Combined Effect of Organic Waste and Inorganic Fertilizers in TheEnvironmental on major Nutrient Content and Uptake in MaizeGroundnut Cropping Sequence

ABSTRACT

A field experiment was carried out under field conditions during both kharif and rabi seasons of 2019-2020 and 2020-2021 at Field No. 50B of Wetland Farm, S. V. Agricultural College, Tirupati campus (under the judicatory of Acharya N. G. Ranga Agricultural University). Nutrient content and uptake of major nutrients NPKduring both the years of study (kharif 2019-2020 and rabi 2020-2021) on maize-groundnut cropping sequence was not significantly affected by the levels of NPK while significantly affected by the application of organic sources. The pooled analysis results also showed similar trend. However, interaction effect was nonsignificant between inorganic and organic sources during both the years.

Key words: *Maize, Groundnut, Kharif, rabi, N, P, K, FYM, Poultry manure, urban compost, NPK.*

INTRODUCTION

Continuous application of fertilizers and manures influence various physical, chemical, chemical and biological properties of the soil. The changes in nutrient content and uptake of plantoccurs because of addition of organic sources due to continuous use of fertilizers and manures assume great significance and sustainability of the cropping system. The interactions between organic and inorganic sources of nutrients are a key subject of research. Long-term application of fertilizer, FYM significantly affected soil soil properties and plant nutrient status of soil and plant nutrient content and uptake by plant.

"Maize (Zea mays L.) – Groundnut (Arachis hypogaea) is one of the important cropping systems in Andra Pradesh of India and maintenance of optimum soil fertility is an important consideration for obtaining higher and sustainable yield. The responses of the succeeding crops in a cropping system are influenced greatly by the preceding crops and the inputs applied there in. Therefore, recently greater emphasis is being laid on the cropping system as whole rather than on the individual crops in a sequence. Maintaining sustained crop production, balanced manuring is essential to build up soil health. Wide use of short statured high yielding varieties and hybrids is common in maize. The organic sources will improve the nutrient use efficiency of added chemical fertilizers by reducing nutrient losses and enhancing nutrient availability to plant. Integration and incorporation of organic manure (FYM, poultry manure and urban compost) in the cropping system helps to improve soil structure, soil microbial activity and soil moisture conservation and which in turn helps to stabilize the production and productivity of the crops. Integrated nutrient management is also important for marginal

farmers who cannot afford to supply crop nutrients through costly chemical fertilizers". [11]

MATERIAL AND METHODS

The field experiment entitled "Dynamics of soil carbon under integrated nutrient management practices in maize - groundnut cropping sequence" was carried out under field conditions during both kharif and rabi seasons of 2019-2020 and 2020-2021 at Field No. 50B of Wetland Farm, S. V. Agricultural College, Tirupati campus. which is geographically situated at 13.5°N latitude and 79.5°E longitude with an altitude of 182.9 m above mean sea level in the Southern Agro Climatic Zone of Andhra Pradesh. According to Trolls classification, it come under the Semi-Arid Tropics (SAT).

The results of the initial soil experimental sample were analysed at 0-15 cm depth ~~was collected~~ and tested for different physical, physico-chemical, chemical and biological properties and the results were texture was sandy clay loam with BD (1.48 g cm-3), PD (2.65 g cm-3), pH of 7.68, Electrical conductivity 0.85 dSm-1, indicated that the experimental soil is sandy clay loam in texture, neutral in reaction, nonsaline, medium in organic carbon low in available nitrogen, high in available phosphorus and medium in available potassium. The experiment was laid out in a split plot design for both the years with three main plots (M1)125%, (M2) 100%, (M3) 75% RDF and four sub plots (S1) control, (S2) FYM 10 t ha-1. (S3) Poultry manure 5 t ha-1 and (S4) urban compost 5 t ha-1 , total 12 treatments consisting of combinations of three replications. In kharif, maize hybrid (Kavery-55K) and in rabi, groundnut (K6) was sown on both (kharif 2019-20 and rabi 2020-21) adopting a spacing of 60 x 20 cm and 22.5 x 10 cm in maize and groundnut crops respectively. In the present study, density of soil decreased significantly due to application of FYM to the soil as compared to inorganic fertilizer treated plots. Many scientists have reported that the decomposition products of organic materials would usually helps in granulation of soil particles and thus increase the porosity of the soil; this in turn would quite naturally lower the bulk density of the soil.

