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Research Article

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT PRACTICES ON DISTRIBUTION OF NITROGEN FRACTIONS BY MAIZE CROP IN SOIL

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ABSTRACT
There were two levels of nitrogen applied through organics (FYM and vermicompost) and in-organics involving nine treatments combinations were tried in a RCBD with three replications. Significantly lower available nitrogen status was recorded in the treatments which received nitrogen only through fertilizers and without any organic matter application (196.00-200.50 kg ha^{-1}) including absolute control compared to all other treatments (238.00-243.60 kg ha^{-1}).A field study was carried out at College of Agriculture, Navile, Shimoga during Kharif 2009 to study the effect of integrated nutrient management practices on distribution of nitrogen fractions in soil. Except inorganic nitrogen fractions, organic nitrogen fractions were recorded high in integrated treatments compared to the treatment which received nitrogen only in the form of fertilizers.

Key words : *Nitrogen Fractions***.**

INTRODUCTION
Maize has high genetic yield potential than other cereal crops. Hence it is called as 'miracle crop' and also as 'queen of cereals'. Being a C_4 plant, it is very efficient in converting solar energy in to dry matter. As heavy feeder of nutrients, maize productivity is largely dependent on nutrient management. Among the essential nutrient elements of plants, nitrogen plays an important role as far as plant growth and development is concerned and accounts for 1 to 4 per cent of dry matter of plants. Nitrogen content in plant tissue depend on its availability in soil which in turn dependent on soil factors like pH, organic matter status in soil and biological activity of soil. Many workers proved that available nitrogen status in soils increased with increased supply of nitrogen in the form of either fertilizers or organic manures which ultimately increased the productivity of maize. Further, they reported that only 30 to 40 percent of the added nitrogen was recovered by crops due to its leaching, volatilization and denitrification losses. The nitrate that is leached from fields, moves with water and contaminates either ground water or surface water bodies and causes an environmental pollution. Hence, management practices may be vital to increase nitrogen use efficiency by crops and also to reduce environmental pollution.

Transformation of added nitrogen through fertilizers or manures into different forms of nitrogen in soil and their availability to crops depends on soil properties and nature of nitrogen sources added to soils. According to the research reports, more than 90 per cent of nitrogen in the soil is present in organic form and concentrations of inorganic form viz., nitrate nitrogen and ammonical nitrogen in soil at any given time is influenced by several soil factors. But, very little information is available with respect to the effect of integrated nutrient management practices on distribution of different forms of nitrogen in soils. The knowledge of distribution of various forms of nitrogen in soil attains greater importance in understanding the potential of a soil in supplying them to the crops and also to understand the nitrogen use efficiency by crops. Hence, it becomes an essential part of nitrogen management during the process of crop production. In soils of sandy loam texture coming under high rainfall areas, owing to their low organic matter status and leaching loss of nitrogen from these soils, the availability of nitrogen in soils is low and this becomes a limiting factor for crop production. Therefore, to understand the transformation of nitrogen into different fractions and their availability to plants becomes an essential part of nitrogen management in order to increase productivity and also to maintain the soil health.

MATERIALS AND METHODS

The experiment was conducted at College of Agriculture, Navile, Shimoga during Kharif 2009 to study effect of INM on distribution of nitrogen fractions in soil The soil of experimental field was sandy loam in texture (Typic Haplustalf) having initial pH 5.10 and organic carbon control of soil were 0.33%. The fertility status of experimental field was found to be low in available nitrogen (197.20 kg ha^{-1}) , high in available P_2O_5 (52.80 kg ha^{-1}) and medium in available K_2O (182.40 kg ha^{-1}). The experiment was laid out in randomized complete block design with three replications.

The treatments were as follows

T_1 – Absolute control
T_2 – 100% N through fertilizer
T_3 – 150% N through fertilizer
T_4 – 100% N + 7.5 t ha^{-1} FYM (Package of practices)
T_5 – 150% N + 7.5 t ha^{-1} FYM
T_6 – 100% N (50% N through fertilizer + 50% N through FYM)
T_7 – 150% N (75% N through fertilizer + 75% N through FYM)
T_8 – 100% N (50% N through fertilizer + 50% N through Vermicompost)
T_9 – 150% N (75% N through fertilizer + 75% N through Vermicompost)

(Note: 100 % P and K applied to all treatments except absolute control)

Table 1: Physical and chemical properties of the representative soil of the experimental site.

