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Research Paper

Effect of integrated nutrient management practices on nitrogen use efficiency by maize crop

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ABSTRACT

A field experiment was conducted during *Kharif* 2009 on a sandy loam soil belongs to the soil taxonomy of Typic Haplustalf, located at College of Agriculture, Navile, Shimoga to study the effect of integrated nutrient management practices on nitrogen fractions, nitrogen use efficiency and productivity of maize (*Zea mays* L.). Two levels of nitrogen applied through organics (FYM and Vermicompost) and inorganics involving nine treatment combinations were tried in a RCBD with three replications. An agronomic nitrogen use efficiency was found highest (73.00) in the treatments involving package of practices compared to other treatments. However, nitrogen use efficiency was found to be more at lower level of nitrogen application and also in the integrated treatments compared to the treatments which received only NPK fertilizers.

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KEY WORDS : Integrated nutrient management, Nitrogen use efficiency, Maize

Maize (*Zea mays*) 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 depends 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 per cent 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.

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 and their availability to plants becomes an essential part of nitrogen management in order to increase productivity and also to maintain the soil health.

RESEARCH PROCEDURE

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 per cent. 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}) (Table A). 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 per cent N through fertilizer, T_3 – 150

Table A : 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

per cent N through fertilizer, T_4 – 100 per cent N + 7.5 t ha^{-1} FYM (Package of practices), T_5 – 150 per cent N + 7.5 t ha^{-1} FYM, T_6 – 100 per cent N (50 % N through fertilizer + 50% N through FYM), T_7 – 150 per cent N (75% N through fertilizer + 75% N through FYM), T_8 – 100 per cent N (50% N through fertilizer + 50% N through Vermicompost), T_9 – 150 per cent N (75% N through fertilizer + 75% N through vermicompost)

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

Nitrogen use efficiency (NUE):

The agronomic nitrogen use efficiency (ANUE), physiological nitrogen use efficiency (PNUE), apparent recovery of applied nitrogen (ARN) and partial factor productivity for applied nitrogen (PFP_N) were calculated using the following equations (Cassman *et al*., 1998).

Agronomic nitrogen use efficiency (ANUE) = $(GY_F – GY_O) / N_F$

where: GYF = Grain yield from nitrogen applied plot

GY_O = Grain yield from absolute controlled plot.

N_F = Fertilizer N applied

Physiological nitrogen use efficiency (PNUE) = GY/ TN

where: GY= Grain yield

TN= Total nitrogen uptake

Apparent recovery of applied N (ARN) = $(TN_F – TN_O) / N_F$

where: TN_F = Total plant N uptake with fertilizer N application

TN_O = Total plant N uptake without N application

N_F = Fertilizer N applied

Partial factor productivity for applied N (PFP_N) = GY_F / N_F

where: GY_F = Grain yield with fertilizer N application

N_F = Fertilizer N applied

All of the above quantities are expressed in kg ha^{-1}

RESEARCH ANALYSIS AND REASONING

The results obtained from the present investigation have been duscussed below:

Effect of integrated nutrient management practices on nitrogen use efficiency by maize crop:

The differential effect of treatments on nitrogen use efficiency was quite obvious in this study. Data presented in (Table 1) reveal that agronomic nitrogen use efficiency (ANUE), physiological nitrogen use efficiency(PNUE), apparent recovery of applied nitrogen(AR) and partial factor productivity for applied N of maize were significantly higher in the treatment T_4 (100% N + 7.5 t ha^{-1} FYM) compared to other treatments. Further integrated treatments (T_6, T_7, T_8 and T_9) recorded better nitrogen use efficiency over control and treatments which received