RESULTS AND DISCUSSION

Nitrogen content and uptake

Nitrogen content and uptake during both the years of study (kharif 2019-2020 and rabi 2020-2021) on maize-groundnut cropping sequence was significantly affected by the levels of NPK and by the application of organic sources. The pooled analysis results ~~also~~ showed similar trend. However, interaction effect was non significant between inorganic and organic sources during both the years. Among the different NPK levels, M1 (125 % RDF) recorded significantly the highest nutrient content and uptake of nitrogen (1.22, 1.16 % and 144.66, 155.71 kg ha-1 in kharif, 2019-20 nutrient content and uptake and 1.64, 1.67 % and 56.25, 63.39 52.63, 61.48 kg ha-1 rabi, 2020-21 nutrient content and uptake, respectively) over all other treatments and the lowest nutrient content and uptake (1.01, 1.03 % and 108.92, 116.24 kg ha-1 in kharif, 2019-20

and 1.33, 1.35 % and 39.87, 42.06 kg ha-1 rabi, 2020-2021, respectively) was recorded in M3 (75 % RDF) during both the years of the study.

However, among organic sources significantly the highest nutrient content and uptake among the organic sources S2 (FYM @ 10 t ha-1) recorded (1.19, 1.28 % and 169.39, 185.74 kg ha-1 in kharif, 2019-20 and 1.74, 1.79, % and 56.25, 63.39 kg ha-1 in rabi, 2020-21 content and uptake, respectively) and was significantly superior over S3 (poultry manure @ 5 t ha-) and S4 (urban compost @ 5 t ha-1) while the lowest (1.16, 0.88 % and 34.29, 30.47 kg ha-1 during kharif, 2019-20 and 1.06, 1.08 % and 26.58, 28.27 kg ha-1 rabi, 2020-21) was recorded in control (S1). Pooled analysis data on nitrogen content and uptake in maize – groundnut cropping sequence also followed the similar trend.

The interaction effect between inorganic and organic sources (INM) over two years (kharif, 2019-20 and rabi, 2020-21,) in maize-groundnut cropping sequence was non significant. However nitrogen content and uptake was high on application of 125 % RDF with S2 (FYM @ 10 t ha-1),

Jagadeeswari and Kumaraswamy (2000) reported that "uptake of N, P and K were significantly higher in treatments that received organic manure than in no manure treatment in groundnut". Singh and Sarkar (2001) from their field experiment conducted at Birsa Agricultural university, Ranchi, Jharkhand indicated that, "total N and K uptake by maize crop was higher with increasing level of N from 180 to 240 kg ha-1 and K from 100 to 200 kg ha-1over the state recommended level of 100 kg N and 40 kg K2O ha-1". In an experiment with four levels of soil fertility, Brar et al. (2001) reported that "nutrient uptake (N, P and K) increased significantly with the rise in soil fertility status".

Phosphorus Content and Uptake

Phosphorus content and uptake during both the years of study (kharif 2019-2020 and rabi 2020-2021) in maize-groundnut cropping sequence was significantly affected by the levels of NPK and by the application of organic sources. The pooled analysis results also showed similar trend. However, interaction effect was non significant between inorganic and organic sources during both the years

Among the different NPK levels, M1 (125 % RDF) recorded significantly the highest content and uptake of phosphorus (0.15, 0.19 % and 28.45, 33.01 kg ha-1 in kharif, 2019-20 and 0.46, 0.52 % and 14.68, 18.56 kg ha-1 rabi, 2020-21 respectively) over all other treatments and the lowest nutrient content and uptake (0.10, 0.10 % and 21.33, 29.09 kg ha-1 in kharif, 2019-20 and 0.39, 0.45 % and 11.70, 13.92 kg ha-1 rabi, 2020-21, respectively) was recorded in M3 (75 % RDF) during both the years of the study .

However, among the organic sources S2 FYM @ 10 t ha-1 recorded significantly higher phosphorus content and uptake (0.18,0.17 % and 33.26, 36.61 kg ha-1 in kharif, 2019-20 and 0.50, 0.56 % and 16.27, 19.09 kg ha-1 rabi, 2020-21 phosphorus, respectively) and was significantly superior over S3 (Poultry manure @ 5 t

ha-1) and S4 (Urban compost @ 5 t ha-1) and the lowest phosphorus content and uptake (0.09, 0.10 and 5.65, 13.42 kg ha-1 in kharif, 2019-20 and 0.31, 0.37 % and 7.45, 8.76 kg ha-1 rabi, 2020-21 respectively) was reported in S1 (control). Similar results were observed in both the years of study in kharif and rabi seasons. Pooled analysis data on phosphorus content and uptake in maize – groundnut cropping sequence also followed the similar trend.