Properties	**Values**
Soil taxonomy	Typic Haplustalf
Sand (%)	71.78
Silt (%)	11.89
Clay (%)	16.33
Textural class of soil	Sandy Loam
Soil pH	5.10
Organic carbon (%)	0.33
Available macronutrient status	
Nitrogen (kg ha^{-1})	197.20
Phosphorus (kg P_2O_5 ha^{-1})	52.80
Potassium (kg K_2O ha^{-1})	182.40

RESULTS AND DISCUSSION

Effect of integrated nutrient management practices on available nitrogen status in soil at different growth stages of maize.

Available nitrogen status in soil at different growth stages of maize significantly increased over control due to imposition of different treatments. Among different treatments, the treatment T_4(100% N + 7.5 t ha^{-1})FYM recorded significantly higher available nitrogen status of 306.00 kg ha^{-1}at 30 days after sowing and found to be significantly superior over other treatments. During 60 days after sowing and also at harvest of the crop, the above treatment was found to be superior over contol, T_2 and T_3 treatments but it was on par with the rest of the treatments. The integrated nutrient treatments (T_6, T_7, T_8 and T_9) did not differ significantly among themselves, however recorded higher available nitrogen status compared to the treatments which received nitrogen only through fertilizers without any organics. The increased availability of nitrogen in soil under the above treatments during the later part of the crop growth was attributed to slow release of nitrogen from these organic manures and less leaching loss of nitrogen from soil under these treatments (Bhardwaj and Omanwar, 1994). At harvest of the crop, the treatment T_4 (100% N + 7.5 t ha^{-1} FYM) recorded lower amounts (248.80 kg ha^{-1}) of available nitrogen in soil compared to integrated treatment because of more uptake by plant (Uma Reddy, 1999). Further, it was noticed that available nitrogen status in soil decreased with the crop growth probably because of increased uptake by crop with its maturity and other loss that took place during crop growth period .These results are akin to the findings of Bhardwaj *et al.* (1994).

Inorganic N fractions

The results presented indicate that exchangeable NH_4^+-N fraction in soil was significantly higher (14.00 mg kg^{-1}) in treatment T_5 (150% N + 7.5 t ha^{-1} FYM), followed by the treatment T_4(100% N + 7.5 t ha^{-1} FYM) which recorded the NH_4^+-N of 13.80 mg kg^{-1}. Integrated treatments recorded higher amounts of exchangeable NH_4^+-N compared to that of the treatments which received only fertilizers. This could be attributed due to the increased rate of mineralization of organic matter in the soil which was enhanced by the addition of organic manures (FYM or vermicompost) and hence caused a build up of NH_4^+-N in soil. Similarly, Yadav and Singh (1991) reported that increasing rates of NPK application had a favourable influence on exchangeable NH_4^+-N in soil. In the treatments where nitrogen applied only through fertilizers, exchangeable NH_4^+-N contents was low probably because of leaching loss (Duraisami *et al.*, 2001). A positive effect of 50 percent and 75 percent N substitution through FYM or vermicompost was observed in terms of improved NH_4^+-N contents of the soil due slow release and retention by soil. This is tune with the observations made by Santhy *et al.* (2001).

The NO^-_3-N content in the soil at any given time depends upon the rate of formation, crop removal, leaching, volatilization, denitrification, addition of NO^-_3-N through fertilizers and organic manures and rate of mineralization (Giesenking, 1975). In this study NO^-_3-N recorded significantly higher in the treatment T_5 (150% N + 7.5 t ha^{-1} FYM) which recorded NO^-_3-N of 8.80 mg kg^{-1}, followed by T_4 (100% N + 7.5 t ha^{-1} FYM). Further, integrated treatments (T_6, T_7, T_8 and T_9) with combined application of organics and fertilizers recorded higher NO^-_3-N compared to treatments which received nitrogen only fertilizers without any organics. This could be attributed to increased microbial activity increase in soil pH might have enhanced nitrification process with a reduction in leaching losses (Udaysoorian *et al.*, 1989; Benbe *et al.*, 1991). In case of only fertilizer treated plots without organics, the conversion of NH_4^+-N to NO^-_3-N was rapid as reported by Udaysoorian *et al.* (1989) and Benbe *et al.* (1991)and this might have resulted in more leaching loss of NO^-_3-N.

