International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(1): 487-490

Received: 07-11-2018
Accepted: 09-12-2018

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Impact of integrated nutrient management on nutrient status and soil microbial population in chilli (*Capsicum annuum* L.)

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Abstract
A field experiment was conducted on impact of INM on nutrient status and soil microbial population in chilli at College of Horticulture, Mudigere. The major nutrient availability in soil, nutrient content in chilli leaf and soil microbial population after the harvest of chilli was studied. The highest availability of major nutrients in soil N (307.67 kg /ha), P (60.17 kg /h) and K (118.55 kg/ ha), and the highest nutrient content in chilli leaf N (3.31%), P (0.65% and K (3.41%) were noticed with the application of *Azospirillum* + PSB + VAM + KSB + 50% RDF + $MgSO_4$ + Micronutrient mixture (T_{12}). Similarly the soil microbial population include were recorded maximum in the treatment T_{12}. Thus integrated use of organic amandments (biofertilizers, FYM) along with chemical fertilizers not only produced highest and sustainable crop yield but also enhanced the efficiency of added fertilizers as well as fertility status of the soil.

Keywords: Integrated nutrient management, nutrient availability, soil microbial population.

Introduction
Chilli (*Capsicum annuum* L.) is one of the important commercial crops of India. It is a crop of tropical and sub-tropical regions and requires a warm humid climate. Though, chilli can be grown in many types of soils, well-drained loamy soils rich in organic matter are best suited for its cultivation. There is an almost need to produce more crop yield which has led to the tendency of using more and more chemical fertilizers. Due to this it has resulted in to deterioration of productive soil [1]. Stated that mineral fertilizers decrease both the biological activities in the soil and aggregate stability. The intensive use of chemical inputs has not only polluted the soil, water and environment causing their slow degradation but also affected the life of human being. Thus, the importance of organic manure in present agriculture is increasing day by day, because of its utility not only improving the physical, chemical and biological properties of soil but also maintaining the soil health without pollution.
From nutrient point of view, the role of organic matter is very meagre. However its value lies more in its action as a soil ameliorant corrective for physical condition and parameter of biological activity to enhance the productivity. The nutritional requirement of chilli crop is partially fulfilled by slow release of nutrients from organic manure but its use alone is not sufficient. Therefore, there is also a need to supplement it with chemical nutrients. The supplementary and complementary use of organic manures and inorganic chemical fertilizers augment the efficiency both the substances to maintain a high level of soil productivity [2].
The beneficial effects of combined application of chemical fertilizers with organic manures *viz.*, farmyard manure, biofertilizers and many more of such materials are universally known. Application of organic manures in general improves the availability of micronutrients like zinc, iron, manganese and copper. A balanced application of both organic, inorganics (NPK) and biofertilizers along with micronutrient mixture appear to be an ideal proposition to meet nutrient requirements of crops rather than single application. In view of this, the present investigation was undertaken to assess the effect of organic and inorganic sources of nutrients on the nutrient status and residual soil microbial population in chilli crop.

Material and methods
To study the effect of integrated nutrient management on chilli (*Capsicum annuum* L.) the field experiment was carried out at College of Horticulture, Mudigere during October 2016 to March 2017.

Design of experiment: Randomized Complete Block Design (RCBD)
Treatments: 14
Crop: chilli
Net plot size: 3.0 m ×2.0 m
Planting: Ridges and furrows method

Replication: 3
Variety: Arka Suphal
Space: 60 cm ×45 cm
Transplanting: 40 days after sowing.

The treatment details as follows
T_1- RDF (Control)
T_2- *Azosipirillum*+100%RDF
T_3- *Azospirillum* +75%N+RD of PK
T_4- PSB+100%RDF
T_5- PSB +75%P+RD of NK
T_6- VAM+100%RDF
T_7- VAM+75%P+RD of NK
T_8- KSB +100% RDF
T_9- KSB+75%K+RD of NP
T_{10}-*Azospirillum* + PSB + VAM + KSB + 75%RDF
T_{11}- *Azospirillum* + PSB + VAM + KSB + 50% RDF
T_{12}- T_{10} + $MgSO_4$+ Micronutrient mixture
T_{13}- T_{11} + $MgSO_4$ +Micronutrient mixture
T_{14}- RDF + $MgSO_4$ + Micronutrient mixture

