea is important pulse crop in India, both in respect of area (14.76 million ha) and production (23.63 million tons) during the year 2010- 2011. Sorghum is main cereal crop of Maharashtra and its contribution of total cereal production in the state is 51%. For achievement of highest yield, precision farming is adopted by the farmers where extra (more than recommended) doses of fertilizers and concentrated doses of pesticides are used. Thus it is essential to develop suitable method for determining the availability of nutrients for specific soil crop system based on field trial i.e. maximum yield nutrient supplying system.

The continuous use of chemical fertilizer over a long period may cause imbalance in the microflora and thereby indirectly affect the biological properties have an adverse effect on the soil leading to land degradation. Bharadwaj and Omanwar (1992) studied the impact of long term fertility treatments on microbial population in soil. Also many workers have showed the importance of soil fertility to the symbiotic nitrogen fixation by Rhizobium (Iswarm *et.al.* (1970); Somani ,1978) . Baink and Datta (1988) found increased seed protein in soybean due to inoculation using 'p' solubilizer. Biodynamic farming consider soil microbiological properties as quality indicator because soil microorganisms are second most important biological agents in the agriculture ecosystem.

Research in India has indicated that use of different nutrient system for significantly increase in plant height, leaves, seed yield and dry matter accumulation in soybean (Sharma *et. al.,* 2002). Considering these facts an experiment was conducted to study the response of sorghum, pigeonpea and soybean to various nutrient supply system in relation to microflora in Rhizosphere soil and biometry i.e. plant height, functional leaves, grain yield and straw yield of soybean, pigeon pea and sorghum.

MATERIALS AND METHODS

The field experiments was conducted at a farm of College of Agriculture, Latur (Marharashtra) during the year 2015-16. The soil of experimental site was sandy loam

*Corresponding author's e-mail: dhanu.dhemre@rediffmail.com

in texture. The experiment was laid out in randomized block design with six treatment combinations replicated two times.

The treatments were: T1-organic (100% R.D.F.), T2-Inorganic nutrient supply system. (Rhizobium + PSB + Azotobactor + FYM), T3—Integrated nutrient supply system. (0% R.D.F. +50% FYM + Rhizobium+ PSB + Azotobactor), T4- Maximum Yield nutrient supply system. T5- Biodyamics or Ecofriendly nutrient supply system. T6- Natural (No fertilizer). The fertilizer was applied as a basal dose as per the treatments. The observation on growth i.e. height of plant and number of functional leaves and yield were recorded by using five randomly selected plants of soybean, pigeon pea and sorghum in each treatment plot. The selected plants were labelled and all subsequent biometric observations were recorded on labelled plants during the course of investigation.

1) Height of plant: The height of plant was measured from the ground level of the plant to the base of apical bud of main shoot with 15 days interval

2) Number of functional leaves per plant: The progressive number of functional leaves i.e. fully opened green leaves per plant was counted at 15 days interval. In case of pigeonpea, trofoliate was considered as one leaf.

3) Yield: The soybean and sorghum crops matured in 120 days and pigeonpea crop was matured in 180 days the plot strips from each gross plot were harvested, threshed, winnowed and cleaned seperately. The produce was sun dried and its final weight was recorded.

For the calculation of Rhizospheric microflora the experiment was laid out in randomized block design with seven treatment combinations replicated two times.

Microbial count: It was counted by following the method given by Pramer and Schmidt (1964). Serial dilution was used for microbial count. For the bacterial count antifungal Natamycin (1 ml of 8ppm contration) was added to each petriplate just after pouring the media (Nutrient agar) and inoculated with 1 ml of dilution from treatments Likewise for fungal count antibacterial Penicillin (1ml of 1ppm concentration) was used which suppressed the growth of fungi . Actinomycetes count was taken using selective media *viz* Glycerol yeast extract agar.