Organic N fractions

Considerable build up in all the organic N fractions viz., hydrolysable NH_4^+-N, Amino acid –N, Hexosamine –N, unidentified hydrolysable –N could be observed in integrated treatment while the lowest concentrations of these fractions were observed in control and the plots which received only fertilizers without any organic manures . Various organic N fractions in soil indicated an appreciable increase in

Table 2: Effect of integrated nutrient management practices on available nitrogen status in soil at different growth stages of maize

Treatments	Available nitrogen (kg ha^{-1})		
	30 DAS	**60 DAS**	**Harvest**
T_1- Absolute Control	196.14	180.20	176.00
T_2-100% N through fertilizer	249.24	210.00	196.00
T_3-150% N through fertilizer	266.30	216.00	200.50
T_4-100% N+7.5t ha^{-1} FYM	306.00	282.00	240.80
T_5-150% N+7.5t ha^{-1}FYM	305.20	280.00	238.00
T_6- 100%N (50%N through fertilizer+50%N through FYM)	288.20	276.00	241.20
T_7- 150% N (75%N through fertilizer+75%N through FYM)	290.33	278.00	243.60
T_8- 100% N (50%N through fertilizer+50%N through vermicompost)	286.20	275.80	239.20
T_9- 150 % N (75%N through fertilizer+75%N through vermicompost)	290.00	278.96	242.90
S.Em±	2.96	4.45	3.46
CD at 5%	8.87	13.35	10.38

DAS - Days after sowing
Note: 100% P & K applied to all treatments except absolute control

Table 3: Effect of integrated nutrient management practices on distribution of different nitrogen fractions in soil at harvest stage of maize . (mg kg^{-1})

Treatments	NO_3-N	Exch. NH_4^+-N	Hydrolysable Nitrogen					NHN	Total Nitrogen
			HAN	HSN	AAN	UHN	THN		
T_1- Absolute Control	4.80 (1.44)	8.20 (2.47)	90.00 (27.03)	19.00 (5.71)	120.00 (36.03)	63.60 (19.09)	292.60	27.40 (8.23)	333.00
T_2-100% N through fertilizer	6.20 (1.83)	10.60 (3.11)	90.00 (26.44)	19.60 (5.76)	120.60 (35.42)	62.80 (18.45)	293.00	30.60 (8.99)	340.40
T_3-150% N through fertilizer	8.00 (2.33)	10.80 (3.14)	91.60 (26.71)	19.80 (5.78)	120.80 (35.21)	61.60 (17.96)	293.80	30.40 (8.87)	343.00
T_4-100% N+7.5t ha^{-1} FYM	8.40 (2.12)	13.80 (3.48)	98.00 (24.75)	26.00 (6.57)	131.60 (33.23)	64.80 (16.36)	320.40	53.40 (13.49)	396.00
T_5-150% N+7.5t ha^{-1}FYM	8.80 (2.22)	14.00 (3.53)	98.80 (24.90)	28.00 (7.05)	132.00 (33.27)	62.80 (15.83)	321.60	52.40 (13.20)	396.80
T_6- 100%N (50%N through fertilizer+50%N through FYM)	6.80 (1.67)	11.40 (2.69)	111.60 (26.44)	35.80 (8.48)	129.80 (30.74)	70.80 (16.76)	348.00	55.80 (13.22)	422.00
T_7- 150% N (75%N through fertilizer+75%N through FYM)	7.20 (1.62)	12.80 (3.00)	112.00 (26.18)	36.00 (8.43)	132.60 (30.99)	71.40 (16.69)	352.00	56.00 (13.09)	428.00
T_8- 100% N (50%N through fertilizer+50%N through vermicompost)	7.00 (1.69)	11.00 (2.60)	110.80 (26.26)	35.20 (8.34)	130.00 (30.82)	71.80 (17.02)	347.80	56.00 (13.27)	421.80
T_9- 150 % N (75%N through fertilizer+75%N through vermicompost)	7.60 (1.67)	12.60 (2.95)	110.90 (25.82)	37.00 (8.62)	132.80 (30.91)	72.30 (16.85)	353.00	56.60 (13.18)	429.80
SEM±	0.45	0.51	1.36	1.06	1.77	0.86	12.26	2.24	1.18
CD at 5%	1.37	1.53	4.09	3.20	5.33	2.59	36.76	6.73	3.54