The soil physical and chemical properties of experimental site was recorded and presented in (Table 1.) At the time of transplanting seedling were dipped in bioinoculants according to treatments and after 10 DAT, 100 g of solid biofertilizers are mixed with 1 kg of FYM and applied to individual plot. Whereas $MgSO_4$ applied as soil application @12.5 kg /acre after the one week of transplanting. Well decomposed FYM @ 25 tons per hectare was applied at the time of land preparation. The recommended dose of 150:75:75 kg NPK/ha) was applied in the form of urea, single super phosphate and muriate of potash, respectively. The micronutrient mixture (vegetable special- IIHR) which contains all the secondary nutrients like boron, zinc, calcium, sulphur and copper was applied as foliar application at 15 days interval gap during 35, 50 and 65 days of the cop growth stage with dosage of 6.5 g/liter of water and at the same time observations on growth, yield and quality parameters were recorded.
Soil samples were collected to a depth of 0-15cm treatment wise after the final picking of chilli (120 DAT). The collected soil samples were shade dried for five days, ground in wooden pestle and mortar, sieved by passing through 2 mm sieve, mixed thoroughly and partitioned by quartering technique to get a composite working soil sample for its analysis. Nitrogen was estimated by Alkaline potassium permanganate method [3], phosphorus by Olsen's method, potassium by Flame Photometer method and for plant analysis, tagged plants were collected randomly from each treatment at final picking stage. The plant samples after digestion were analysed for nutrients content by following standard procedure and nutrient availability was computed. Nitrogen was estimated by Kjeldahl's digestion and distillation method, phosphorus by Vanadomolybdate method, potassium by Flame Photometer method, respectively. Whereas microbial population in respect of total bacteria, fungi and actinomycets were assessed after harvest by serial dilution technique. Specific media used for enumeration of soil microorganisms such as Nutrient Agar (NA) for Bacteria, Martin's Rose Bengal Agar (MRBA) for Fungi and Kuster's Agar (KA) for Actinomycetes.

Table 1: Physical, Chemical properties and fertility status of experimental site.

Physical parameters						
Purticulars		Sand %	clay %	Silt %		Texture
values		42.5	14.3	28.6		sandy loam
Chemical parameters						
Purticulars	**Soil pH**	**Electrical Conductivity (dsm^{-1})**	**Organic Carbon (%)**	**Available nitrogen (kg/ha)**	**Available Phosphorus (kg/ha)**	**Available potassium (kg/ha)**
values	5.85	0.101	0.40	325.6	20.6	165.4

Result and Discussion
The nutrient status of nitrogen, phosphorus and potassium in both soil as well as plant were significantly influenced by the effect of combined application of organic and inorganic source of nutrients on chilli (Table 2). Significantly the highest available nitrogen in the soil (440.00 kg/ha) was recorded with the treatment T_{12} (*Azospirillum* + PSB + VAM + KSB + 75% RDF + MgSO4 + Micronutrient mixture) and it was on par with T_6, T_{10}, T_{11} and T_{13} (381.04, 422.67, 386.67 and 416.67 kg/ha, respectively). However, lowest available nitrogen in soil (307.67 kg/ha) was registered in T_1 (RDF). Application of *Azospirillum* + PSB + VAM + KSB + 75% RDF + MgSO4 + Micronutrient mixture (T_{12}) recorded significantly maximum available phosphorus (129.67 kg/ha) in the soil and it was on par with and T_{13} (125.33 kg/ha). However, minimum available phosphorus in the soil (60.17 kg/ha) was registered with RDF (T_1). Similarly, Significantly highest available potassium in soil (241.33 kg/ha) was reported with the application of *Azospirillum* + PSB + VAM + KSB + 75% RDF + MgSO4 + Micronutrient mixture (T_{12}) and it was superior over rest of the treatments. However, T_{10}, T_{11} and T_{13} (221.33, 211.88 and 218.33 kg/ha, respectively) were on par with each other. Whereas, T_1 supplied with RDF reported lowest available potassium in the soil (118.55 kg/ha). The increased in nitrogen status of soil was due to use of organic manures, especially FYM and balance use of chemical fertilizers [4]. The build-up of available phosphorus and potassium in the soil could be due to the organic acids which were released by increased microbial population in soil by the application of PSB and KSB. Similar results were find in [5]. With respect to nutrient content in plants, significant results were found among the different treatments, the combine application of *Azospirillum* + PSB + VAM + KSB + 75% RDF + $MgSO_4$ + Micronutrient mixture (T_{12}) received maximum nitrogen content (3.31 %), phosphorus content (0.65 %) and potassium content was (3.41%). Whereas RDF (T_1) recorded minimum nitrogen content (2.12 %), phosphorus content (0.09 %) and potassium content was (1.84 %), respectively. The probable reason for recording higher nutrient content in chilli leaves may be due to the synergetic effect of organic and inorganic fertilizers lead to the