The interaction effect between inorganic and organic sources (INM) over two years (kharif, 2019-20 and rabi, 2020-21,) in maize-groundnut cropping sequence was non significant. However, phosphorus content and uptake were high on application of 125 % RDF with S2 (FYM @ 10 t ha-1),

Devi et al. (2003) in "an experiment with groundnut reported that the uptake of N, P and K increased with the application of various organic manures". This might be due to adequate supply of N, P and K. Kumar and Thakur (2004) observed that "application of 150 per cent recommended fertilizer resulted in higher uptake followed by recommended fertilizer + FYM @ 10 t ha-1". Saha and Prasad et al. (2010) reported that "application of 50 per cent NPK + 50 per cent nitrogen through FYM increased the uptake of N, P and K by maize crop (115, 24 and 126 kg ha-1, respectively) as compared to different doses of inorganic fertilizers in sandy clay loam soils. Sheetal et al. (2014) observed that the highest nutrient content and uptake was recorded in 150% RDF (37.5:75:37.5 kg ha-1) and found at par with 5t FYM ha-1 +50% RDF + neem cake 500 kg ha-1 + biofertilizers in pod and haulm in groundnut respectively".

Potassium Content and Uptake

Potassium content and uptake of (kharif maize 2019-2020 and rabi groundnut 2020-21) was significantly influenced by the levels of NPK and organic sources (Table 1, 2, 3, 4). However, interaction effect was non significant between main and sub-plots treatments during both the years.

Among the different NPK levels, M1 (125% RDF) recorded significantly the highest content and uptake of potassium (2.13, 2.20 % and 141.69, 157.73 kg ha-1 in kharif maize 2019-20 and 1.28, 1.31 % and 40.92, 47.77 kg ha-1 in rabi groundnut 2020-21, respectively) compared to other treatments and lowest content and uptake (2.00, 2.01 % and 98.56, 109.72 kg ha-1 in kharif, maize, 2019-20 and 1.08, 1.11 % and 32.65, 34.76 kg ha-1 in rabi, groundnut 2020-21) was recorded in M3 (75 % RDF) during both the years of the study.

However, among the organic sources S2 FYM @ 10 t ha^{-1} recorded significantly higher potassium content and uptake (2.18, 2.17 % and 156.17, 167.65 kg ha-1 in kharif, maize 2019-20 and 1.39, 1.42 % and 45.02, 50.50 kg ha-1 in rabi, groundnut 2020-21) which was significantly superior over S3 (poultry manure @ 5 t ha-1) and S4 (urban compost @ 5 t ha-1) and lower potassium content and uptake was recorded (1.92, 1.97 % and 34.39, 43.81 kg ha-1 kharif, maize 2019-20 and 0.85, 0.87 % and 21.09, 22.24 kg ha-1 in rabi, groundnut 2020-21) was reported in S1 (control).

Pooled analysis data on potassium content and uptake in maize – groundnut cropping sequence also followed the similar trend.

The interaction effect between inorganic and organic sources (INM) over two years (kharif, 2019-20 and rabi, 2020-21,) in maize-groundnut cropping sequence was non significant. However, potassium content and uptake were high on application of 125 % RDF with S2 (FYM @ 10 t ha-1),

It was observed from a field study that application of optimum dose of NPK in conjunction with FYM recorded highest uptake of N, P and K in pod and haulm of groundnut. According to Sunilkumar et al. (2005), "nutrient content and uptake by forage sorghum was significantly influenced by integration of organic and inorganic nutrients over control. Higher N (136.6 kg ha-1), P (23.5 kg ha-1) and K (218.4 kg ha-1) uptake was recorded with 50% recommended dose of NP + vermicompost @ 5 t ha-1 + FYM @ 5 t ha-1. They also reported that nutrient content and uptake by forage sorghum was significantly influenced by integration of organic and inorganic nutrients over control".