Note: *100% P & K applied to all treatments except absolute control.*
Total N =[NO_3-N + Exch. NH_4^+-N + THN + NHN]
Figures in parenthesis indicate percentage distribution of nitrogen fractions

HAN – Hydrolysable Ammonical Nitrogen
THN – Total Hydrolysable Nitrogen
UHN – Unidentified Hydrolysable Nitrogen
AAN- Amino acid Nitrogen
HSN – Hexosamine Nitrogen
NHN–NonHydrolyableNitrogen

T_1- Absolute Control
T_2-100% N through fertilizer
T_3-150% N through fertilizer
T_4-100% N+7.5t ha^{-1} FYM
T_5-150% N+7.5t ha^{-1}FYM
T_6-50%N through fertilizer+50%N through FYM
T_7-75%N through fertilizer+75%N through FYM
T_8-50%N through fertilizer+50%N through vermicompost
T_9-75%N through fertilizer+75%N through vermicompost

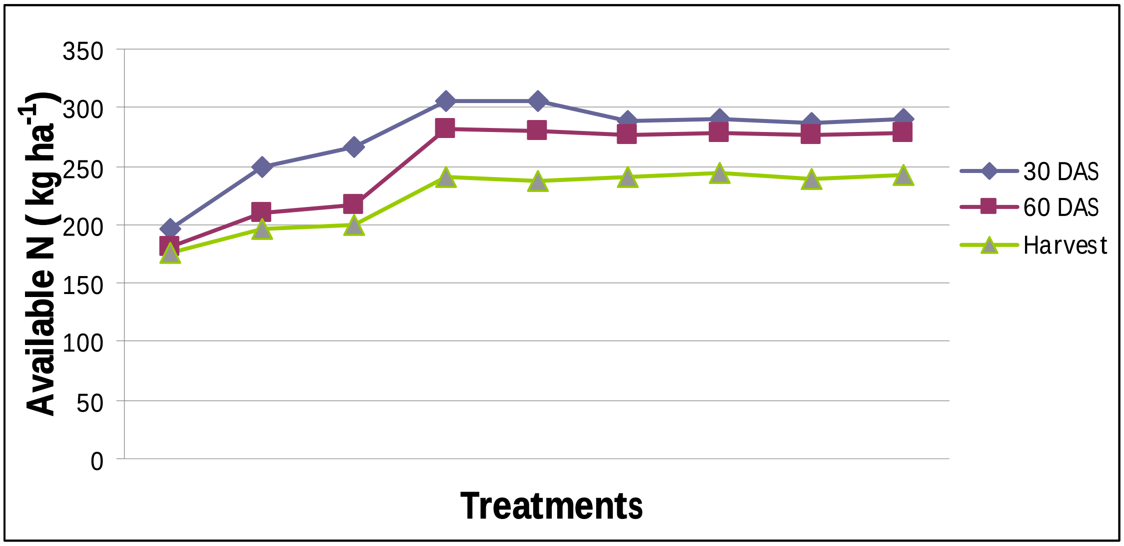

Figure 1: Effect of integrated nutrient management practices on available nitrogen status in soil at different growth stages of maize.

Organic N fractions

Considerable build up in all the organic N fractions viz., hydrolysable NH_4^+-N, Amino acid –N, Hexosamine –N, unidentified hydrolysable –N could be observed in integrated treatment while the lowest concentrations of these fractions were observed in control and the plots which received only fertilizers without any organic manures . Various organic N fractions in soil indicated an appreciable increase in their contents due to the treatment T_4 (100% N+ 7.5 t ha^{-1}FYM) and graded levels of fertilizers along with FYM and vermicompost (integrated treatment). Among the organic N- fraction, amino acid –N was the most dominant fraction (30.74 -36.03% of total N) followed by hydrolysable NH_4^+-N (24.75- 27.03% of total N) and hexosamine –N (5.71-8.62 % of total N). This indicates that total hydrolysable –N contributed more to the total –N compared to other fractions, thus indicating the existence of major portion of N in the organic form (Tisdale *et al.*, 1985).