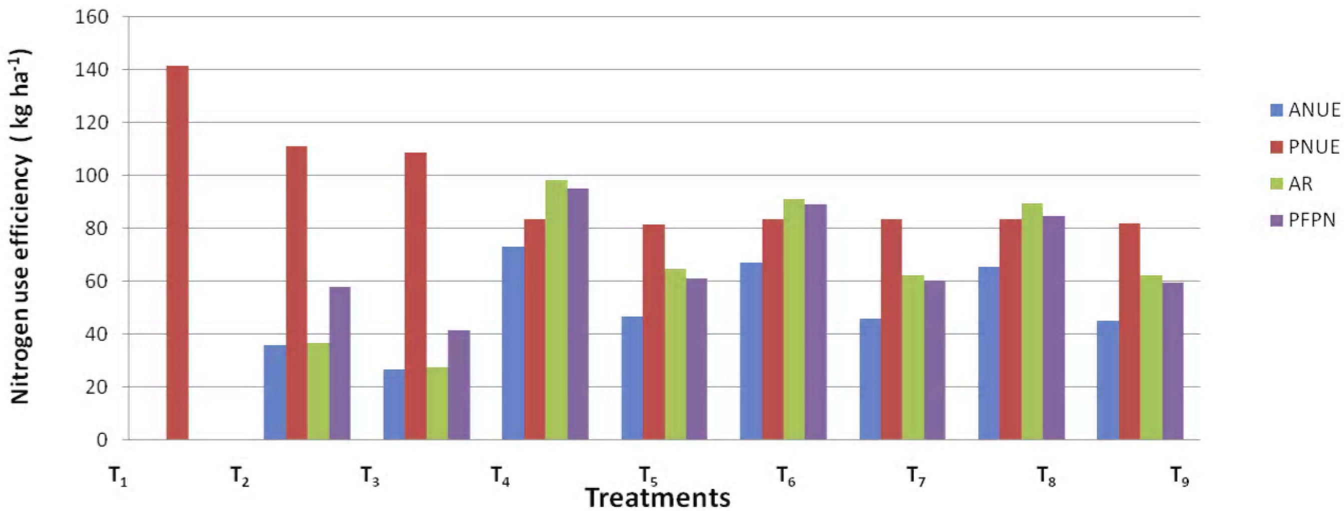
Table 1 : Effect of integrated nutrient management practices on nitrogen use efficiency of maize

Treatments	ANUE	PNUE	AR	PFP_N
T_1- Absolute control	0.00	141.52	0.00	0.00
T_2-100% N through fertilizer	36.00	111.14	36.53	58.00
T_3-150% N through fertilizer	26.73	108.72	27.56	41.33
T_4-100% N+7.5t ha^{-1} FYM	73.00	83.34	98.24	95.00
T_5-150% N+7.5t ha^{-1}FYM	46.50	81.52	64.57	61.11
T_6- 100%N (50%N through fertilizer+50%N through FYM)	67.00	83.33	91.24	89.00
T_7- 150% N (75%N through fertilizer+75%N through FYM)	45.90	83.33	62.16	60.44
T_8- 100% N (50%N through fertilizer+50%N through vermicompost)	65.56	83.34	89.47	84.56
T_9- 150 % N (75%N through fertilizer+75%N through vermicompost)	44.86	81.96	62.22	59.51
S.E.$\pm$	3.11	0.74	3.50	3.23
C.D. (P=0.05)	9.33	2.23	10.51	9.71

Note: 100% P & K applied to all treatments except absolute control.

ANUE -Agronomic nitrogen use efficiency PNUE -Physiological nitrogen use efficiency

AR -Apparent recovery of applied N PFP_N -Partial factor productivity for applied N



ANUE - Agronomic nitrogen use efficiency

AR - Apparent recovery of applied N

PNUE - Physiological nitrogen use efficiency

PFP_N - Partial factor productivity for applied N

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

Fig.1: Effect of integrated nutrient management practices on nitrogen use efficiency of maize

only fertilizers without any organic manure. This may be due to favourable influence of soil moisture coupled with adequate nutrient supply during crop growth. The maximum nitrogen use efficiency seemed to have been registered in the treatment T_4 (100% N + 7.5 t ha^{-1} FYM) in all the parameters studied. Finally, it is recognized that efficiency of added nitrogen would increase when other nutrient are in adequate supply for crop growth.

On the whole it can be concluded that blending of 50 and 75 per cent N fertilizer integrating with 50 and 75 per cent N through organic manures had the potential to substitute recommend fertilizer N and is likely that N losses due to leaching, de-nitrification might have reduced due to blending of N fertilizer with manures resulting in improved N use efficiency and long term release of nutrients from manures (Table 1 and Fig. 1). This premise is supported by the fact of N contents in stover and grain and total N uptake by maize. These results are in line with the findings of (Wolkowski, 2003, Rizwan Ahmad *et al.*, 2006; Moll *et al.*, 1982).

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