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RESEARCH PAPER

Integrated nutrient management in the maize (*Zea mays* L.) yield and soil properties

K.K. PANDEY* AND A. AWASTHI
Department of Agricultural Statistics, V.C.S.G. College of Horticulture, Uttarakhand University of Horticulture and Forestry, Bharsar, PAURI (UTTARAKHAND) INDIA
(Email : kkpandeystat@gmail.com)

Abstract : Low soil fertility is one of the bottlenecks to sustain agricultural production and productivity in India. Anthropogenic factors such as inappropriate land use systems, mono cropping, nutrient mining and inadequate supply of nutrients are aggravated the situation. A field experiment was conducted at experimental field of Narendra Dev University of Agriculture and Technology, Kumarganj, Faizabad during *Rabi* season on alluvial, clay soil under irrigated agro-ecosystem of Faizabad district of Uttar Pradesh. The experiment comprised of four treatment combinativns *viz.*, T_1 (Control), T_2 (RDF) T_3 (RDF +Zn) and T_4 (RDF +FYM 10 t ha^{-1}). The treatments were arranged in Randomized Completely Block Design with three replications. The grain yield was higher in T_4 (29.29 q ha^{-1}) followed by T_3 (28.59 q ha^{-1}). However, straw yield was higher in T_3 followed by T_4. The result revealed that ratio of grain and straw yield was good and highest in T_4 followed by T_2.Recommendation of the result was RDF along with FYM is suitable combination of yield as well as straw (fodder) for maize crop in eastern Uttar Pradesh.

Key Words : : FYM, RDF, Maize, Grain yield, Straw yield

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INTRODUCTION

Maize is third most important cereal in India after wheat and rice. Currently it is cultivated over 8.33millon ha with 16.88 million tonnes production having an average productivity of 2002 kg ha^{-1}, contributing nearly 8 per cent in national food basket. Chemical fertilizers can not be avoided completely since they are the potential source of high amount of nutrients in easily available forms. Most of the crops respond quickly to chemical fertilizers and give higher yield and maize is more responsive. But, continuous application of chemical fertilizers alone is not desirable as it has been reported to deteriorate soil health. At the same time, application of organic manures alone do not produce required yield due to their low nutrient status (Ravi *et al.*, 2012). Sustainable yield levels could be achieved only by applying appropriate combination of green manures or organic manures and chemical fertilizers (Verma, 1991; Obi and Ebo, 1995). Keeping these points in view, a field experiment was conducted to evolve a viable nutrient management system for quality maize in *Rabi* season. Low soil fertility is one of the bottlenecks to sustain agricultural production and productivity in India. Anthropogenic factors such as inappropriate land use systems, mono cropping and nutrient mining and inadequate supply of nutrients are aggravated the situation. Integrated nutrient management is an option to alleviate soil fertility problem as it utilize available organic and inorganic nutrients for sustainable agricultural production and productivity.

Introduction of high yielding varieties and expansion in area under assured irrigation have led to a major shift from organic based nutrient application to chemical fertilizers. However, these chemical fertilizers are costly and affect the soil health adversely, if not used as per recommendation. In such a situation, integrated nutrient management has been found to be quite promising not only in maintaining higher

*** Author for correspondence**

productivity but also in providing greater stability in crop production. So, an attempt has been made in the present investigation to evolve an efficient and economic INM package for cultivation of maize crop in the region.

MATERIAL AND METHODS

Geographically, the study site is located at Experimental Field of Narendra Dev University of Agriculture and Technology, Kumarganj, in Faizabad district of Eastern Plane Zone (EPZ) of Uttar Pradesh. The Latitude and Longitude of experimental site is, respectively, 26^0 47' N and 82^0 12' E and the mean sea level is 113 m. It has average annual rainfall of about 1002 mm and is liberally sourced by the Sarju (Ghaghra) river and its tributaries. Soils are deep alluvial, medium to medium heavy textured but are easily ploughable. The soils have pH 7.62 with medium value of organic carbon (OC 8 gkg^{-1}). Field trial was conducted during *Rabi* season of 2010-11to evolve INM package at, by taking two sources of nutrients *viz*., organic and inorganic.

