The Andhra Agric. J 60(4):832-836, 2013

Effect of Integrated Nutrient Management on Performance and Economics of Maize (*Zea mays L.*)

K C Vaisakhi, P Madhu Vani, P Prasuna Rani and K L Narasimha Rao
Department of Soil Science and Agricultural Chemistry, Agricultural College,Bapatla 522 101

ABSTRACT

A field experiment was conducted to study the effect of integrated nutrient management on performance and economics of maize (*Zea mays L.*) during *kharif,* 2011 on sandy loam soils of Agricultural College Farm, Bapatla. The results showed that the highest drymatter production, yield attributes and yield were observed when 125 per cent of recommended dose of fertilizer nitrogen (RDFN) was applied along with 50 per cent of nitrogen through poultry manure (PM) followed by 50 per cent nitrogen through FYM. Lowest was recorded with the sole application of inorganic fertilizer nitrogen at 100 per cent RDF. Treatments which received poultry manure recorded higher drymatter production, yield attributes and yield as compared to FYM either at 100 or 125 per cent recommended dose of fertilizer nitrogen. However, there was no significant influence of integrated application of inorganic nitrogen and FYM/ poultry manure at different levels on harvest index and shelling percentage. The highest net returns and benefit-cost ratio were observed in integrated application of inorganic nitrogen at 125 per cent + 50 per cent nitrogen through poultry manure.

Key words : Economics, FYM, Grain yield, Poultry manure, Maize, Stover yield.

Maize *(Zea mays* L.) is one of the important cereal crop next to wheat and rice in the world. In India, it plays a vital role in agricultural economy both as staple food and feed for livestock as well as raw material for industry. In India, it covers an area of 8.26 M ha producing 17.04 M t while in Andhra Pradesh, it occupies an area of 7.86 lakh hectares producing 36.2 lakh tonnes (Ministry of Agriculture, Govt. of India, 2008-2009).

Maize is called "King of cereals" because of its productive potential compared to any other cereal crop. The productivity of maize mainly depends on its nutrient management especially nitrogen. Maize crop which gives grain yield of 10 to 12 t ha^{-1} requires 200 kg of N, 30 kg of P_2O_5, 167 kg of K_2O, and 42 kg of S ha^{-1}(BARC, 2005). But, continuous massive and imbalanced use of high analysis chemical fertilizers adversely influences production potential and soil health. On the other hand, use of locally available organic manures such as FYM and poultry manure can substantially reduce chemical fertilizer use without detrimentally affecting crop yields. In this context integrated nutrient management involving both organic and inorganic sources of nutrients holds good for sustainable production without impairing the soil health. Keeping these points in view, the present study was carried out on integrated use of FYM and poultry manure along with inorganic nitrogen and its effect on productivity and economics of maize cultivation.

MATERIAL AND METHODS

The experimental soil was non-saline, slightly alkaline and sandy loam in texture with low organic carbon and available nitrogen, medium in available phosphorus and high in potassium as analysed by standard methods. The characteristics of experimental soil were given in Table 1. The experiment was laid out in a randomized block design with ten treatments comprised of sole application of inorganic nitrogen at 100 and 125 per cent RDF (120kg ha^{-1}) and integrated application with FYM and poultry manure at 25 and 50 per cent nitrogen at both the levels. The treatments were replicated three times and the details are T_1- 100% RDFN; T_2- 100% RDFN + 25% N through FYM; T_3- 100% RDFN + 50% N through FYM; T_4- 100% RDFN + 25% N through poultry manure; T_5- 100%RDFN + 50% N through poultry manure; T_6- 125% RDFN; T_7- 125% RDFN + 25% N through FYM; T_8- 125% RDFN

Table1. Characteristics of experimental soil.

Characteristics	Value
Particle size analysis	
Sand (%)	77.68
Silt (%)	14.32
Clay (%)	8.0
Soil texture	Sandy loam
Bulk density (Mg m^{-3})	1.5
Soil pH (1:2.5 soil:water)	7.6
Electrical conductivity (dSm^{-1}) (1:2.5 soil:water)	0.11
Cation exchange capacity (c mol (p+) kg^{-1})	13.9
Organic carbon (%)	0.19
Available nitrogen (kg ha^{-1})	122
Available P_2O_5 (kg ha^{-1})	40.4
Available K_2O (kg ha^{-1})	392
Available micronutrients	
i) Iron (mg kg^{-1})	8.12
ii) Zinc (mg kg^{-1})	0.53
iii) Manganese (mg kg^{-1})	6.49
iv) Copper (mg kg^{-1})	1.68

+ 50% N through FYM; T_9- 125% RDFN + 25 % N through poultry manure; T_{10}-125%RDFN + 50% N through poultry manure. Nitrogen, phosphorus and potassium were applied through urea, single superphosphate (SSP) and muriate of potash (MOP). Nitrogen was applied at 100 and 125 per cent of recommended dose as per the treatments in three equal splits, at the time of sowing, at knee high stage and at tasseling. Recommended dose of 60 kg P_2O_5 and 40 kg K_2O ha^{-1} was applied uniformly to all the plots. Entire quantity of phosphorus was applied as basal whereas, potassium was applied in two equal splits, one at the time of sowing and other at tasseling stage. FYM and poultry manure were applied 10 days before sowing based on their nitrogen content. The variety of maize seeds used was hybrid pioneer (30V92). The crop was harvested 100 days after sowing.