Prasannakumar et al. (2007) reported that "among inorganic fertilizer levels, application of 125 per cent RDF recorded significantly higher nitrogen, phosphorus and potassium uptakes when compared to 100 per cent RDF and it was on par with 75 per cent RDF". Setia and Sharma (2007) reported that "potassium uptake by grain (10.4 kg ha-1) and stover (13.0 kg ha-1) in maize was higher when N, P and K were applied @ 180:35:33 kg ha-1 as compared to lower doses of fertilizers" Mohanty et al., (2005) also reported that "application of organic manures had significant direct and residual effect on biomass yield and NPK uptake in both groundnut and maize in groundnut and maize cropping system. They also recorded more 'N' uptake with FYM, 'P' uptake with inorganic fertilizers and 'K' uptake with FYM".

Table 1. Effect of INM practices onnutrient content (%) at harvesting in maize

Treatments	Nitrogen			Phosphorus			Potassium		
	2019	**2020**	**Pooled**	**2019**	**2020**	**pooled**	**2019**	**2020**	**pooled**
Main plots									
M_1= 125 % RDF	1.22	1.16	1.19	0.15	0.19	0.17	2.13	2.20	2.17
M_2= 100 % RDF	1.05	1.14	1.10	0.11	0.11	0.11	2.06	2.06	2.06
M_3= 75 % RDF	1.01	1.03	1.02	0.10	0.10	0.10	2.00	2.01	2.01
SEm±	**0.003**	**0.015**	**0.007**	**0.001**	**0.002**	**0.001**	**0.005**	**0.004**	**0.004**
CD (P=0.05)	**0.013**	**0.058**	**0.026**	**0.011**	**0.006**	**0.005**	**0.020**	**0.015**	**0.014**
Sub plots									
S_1 = Control	1.16	0.88	1.02	0.09	0.10	0.10	1.92	1.97	1.95

S_2 = FYM @ 10 t ha^{-1}	1.19	1.28	1.23	0.18	0.17	0.16	2.18	2.17	2.17
S_3 = Poultry manure @ 5 t ha^{-1}	1.08	1.14	1.11	0.11	0.13	0.12	2.11	2.13	2.12
S_4 = Urban compost @ 5 t ha^{-1}	1.04	1.11	1.08	0.11	0.13	0.13	2.05	2.10	2.07
SEm±	**0.004**	**0.019**	**0.009**	**0.002**	**0.002**	**0.002**	**0.009**	**0.005**	**0.005**
CD (P=0.05)	**0.01**	**0.06**	**0.03**	**0.005**	**0.006**	**0.006**	**0.026**	**0.016**	**0.014**
Interaction									
Sub at same level main (S x M)									
SEm±	**0.013**	**0.056**	**0.028**	**0.005**	**0.006**	**0.006**	**0.026**	**0.016**	**0.014**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Main at same or different level sub (M x S)									
SEm±	**0.070**	**0.295**	**0.150**	**0.026**	**0.034**	**0.033**	**0.138**	**0.083**	**0.073**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Table 2. Effect of INM practices on nutrient uptake (kg ha^{-1}) at harvesting in maize

Treatments	**Nitrogen**			**Phosphorus**			**Potassium**		
	2019	**2020**	**Pooled**	**2019**	**2020**	**Pooled**	**2019**	**2020**	**pooled**
Main plots									
M_1= 125 % RDF	144.66	155.71	146.04	28.45	33.01	30.54	141.69	157.73	149.71
M_2= 100 % RDF	136.16	139.99	132.83	24.30	29.48	26.89	117.16	126.22	121.69
M_3= 75 % RDF	108.92	116.24	108.35	21.33	29.09	25.21	98.56	109.72	104.14
SEm±	**0.68**	**1.44**	**0.55**	**0.18**	**0.70**	**0.38**	**1.02**	**0.96**	**0.55**
CD (P=0.05)	**2.67**	**5.65**	**2.15**	**0.72**	**2.74**	**1.49**	**4.00**	**3.77**	**2.14**
Sub plots									