The description of the material is given below:

Design of experiment : RCBD (Randomized Completely Block Design)

Number of treatment : 4

Number of replication : 5

Treatments : T_1 (Control), T_2 (RDF), T_3 (RDF+Zn) and T_4 (RDF +FYM 10 t ha^{-1})

Season : *Rabi*

The recommended dose of fertilizer for maize is 120 kg N, 60 kgP_2O_5 and 40 kg K_2O ha^{-1}. Fertilizer doses were calculated as per treatment and applied to each plot using urea, diammonium phosphate and muriate of potash. Entire dose of phosphorus and potassium and 33.33 per cent of nitrogen were applied at the time of sowing. Remaining 2/3 of the nitrogen was top dressed @ 33.33 per cent at 30th and 45th day after sowing in the form of urea.

RESULTS AND DISCUSSION

Application of FYM in conjugation with chemical fertilizers resulted in higher grain and straw yield over the RDF. The highest grain yield of maize (29.29 qha^{-1}) was recorded in the treatment T_4 (RDF+FYM) which was superior over the other treatments (Table 1). Among these treatments T_3 also recorded good result (28.59 qha^{-1}) than the 100% chemical fertilizer (T_2 RDF) (26.83 qha^{-1}) and control (T_1) (9.82 qha^{-1}). The maximum reduction in pH was recorded in T_4 (7.34) followed by T_2 (7.35) and T_3 (7.37).The reduction of Bulk Density (BD) was recorded highest in T_4 (1.30) followed by T_3(1.35). The decrease in EC might be attributed due to chelation of metals and non- metal ions and their less mobility in soil. EC also decreases maximum in T_3 (0.26) and T_1 (0.30) (Table 2). This decrease might also be due to increase in the permeability and thereby leaching of salts from the upper horizon of soil (Tan, 2002). Panwar (2008) reported positive effect of organic matter on intercropping with maize in mid hills of Meghalya.

The porosity (%) increased in T_4 (FYM treated soil) (47.46 %) followed by T_3 (45.73%) and T_2 (44.06%). The cat-ion exchange capacity (C.E.C.) recorded highest in T_4 (18.03) followed by T_3 (17.80) (Table 2). Application of FYM in combination with 100 per cent NPK resulted in maximum organic carbon; available N, P_2O_5 and Zn build up in soil. These results are in conformity with Kumar (2002). Dorji and Khan (2009) also reported same result on maize with intercropping of cowpea and residual effect on oats crop

Table 1: Effect of INM on yield and grain-straw ratio of maize

Treatments	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological yield (q ha^{-1})	Grain straw ratio
T_1 (Control)	9.82	20.16	29.98	0.48
T_2 (RDF)	26.83	37.26	64.09	0.72
T_3 (RDF + Zn)	28.59	40.86	69.45	0.69
T_4 (RDF + FYM)	29.29	36.28	65.57	0.81
S.E.±	0.95	0.62	1.58	0.011
C.D. (P=0.05)	2.87	1.86	4.75	0.035

Table 2 : Effect of INM on physico–chemical properties of soil

Treatments	pH	EC (dSm^{-1})	BD ($Mg\ m^{-3}$)	Porosity (%)	C.E.C. ($cmol(p^+)kg^{-1}$)
T_1 Control	7.38	0.30	1.40	44.00	17.66
T_2 RDF	7.35	0.33	1.40	44.06	16.10
T_3 RDF + Zn	7.37	0.26	1.35	45.73	17.80
T_4 RDF + FYM	7.34	0.31	1.30	47.46	18.03
S.E.±	0.069	0.014	0.017	0.73	0.35
C.D. (P=0.05)	NS	0.04	0.051	2.19	NS

NS=Non-significant

for irrigated agro-ecosystem of Kashmir Valley.

Increase in available P with the addition of FYM is might be due to enhanced activity of phosphorus solubilizing microbes in soil with appreciable quantity of organic matter in soil (Negassa *et al.,* 2007). Karforma *et al.* (2012) found the same result for maize in rainfed upland of tarai region of West Bengal. Sarwar *et al.* (2012) reported that effect of organic matter on maize yield along with nutrition uptake of plants. From the results of the present study, it may be inferred that maize crop for higher yield and higher quantity of straw needs to be inoculated with organic matter (FYM) in conjunction with fertilizer nitrogen (recommended dose) for higher yield and soil quality. Rao *et al.* (2010) found the positive result to increase the soil productivity with the help of integrated nutrient management.

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