RESULTS AND DISCUSSION

Yield attributes

The result showed that the highest no. of seeds per cob, weight of seeds per cob, 1000 seed weight, was observed in T_{10} (125%RDFN + 50% N-PM) which was followed by T_8 (125% RDFN + 50% N –FYM) and T_9 (125% RDFN + 25 % N – PM). Integration of poultry manure and inorganic nitrogen performed better than their corresponding combinations of FYM at all levels. The lowest was recorded in treatments which received only inorganic fertilizers @ 100% RDFN (120 kg N ha^{-1}). There was no significant difference in shelling percentage among different treatments.

The increase in 1000-grain weight over that of control was mainly due to balanced supply of nutrients from both urea and poultry manure throughout development of plant. In other words, 1000-grain weight under poultry manure treatments had a noticeable increase which could be due to the production of larger and heavier seeds in those treatments. This might be due to the accelerated mobility of photosynthates from the source to sink as influenced by the growth hormone synthesized due to the organic sources. These results are in accordance with the findings of Ma *et al*. (1999) and Garg and Bahla, (2008). Material transition in phloem vascular caused transition of growth stimulation material and increased cell division and grain number. Similar results were also obtained

Table 2. Effect of integrated nutrient management on yield components of maize.

TREATMENTS	1000 seed weight (g)	Seed weight per cob (g)	No. of seeds per cob	Shelling percentage (%)
T_1 : 100% RDFN	256.1	68.0	264.5	65.1
T_2 : 100% RDFN + 25% N - FYM	263.5	70.2	265.6	64.3
T_3: 100% RDFN + 50% N - FYM	280.2	79.0	281.1	66.6
T_4: 100% RDFN + 25% N - PM	270.3	74.3	275.6	64.6
T_5: 100%RDFN + 50% N - PM	285.5	81.7	285.5	68.7
T_6: 125% RDFN	276.2	78.3	283.7	62.3
T_7: 125% RDFN + 25% N- FYM	290.6	87.0	299.2	67.9
T_8: 125% RDFN + 50% N -FYM	307.9	95.3	310.1	64.6
T_9: 125% RDFN + 25 % N – PM	291.3	93.7	321.8	66.0
T_{10}:125%RDFN + 50% N-PM	313.7	105.3	335.8	68.8
SEm±	7.8	4.7	13.6	2.3
CD	23.0	14.0	40.4	NS
CV%	4.7	9.8	8.1	6.0

Table 3. Effect of integrated nutrient management on drymatter production, yield and harvest index of maize

TREATMENTS	Dry matter production at tasseling (kg ha^{-1})	Stover yield (kg ha^{-1})	Grain yield (kg ha^{-1})	Harvest index (%)
T_1 : 100% RDFN	4187	7497	4747	39.1
T_2 : 100% RDFN + 25% N - FYM	4618	7973	5291	40.0
T_3: 100% RDFN + 50% N - FYM	5095	8397	5979	41.6
T_4: 100% RDFN + 25% N - PM	4732	8077	5615	41.2
T_5: 100%RDFN + 50% N - PM	5156	8663	6353	42.6
T_6: 125% RDFN	4954	8365	5783	40.9
T_7: 125% RDFN + 25% N- FYM	5255	8968	6284	41.3
T_8: 125% RDFN + 50% N -FYM	5910	9348	6818	42.3
T_9: 125% RDFN + 25 % N – PM	5656	9144	6530	41.8
T_{10}:125%RDFN + 50% N-PM	6337	9825	7225	42.3
SEm±	256	280	261	1.2
CD	761	833	776	NS
CV%	8.6	5.6	7.5	4.9

by Raisi and Nejad (2012). Organic manures positively influenced the 1000 seed weight and no. of seeds per cob, which in turn increased the weight of seeds per cob. Shelling percentage of maize did not differ significantly between different treatments. Numerically higher and lower shelling percentage were observed in T_{10} (125%RDFN + 50% N-PM) and T_6 (125% RDFN).

Grain and stover yield

The data (Table 2) revealed that application of organic manures exerted significant influence on grain and stover yield of maize. The treatment which received 125% RDFN + 50% N through poultry manure (T_{10}) gave the highest grain yield (7225 kg ha^{-1}) and stover yield (9825 kg ha^{-1}) as compared to rest of the treatments. Application of 125% RDFN + 50% N through FYM (T_8) was identified as the next best treatment followed by 125% RDFN + 25 % N through poultry manure (T_9). However, the treatments were on par with each other. Significantly the lowest grain and stover yield of was recorded in 100% RDFN.