accumulation of more nutrients during the crop growth period as compared to RDF (T_1). Similar results were reported by [6]. With respect to microbial population in soil, The bacterial population varied significantly due to different treatments (Table 3) The higher bacterial population of 236.67 and 205.67 *cfu*/gram soil was observed under *Azospirillum* + PSB + VAM + KSB + 75% RDF + $MgSO_4$ + Micronutrient mixture (T_{12}) at 10^{-5} and 10^{-6} dilution, respectively. While, minimum number of cell count was observed in T_1 with 100 % RDF (34.67 *cfu*/g soil) at10^{-5} dilution and (21.67 *cfu*/g soil) at 10^{-6} dilution. With regard to total fungus population in soil, at 10^{-3} and 10^{-4} dilution, the higher fungi biomass of 50.47 and 45.00 *cfu* per gram of soil, respectively was noticed with the inoculation of *Azospirillum* + PSB + VAM + KSB + 75% RDF + $MgSO_4$ + Micronutrient mixture (T_{12}). Whereas, treatment T_1 (RDF) recorded least number of fungal colonies (18.03 and 13.00 *cfu*/g soil, respectively) at 10^{-3} and 10^{-4} dilution. Similarly the higher actinomycetes biomass of 41.67 and 30.67 *cfu* per gram of soil at 10^{-2} and 10^{-3} dilution respectively was reported with the application of *Azospirillum* + PSB + VAM + KSB + 75% RDF + MgSO4 + Micronutrient mixture (T_{12}). However, the treatment T_1 (100 % RDF) recorded lowest number of colonies of 16 and 9.33 *cfu*/gram of soil at 10^{-2} and 10-^{3} dilution, respectively. The increase in bacterial, fungus and actinomycets biomass under this treatment might be due to increased microbial activity and multiplication as it was inoculated with microbial consortium. These results get support from the findings of [7] and [8]. Therefore present investigation concluded that application of *Azospirullum* + PSB + VAM + KSB + MgSO4 + micronutrient mixture + 75% RDF has more beneficial effects with respect to soil health and nutrient status of soil as well as plants and at the same time microbial population also improved as compared to application of recommended dose of NPK fertilizers (RDF) under field condition.

Table 2: Effect of INM on nutrient availability in soil and nutrient content in chilli leaf after crop harvest

Treatments	Nutrient availability in soil after crop harvest			Nutrient content in chilli leaf.		
	N (kg/ha)	P (kg/ha)	K (kg/ha)	N (%)	P (%)	K (%)
T_1	307.67	60.17	118.55	2.12	0.09	1.84
T_2	376.81	77.37	132.33	2.75	0.24	2.35
T_3	348.67	65.17	119.27	2.32	0.17	2.15
T_4	359.19	101.73	143.85	2.7	0.36	2.23
T_5	337.78	93.4	135	2.65	0.34	2.11
T_6	381.04	107.07	155.33	3.05	0.39	2.76
T_7	379.15	103.03	152.77	2.53	0.36	2.54
T_8	362.45	98.33	178.55	2.67	0.34	3.19
T_9	338.3	92.87	165.27	2.52	0.32	3.13
T_{10}	422.67	125.5	221.33	3.17	0.5	3.3
T_{11}	386.67	121.67	211.88	3.16	0.47	3.18
T_{12}	440	129.67	241.33	3.31	0.65	3.41
T_{13}	416.67	125.33	218.33	3	0.61	3.34
T_{14}	322	116	200.33	2.76	0.36	2.87
S.Em±	21.51	7.8	11.91	0.16	0.02	0.17
C D@5%	62.54	22.67	34.63	0.47	0.07	0.5