S_1 = Control	34.29	30.47	42.39	5.65	13.42	9.28	34.39	43.81	39.10
S_2 = FYM @ 10 t ha^{-1}	169.39	185.74	158.60	33.26	36.61	34.94	156.17	167.65	161.91
S_3 = Poultry manure @ 5 t ha^{-1}	161.58	169.55	162.28	30.55	37.46	34.00	146.61	158.43	152.52
S_4 = Urban compost @ 5 t ha^{-1}	154.39	163.51	153.01	29.31	34.63	31.97	139.37	154.99	147.18
SEm±	**1.18**	**1.28**	**2.49**	**0.41**	**0.44**	**0.33**	**0.84**	**0.68**	**0.53**
CD (P=0.05)	**3.51**	**3.81**	**7.40**	**1.22**	**1.31**	**0.98**	**2.50**	**2.02**	**1.57**
Interaction									
Sub at same level main (S x M)									
SEm±	**3.55**	**3.84**	**7.47**	**1.23**	**1.32**	**0.99**	**2.52**	**2.04**	**1.58**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Main at same or different level sub (M x S)									
SEm±	**18.57**	**20.58**	**38.87**	**6.41**	**7.28**	**5.32**	**13.56**	**11.13**	**8.45**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Table 3. Effect of INM practices on nutrient content (%) at harvest in groundnut

Treatments	Nitrogen			Phosphorus			Potassium		
	2020	**2021**	**pooled**	**2020**	**2021**	**pooled**	**2020**	**2021**	**pooled**
Main plots									
M_1= 125 % RDF	1.64	1.67	1.65	0.46	0.52	0.49	1.28	1.31	1.29
M_2= 100 % RDF	1.52	1.55	1.54	0.43	0.49	0.46	1.16	1.19	1.18
M_3= 75 % RDF	1.33	1.35	1.34	0.39	0.45	0.42	1.08	1.11	1.10
SEm±	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**	**0.005**	**0.005**	**0.005**
CD (P=0.05)	**0.010**	**0.010**	**0.008**	**0.008**	**0.008**	**0.008**	**0.019**	**0.019**	**0.019**
Sub plots									
S_1 = Control	1.06	1.08	1.07	0.31	0.37	0.34	0.85	0.87	0.86
S_2 = FYM	1.74	1.79	1.76	0.50	0.56	0.53	1.39	1.42	1.41

@ 10 t ha^{-1}									
S_3 = Poultry manure @ 5 t ha^{-1}	1.66	1.68	1.67	0.49	0.54	0.52	1.28	1.31	1.29
S_4 = Urban compost @ 5 t ha^{-1}	1.53	1.55	1.54	0.42	0.47	0.44	1.18	1.21	1.19
SEm±	**0.003**	**0.003**	**0.002**	**0.003**	**0.003**	**0.003**	**0.005**	**0.005**	**0.005**
CD (P=0.05)	**0.010**	**0.010**	**0.006**	**0.008**	**0.008**	**0.008**	**0.014**	**0.014**	**0.014**
Interaction									
Sub at same level main (S x M)									
SEm±	**0.010**	**0.010**	**0.006**	**0.008**	**0.008**	**0.008**	**0.014**	**0.014**	**0.014**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Main at same or different level sub (M x S)									
SEm±	**0.052**	**0.054**	**0.032**	**0.042**	**0.042**	**0.042**	**0.073**	**0.073**	**0.073**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Table 4. Effect of INM practices on nutrient uptake (kg ha^{-1}) at harvest in groundnut

Treatments	Nitrogen			Phosphorus			Potassium		
	2020	2021	pooled	2020	2021	pooled	2020	2021	pooled
Main plots									
M_1= 125 % RDF	52.63	61.48	57.05	14.68	18.56	16.62	40.92	47.77	44.34
M_2= 100 % RDF	46.85	48.17	47.51	13.18	15.05	14.11	35.30	36.65	35.98
M_3= 75 % RDF	39.87	42.06	40.97	11.70	13.92	12.81	32.65	34.76	33.70
SEm+	**0.43**	**0.70**	**0.34**	**0.11**	**0.28**	**0.14**	**0.40**	**0.57**	**0.33**
CD (P=0.05)	**1.68**	**2.75**	**1.34**	**0.43**	**1.10**	**0.55**	**1.56**	**2.24**	**1.29**
Sub plots									
S_1 = Control	26.58	28.27	27.43	7.45	8.76	8.11	21.09	22.24	21.66
S_2 = FYM @ 10 t ha^{-1}	56.25	63.39	59.82	16.27	19.99	18.88	45.02	50.50	47.76
S_3 = Poultry manure @ 5 t ha^{-1}	52.77	60.94	56.86	15.53	18.66	16.60	40.68	47.32	44.00
S_4 = Urban compost @ 5 t ha^{-1}	50.18	49.70	49.94	13.50	15.06	14.28	38.37	38.85	38.61
SEm+	**0.47**	**0.81**	**0.49**	**0.14**	**0.24**	**0.15**	**0.41**	**0.66**	**0.43**
CD (P=0.05)	**1.40**	**2.40**	**1.45**	**0.41**	**0.73**	**0.45**	**1.21**	**1.96**	**1.29**
Interaction									
Sub at same level main (S x M)									
SEm+	**1.41**	**2.43**	**1.47**	**0.42**	**0.73**	**0.46**	**1.22**	**1.98**	**1.30**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Main at same or different level sub (M x S)									
SEm+	**7.50**	**12.84**	**7.72**	**2.19**	**3.94**	**2.42**	**6.49**	**10.50**	**6.85**
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Conclusion