For azotobactor count, soil sample were collected from experimental plot of sorghum and dried in shade to removed excess moisture. 10 gm soil sample was diluted from 10^{-1} to 10^{-6} and one ml of each diluation series was used to inoculated each of petriplate of Ashby's media. Enumeration of of azotobactor number was made by a MPN procedure.

In case of phosphate solubilising bacterial count soil samples were collected from rhizosphere of crops at flowering stage from experimental plots. Isolation was done by the dilution and plating method. Serial dilution of PSB was made by following method like Azotobactor. One ml of suspension from each test tube was transfered in sterilised petriplates, sterilised Pikvovaskaya's medium before solidification (45 temperature) was poured in each petriplate. After solidification the medium plates were kept at 30^0C in incubator for 4-5 days and colonies showing transparent zones of phosphate solubilizing bacteria were counted.

RESULTS AND DISCUSSION

Plant height: Mean height of soybean plants were recorded upto 90 days. In treatment T4 (MYNSS) higher plant height were recorded in over all treatments. The treatment T6 showed significantly lowest plant height and was at par with T 1, T2, T3 and T5 (Table 1).

This clearly indicated the need for adding organic manures to the soil conjunctive with inorganic fertilizers, which increased the availability of nutrients considerably resulting in a positive effect on growth parameters. These findings were in accordance with the results of Babalad (1999) who had observed increased plant height, number of trifoliate leaves per plant and number of branches per plant in soybean due to the application of organic manure and inorganic fertilizers.

In pigeonpea,treatment T3 was significantly superior over all other treatments except T4 which were at par. These finding were in confirmity with, finding of Rajput *et al. (*2002) observed that integrated phosphorus management

Table 1: Height and functional leaves of soybean, pigeon pea and sorghum.

Particular	Plant height (cm)			Functional leaves / plant		
(Treatments)	Soybean,	Pigeon pea	Sorghum.	Soybean,	Pigeon pea	Sorghum.
T1	21.2	175.7	148.2	16.0	116.6	9.7
T2	21.4	177.6	152.2	16.4	134.4	10.65
T3	22.0	185.4	156.9	18.6	110.8	11.9
T4	22.5	183.7	155.2	21.4	152.2	11.65
T5	20.4	180.7	142.2	14.2	119.2	8.5
T6	20.1	168.2	135.25	14.6	84.4	6.3
S.E.	0.13	2.20	6.23	0.42	7.62	0.20
C.D.	0.49	6.80	22.6	1.54	2.62	0.75
C.V.	3.08	4.23	5.94	3.57	7.71	3.02

were significantly affected plant height at 45,90 and 135 days after sowing. (Table 1).

Sneha *et.al.* (2003) noticed that application of 15 kg N+ 32 kg P_2O_5 / ha + Rh + PSB +MO recorded maximum plant height and yield over seed dressing with Rh + PSB.

Functional leaves: In soybean and pigeonpea, treatment T4 (MYNSS) had significanly more number of functional leaves. The lowest numbers of functional leaves were observed in T6. In sorghum, treatment T3 (INM) was found more effective followed by T4 (MYNSS).These results were in confirmity with finding recorded by Dhonde et.al.(2004) who reported that the highest average number of leaves per plant(4.78/plant) were with 50% RDR and 50% N through gliricidia leaves. (Table 1).

Menaria *et.al.*(2003) observed that application N_2 O + P_2O+ K_2O +S_4O kg/ha and Rh +PSB had significantly increased growth parameters.

Yield:-The grain yield in soybean (26.04 q /ha) and pigeonpea (18.68q/ha) was highly increased due to T4 (MYNSS) treatment than other treatments. In sorghum, treatments T3 (INM) was more significant than other and was at par with T4 (MYNSS), treatment. (Table 2).