Table 3: Effect of INM on total microbial population of soil after harvest of chilli

Treatments	Total bacteria *(cfu/g soil)*		Total fungai *(cfu/g soil)*		Total actinomycets *(cfu/g soil)*	
	10^{-5}	10^{-6}	10^{-3}	10^{-4}	10^{-2}	10^{-3}
T_1	34.67	21.67	18.03	13	16	9.33
T_2	68.37	63.93	25.33	16.67	17.2	14.67
T_3	52.17	54.33	19.83	17.33	16.13	10.33
T_4	121.33	130.67	36.1	16.67	21.67	14.33
T_5	99.67	99.33	28.33	14.33	20.67	11.77
T_6	136.00	139.67	40.1	32.00	27.00	19.00
T_7	119	113.33	31.6	18.33	22.67	17.67
T_8	180.67	175.33	37.17	26.00	29.67	19.47
T_9	157.33	149.67	32.27	17.67	28.33	15.50
T_{10}	215.67	191.00	45.67	35.00	38.33	26.00
T_{11}	210.33	184.67	39.67	28.33	32.33	22.07
T_{12}	236.67	205.67	50.47	45.00	41.67	30.67
T_{13}	225.00	196.67	45.17	38.33	40.23	27.67
T_{14}	168.00	158.33	37.33	29.67	27.33	17.33
S.Em±	10.52	9.50	3.53	2.80	2.37	2.06
C D@5%	30.58	27.61	10.25	8.15	6.88	6.00

Conclusion

It can be concluded that combined application of *Azospirillum* + PSB + VAM + KSB + 75% RDF + $MgSO_4$ + Micronutrient mixture (T_{12}) showed significantly highest soil available nitrogen, phosphorous, potassium and the significant higher microbial population were also found maximum in the same treatment.

References

1. Kukereja KM, Mishra SS, Dhankar KK, Kapoor, Gupta AP. Effect of long term manurial application on microbial biomass. J Indian Soc. Soil Sci. 1991; 39:685-688.
2. Kondapanaidu D, Radder BM, Patil PL, Hebsur NS, Alagundagi SC. Effect of INM on yield, nutrient uptake

and quality of chilli (Cv. Byadgi Dabbi) in a vertisol. Karnataka. J Agric. Sci. 2009; 22(2):438-440.
3. Subbaiah BV, Asija GL. A rapid procedure for the estimation of available nitrogen in soil. Curr. Sci. 1956; 25:259-261.
4. Shaktawat RP, Shekawat PS. Soil fertility status as affected with and without farm yard manure in kharif crops and fertilizers levels in barley (*Hordeum vulgare* L.). Indian J Agric. Sci. 2010; 80(9):791-794.
5. Vimera K, Kanaujia SP, Singh VB, Singh PK. Integrated nutrient management for quality production of King chilli (*Capsicum chinense* Jackquin) in an acid alfisol. J Indian Society Soil Sci. 2012; 60(1):45-49.
6. Ranjit, Bandyopadhyay S. Studies on effect of organic, inorganic and biofertilizers on plant nutrient status and availability of major nutrients in tomato. Int. J Bio-resource and Stress Management. 2014; 5(1):093-097.
7. Suja GS, Sundaresan, Kuzhivilayil SJ, Janardanan S, Rajsekhar M. Higher yield, profit and soil quality from organic farming of elephant foot yam. Agron. Sustain. Dev. 2012; 32:755-764.
8. Deshpande RP, Tamgadge S, Deshmukh A, Deshmukh S. Effect of organic and inorganic manures on growth and yield of chilli. Inter. J For & Crop Improvement. 2010; 1(2):146-148.