Nutrient content and uptake of NPK at different stages of maize-groundnut cropping sequence was significantly influenced by levels of NPK and organic manures application. The highest values were recorded in 125 % RDF (M_1) and lowest was found in 75 % RDF (M_3). However, among organic sources the highest plant nutrient content was recorded with application of poultry manure @ 5 t ha^{-1} (S_3) and the lowest in control (S_1). Interaction effect and pooled analysis of two years data also showed same trend.

Reference

1. Prasannakumar, a. S. Halepyati , b. T. Pujari and b. K. Desai. 2007 Effect of integrated nutrient management on productivity, nutrient uptake and economics of maize (*Zea mays* L.) under rainfed condition. *Karnataka Journal of Agricultural Science.* 20(3): 462-465.

2. Setia, R. K and Sharma, K. N. 2007. Dynamics of forms of inorganic phosphorus during wheat growth in a continuous maize- wheat cropping system. *Journal of the Indian Society of Soil Science.*55(2):139-146.
3. Mohanty,S.Kumar,N.P. and Rajan,A.R.2005,Uptake of major nutrients from manures in groundnut(Arachis hypogaea L.)-Corn(Zea mays L.) sequence. Annals of Agricultural Research New Series, 26(3):349-352.
4. Sunil Kumar Rawat, C.R., Shiva Dhar and Suchitkrai. 2005. Dry matter accumulation, nutrient uptake and changes in soil fertility status as influenced by different organic and inorganic sources of nutrients to forage sorghum (Sorghum bicolor). Indian Journl of Agricultural Sciences. 75 (6): 340-342.

5. Sheetal,T.,Gabhane,V.V. and Pushpa,B.,2014,Effect of integrated nutrient management on yield,quality,nutrient content and uptake of groundnut in shrink-swell soil. *International Journal of Agricultural Sciences,* **10**(1):291-293.

6. Saha, M and Mondal, S. S. 2006. Influence of integrated plant nutrient supply on growth productivity and quality of baby corn (Zea mays) in Indo- Gangetic plains. Indian Journal of Agronomy. 51 (3): 202- 205.
7. Kumar and Thakur, K. S. 2004. Effect of integrated nutrient management on promising composite maize (Zea mays) varieties under rainfed mid-hill conditions of Himachal Pradesh. Indian Journal of Agricultural Sciences. 74 (1): 40-42.
8. Chaithanya Devi, M., Ramavatharam, N., Naidu, M. V. S. and Reddy, K. S. 2003, Effect of inorganic fertilizers and organic manures on growth, yield and uptake of nutrients by groundnut (Arachis hypogaea). Journal of Oilseeds Research, 20(1): 126-128.
9. Jagadeeswari, P.V and Kumaraswamy, K. 2000. Long-term effects of manure-fertilizer schedules on the yield of and nutrient uptake by rice crop in a permanent manorial experiment. Journal of the Indian Society of Soil Science. 48: 833-836.

10. Surendra Singh and Sarkar, A. K., 2001, Balanced use of major nutrients for sustaining higher productivity of maize (*Zea mays*) - wheat cropping system in acidic soils of Jharkhand. *Indian Journal of Agronomy*, **46** (4): 605-610.

11. Prabhavathi N, Nagaraju K, Madhuri KN, Prasad PR. Effect of INM on growth and physiological parameters of maize in maize-groundnut cropping system. The pharma innovation Journal. 2021;10(5):250-3.

Pic 1. Experimental site

Pic 2.Crop productivity

Pic 3.Agricultural field

Pic 4. Crop plantation

Pic 5. Sample processing

Pic 6. Sample processing and tagging