Straw yield in soybean ((39.05 q/ha) increased due to T4 (MYNSS) treatment and was at par with T3 (INS) treatment. In pigeon pea and sorghum treatment T3(INM) were found more effective (24.02q/ha and 38.03 q/ha respectively) followed by T4 (MYNSS) treatment. (Table 2) These finding were in confirmity with, finding of Reddy (1987) reported that grain yield, Stover yield was significantly increased with increase in level of 'P' from 0-80 kg P_20_5 /ha in soybean.

Shaha and Joshi (1986) observed that in cereal crops recommended dose + biofertilizer resulted in higher yields to the tune of 10 to 15 per cent compared to only recommended fertilizer dose.

Kumarawt *et.al.*(1997) evaluated hat the influence of different biofertilizer applied along with chemical fertilizers on yield of soybean and reported that seed yield increased significantly due to application of Rhizobium and NPK fertilizers.

The findings of present investigation were the maximum yield nutrient supply system is significantly superior over other system and it was at par with integrated nutrient supply system.

Results obtained from analysis indicated that there were significant difference between organic , inorganic and combine effect of these treatment on rhizosphere microflora of soybean, pigeon pea and sorghum. Among the nutrient supply system, treatment T4 i.e. Maximum Yield nutrient supply system (MYNSS) supported for proliferation of azotobactor (i.e. 31.3 x 10^4 cell/g) in sorghum crop followed by Integrated nutrient supply system (24.9 $X10^4$ cell/g) (Table 3). In pigeon pea and soybean, Integrated nutrient supply system enhanced the proliferation of azotobactor upto 23.00 x 10^4 cell/g and 24.20 $X10^4$ cell/g respectively followed by biodyamics and organic nutrient supply system respectively.

Table 2: Effect of differents nutrient supply system on yield of soybean, pigeon pea and sorghum.

Particular	Grain yield (q/ha))			Straw yield (q/ha))		
(Treatments)	Soybean,	Pigeon pea	Sorghum.	Soybean,	Pigeon pea	Sorghum.
T1	20.67	18.38	15.99	31.02	23.11	28.33
T2	23.67	16.93	19.22	35.79	23.57	31.66
T3	24.8	17.51	21.08	38.21	24.02	38.03
T4	26.04	18.68	20.25	39.05	23.01	36.00
T5	20.68	12.57	12.53	31.05	21.15	24.33
T6	16.80	9.12	10.99	27.03	18.8	20.8
S.E.	0.85	0.92	1.37	0.42	0.24	0.76
C.D.	3.09	3.34	5.0	1.55	0.92	2.78
C.V.	5.45	8.42	11.68	1.79	1.57	3.68

Table 3: Abundance of azotobactor and phosphate solubilising bacteria in rhizosphere soil .(10^4 cells/gm).

Treatment	Azotobactor			PSB		
	Sorghum	Pigeonpea	Soybean	Sorghum	Pigeonpea	Soybean
T1	20.8	17.20	17.1	22.15	30.20	35.80
T2	21.9	22.15	22.5	31.10	48.20	46.00
T3	24.9	23.00	24.2	35.20	55.40	50.80
T4	31.3	19.00	20.15	33.00	45.50	49.20
T5	25.0	22.10	19.20	28.20	42.15	44.00
T6	18.9	13.20	15.40	19.00	25.20	29.10
T7	11.2	11.10	13.10	14.50	14.10	12.10
MEAN	22.85	17.96	18.80	26.16	37.25	38.14

Table 4: Abundance of fungi, actinomycetes ,Total micro organism in rhizosphere soil (10^4 cell/gm).