The increase in grain and stover yield under organic material treated plots might be due to continuous availability of nutrients for plants up to cob development which ultimately increased the grain yield (Farhad *et al.*, 2009). As compared to application of fertilizer nitrogen alone, its combined use with organic manures ensured optimum supply of essential nutrients at right time of crop requirement. Increased level of nitrogen either in sole inorganic nitrogen treatments or in integrated nitrogen treatments recorded higher 1000 seed weight, weight of seeds per cob, no. of seeds per cob and yield. This might be due to maize responds well to applied nitrogen. As a result of its well-developed root system, crop absorbed required nutrients from soil for effective dry matter production and translocation of photosynthates from leaves to the sink for better development of grains. The results are in conformity with the findings of Shilpashree *et al.* (2012). The higher yield in treatments where poultry manure was used as organic source instead of FYM can be attributed to the higher content of macro and micro nutrients in poultry manure as compared to FYM.

Increase in stover yield might have been on account of overall improvement in the vegetative growth of the plant due to the application of organic manures in combination with inorganic N fertilizer. Similar results were obtained from Makinde and

Table 4. Economics of maize as influenced by integrated nutrient management.

TREATMENTS	Cost of cultivation(Rs)	Gross returns(Rs)	Net returns (Rs)	BCR
T_1 : 100% RDFN	28794	64714	35920	1.2
T_2 : 100% RDFN + 25% N - FYM	31194	71976	40783	1.3
T_3: 100% RDFN + 50% N - FYM	33594	81086	47493	1.4
T_4: 100% RDFN + 25% N - PM	29419	76220	46801	1.6
T_5: 100%RDFN + 50% N - PM	30044	86056	56013	1.9
T_6: 125% RDFN	29159	78526	49367	1.6
T_7: 125% RDFN + 25% N- FYM	31559	85275	53716	1.7
T_8: 125% RDFN + 50% N -FYM	33959	92371	58411	1.7
T_9: 125% RDFN + 25 % N – PM	29784	88548	58764	2.0
T_{10}:125%RDFN + 50% N-PM	30409	97851	67442	2.2
SEm±		3424	3424	0.1
CD		10173	10173	0.3
CV%		7.2	11.5	11.6

Ayoola (2010) who reported that complementary application of organic and inorganic fertilizers is effective for the growth of maize and the development of the leaves. This might be due to addition of organic material which can markedly increase soil productivity by providing essential plant nutrients and by improving physical properties (Shah *et al*., 2010).

Economics

The maximum gross returns (Table 4) was obtained by T_{10} (125%RDFN + 50% N-PM) which gave Rs. 97851 followed by T_8 (125% RDFN + 50% N –FYM) with returns of Rs. 92371. Net returns from T_{10} (125%RDFN + 50% N-PM) was Rs. 67442 which with followed by T_9 (125% RDFN + 25% N –PM) was Rs. 58764. This can be attributed to higher yield from poultry manure treatments and lower cost of poultry manure than FYM. This was prominent in B: C ratio, as B: C ratio of FYM treatments ranged from 1.3 to 1.7 and poultry manure treatments ranged from 1.6 to 2.2. The highest B: C ratio (2.2) was observed in T_{10} (125%RDFN + 50% N-PM) while the lowest (1.2) was observed in T_1 (100% RDFN).

In conclusion, integrated application of inorganic nitrogen with poultry manure or FYM performed better with respect to productivity and economics of maize than application of only inorganic nitrogen.

LITERATURE CITED

BARC- Bangladesh Agricultural Research Council. *Fertilizer guide*. 2005.

Farhad W, Saleem M F, Cheema M A and Hammad H M 2009 Effect of poultry manure levels on the productivity of spring maize (*Zea mays* l.). *The Journal of Animal and Plant Sciences,* 19(3):122-125.

Garg S and Bahla G S 2008 Phosphorus availability to maize as influenced by organic manures and fertilizer P associated phosphatase activity in soils. *Bioresource Technology,* 99(13): 5773-5777.

Ma B L, Dwyer L M and Gregorich E G 1999 Soil nitrogen amendment effects on nitrogen uptake and grain yield of maize. *Agronomy Journal*, 9: 650– 656.

Makinde E A and Ayoola O T 2010 Growth, yield and npk uptake by maize with complementary organic and inorganic fertilizers. *African journal of food, agriculture, nutrition and development*, 10(3): 2203-2217

Ministry of Agriculture, Directorate of economics and statistics, Govt. of India. (2008-09).

Raisi M J and Nejad E T 2012 Effect of organic manure and foliar potassium application on yield performance of wheat cultivars (*Triticum aestivum L.*). *International Research Journal of Applied and Basic Sciences*, 3 (2): 286-291.

Shah A, Mohammad S, Jehan B, Wisal M, Mahmood S, Jan M T, Khan M J, Zahir S and Raziuddin 2010 Effect of integrated use of nitrogen on yield and N uptake of maize crop. *Pakistan Journal of Botany,* 42(5): 3633-3638.

Shilpashree V M, Chidanandappa H M, Jayaprakash R and Punitha B C 2012 Influence of Integrated Nutrient Management Practices on Productivity of Maize Crop. *Indian Journal of Fundamental and Applied Life Sciences,* 2 (1): 45 -50

(Received on 16.06.2012 and revised on 30.09.2012)