The application of NPK along with either FYM or vermicompost favoured immobilization of N in different hydrolysable fractions and also improved the level of organic nitrogen. The accumulation of slightly higher amounts of N as hydrolysable and non-hydrolysable in INM treatments was observed. This could be due to higher biomass production and predominance of cereal crops which will return lot of roots and stubbles to the soil (Subba Rao and Ghosh, 1981). Similarly, Duraiswamy, (1992) reported that increased amounts of organic N fractions under FYM and vermicompost plus fertilizers treatments would indicate that the added forms of inorganic and organic N undergo series of transformation processes and thereby contributing to each pool of organic N formed in soil . A study conducted by Subba Rao and Ghosh (1981) revealed that there existed a metastable equilibrium between immobilization and mineralization processes going on individual fractions with a clear and perceptible shift towards greater immobilization and consequent accumulation of nitrogen in organic forms.

REFERENCES

BENBE, DK, BISWAS, CR AND KALKAI JS (1991) Nitrate distribution and acccumualtion in an ustochrept soil profile in a long term fertilizer experiment. *Journal* of *Fertilizer and Research*, **28** (2): 173-177.

BHARADWAJ, V. AND OMANWAR, P.K. AND VISHWANATH., 1994, Long term effects of continuous rotational cropping and fertilization on crop yields and soil properties II. Effects on EC, pH, organic matter and available nutrients of soil. *Journal of Indian Society of Soil Science,* **42** (6): 387-392.

BHARDWAJ, V. AND TYAGI, V.V., 1994, Impact of continuous manuring on crop yields and uptake of nitrogen, phosphorus and potassium. *Journal of Pottassium Research* **10** (3): 290-293.

DURAISAMI, V.P., PERUMAL, R. AND MANI, A.K., 2001, Changes in organic carbon, available nitrogen and inorganic nitrogen fractions under integrated nitrogen management of sorghum in a mixed black soil. *Journal of Indian Society of Soil Science,* 49**(4)**: 435-439.

DURAISWAMY, P., 1992, Efficacy of fertilizer nitrogen with and without coir pith and biofertilizers on role and inter cropped sorghum – maize – soyabean cropping sequences. *Ph.D Thesis,* Tamilnadu agriculture university, Coimbatore.

GIESENKING, J.E., 1975, Soil components : *Inorganic components,* Springer Verlay, Berlin – Heidelberg, New York. **14** (2) : 12-16

SANTHY, P., MUTHUVEL, P. AND SELVI, D., 2001, Nitrogen fractions : status and impact of yield, uptake and available nitrogen in a long term fertilizers experiment. *Madras journal of agricultural sciences* **88** (2): 26-31.

SUBBA RAO, A. AND GHOSH, A.B., 1981, Effect of continuous cropping and fertilizer use on the organic nitrogen fractions in a typic ustochrept soils. *Plant and Soil* , **62** (1): 377-383.

TISDALE, S.L., NELSON, W.L. AND BEATON, J.D., 1985, Soil fertility and fertilizers *4^{th} edition* . *Me MIllan publishing company*, New York, **12** (5) : 251.

UDAYSOORIAN, C., SREERAMULU, U.S AND PARAMASIVAM, P., 1989, Effect of continuous manuring and fertilization on the fractions of soil nitrogen. *Madras journal of Agricultural Sciences* , **76** (5): 257-261.

UMA REDDY, R., 1999, Integrated nutrient management in tomato-onion cropping system. *Ph.D. Thesis, Acharya N.G. Ranga Agricultural University,* Hyderabad.

YADAV, M.D AND SINGH, K.D., 1991, Transformation of applied nitrogen in relation to its availability to sugarcane in a calcareous soil. *Journal of Indian Society of Soil Science* **39**(6): 292-297.