Treatments	Fungi (X $x10^3$)			Actinomycetes (10^2)			Total Micro-organism (10^4))		
	Sorghum	PigeonPea	Soybean	Sorghum	Pigeonpea	Soybean	Sorghum	Pigeonpea	Soybean
T1	10.0	12.6	14.5	80.8	114.5	98.2	86.8	133.34	120.38
T2	10.3	11.1	15.5	90.7	127.2	110.7	93.9	162.32	141.60
T3	12.4	14.5	18.7	95.2	136.2	117.7	107.15	170.76	160.97
T4	11.2	10.2	22.2	93.4	118.2	124.6	97.03	156.18	165.44
T5	8.5	10.1	12.6	72.4	112.3	86.6	79.52	143.12	127.06
T6	4.10	11.2	7.15	55.4	110.3	80.2	68.95	121.10	92.60
T7	3.10	8.9	3.10	52.2	85.5	50.2	64.62	96.65	61.80
MEAN	8.51	11.22	13.4	77.1	114.9	95.48	85.42	140.65	124.25

Findings were in confirmity with finding recorded by Jones and Screenivasa (1993) studied the effect of inoculation of VAM or PSB on the population of free living nitrogen fixing azotobactor and PSB in rhizosphere of sunflower. Also Raut (1980) observed the increase in azotobactor number due to inoculation was about four times (11.5 x 10^4 cell/g) greater than it's count in uninoculated control.(2.9 x 10^4 cell/g).

In case of PSB (Phosphate Solubilizing Bacteria), Integrated nutrient supply system significantly enhanced the abundance of PSB in sorghum (35.20 x 10^4 cell/g), pigeonpea (55.40 x 10^4 cell/g), soybean (50.80 x 10^4 cell/g) followed by maximum yield nutrient supply system. (Table 3).These findings were in confirmity with,Patil (1999) measured the abundance of phosphate solubilizing bacteria and observed that bacterial population ranged from 25.33 to 33.60 x 10^4 cell/g soil from Parbhani district.

Also Sulveestar *et.al.* (1982) who observed that phosphate solubilizing bacteria were more in legume than in grass rhizophere.

Fungi:- In fungi, among nutrient supply systems , maximum bacterial population in sorghum (12.4 x 10^3 cell/g) and pigeonpea (14.5x 10^3 cell/g) was recorded in integrated nutrient supply system followed by maximum yield nutrient supply system and in soybean, maximum yield nutrient supply system was responsible to enhance the population of fungi (22.2 x 10^3 cell/g) followed by integrated nutrient supply system.(Table 4)

These findings were in confirmity with findings of Bagyaraj and Rangaswami(1968) reported that inorganic N,P,K fertilizers found to proliferate the growth of fungi but when FYM,the fungal population significantly increased over fertilizer alone.

Actinomycetes: The integrated nutrient supply system, significantly enhanced the actinomycetes population in sorghum (95.2 x10^2) and pigeonpea (136.2 x 10^2) followed by maximum yield nutrient supply system and in soybean population of Actinomyces was enhanced by MYNSS (124.6 x 10^2) followed by organic nutrient supply system and integrated nutrient supply system. (Table 4).

This findings were in confirmity with Emminath and Rangaswami (1971) reported that multiplication of actinomycetes was in higher order where inorganic fertilizers were combined with FYM.

Total Micro-organism: Abundance of total soil micro-organisms were enhanced in Rhizosphere soil of sorghum (107.15x10^4) and pigeonpea (170.76x10^4) by integrated nutrient supply system. In case of soybean the total abundance of micro-organism (166.44x10^4) was enhanced by MYNSS followed by Integrated nutrient management system. The lowest population of total micro-organism was observed in treatment T7 i.e. fallow land, (Table 4). Result were confirmed with Kukrej *et.al.*(1991) conducted a long term experiment to study the effect of long term manurial application on microbial biomass.

The present investigation concludes that MYNSS supported for maximum proliferation of azotobactor in sorghum while integrated nutrient supply in pigeonpea and soybean . Integrated nutrient supply system was found effective to enhance maximum abundance of phosphate solubilizing bacteria in sorghum, pigeonpea and soybean. Similarly total soil micro-organisms were enhanced by integrated nutrient supply system in sorghum and pigeonpea while maximum yield nutrient supply system enhanced in sorghum.

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