

Assessment of Yield and Yield Attributing Characters of Hybrid Maize using Nutrient Expert® Maize Model in Eastern Terai of Nepal

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Abstract— Indiscriminate use of fertilizer and lack of site specific nutrient management technology is the main cause of low maize productivity in Nepal. Thus, field experiments on farmer's field were conducted on maize to assess the productivity at two sites of Jhapa district viz. Damak and Gauradaha using Nutrient Expert® Maize model from November 2015 to May 2016. The experiment was laid out in Randomized Completely Block Design consisting two treatments viz. NE (Nutrient Expert recommendation) and FFP (Farmer's Fertilizer Practice) with twenty replications. The result revealed significant differences in terms of grain yield, stover yield, biological yield, and yield attributing characters. NE based practices produced higher grain yield (9.22 t ha^{-1}), which was 86.6 percent higher than FFP (4.94 t ha^{-1}). Similarly, higher average cob number m^{-2} (8.2), average kernel rows cob^{-1} (14.2), average kernels number row^{-1} (589.9) and test weight (361.4 g) were recorded in NE based practice. Thus, NE based practice can be adopted for obtaining higher productivity in eastern terai region of Nepal.

Keywords— grain yield, maize, nutrient expert.

I. INTRODUCTION

Maize (*Zea mays* L.) is the second most important cereal crop after rice in Nepal. It is used as food, feed, fodder and raw materials for industries. It is cultivated in 891,583 hectares of land with production and productivity of 2,231,517 tons and 2.5 t ha^{-1} , respectively (MoAD, 2017). It is the major food crop in the hills of Nepal and accounts about 71% of maize production of the country (MoAD, 2017). The demand of maize grain has increased, but the productivity in farm level is almost stagnant around $2\text{--}2.5 \text{ t ha}^{-1}$ in last decade (MoAD, 2017). The farm level yield of maize (2.5 t ha^{-1}) is not satisfactory as compared to attainable yield (5.7 t ha^{-1}) in Nepal (MoAD, 2017; KC *et al.*, 2015). Indiscriminate use of fertilizer and lack of site specific nutrient management technology is the main cause

of low maize productivity in Nepal. Therefore, nutrient management is always the major concern in maize for increasing production in Nepal.

Site specific nutrient management (SSNM) is a plant based approach for supplying crops with nutrients in right amount and time. It strives to enable farmers to adjust fertilizer use dynamically to make up the deficit in nutrients needs between that required by a high-yielding crop and nutrient supply from naturally occurring indigenous sources (i.e. soil, crop residues, manures and irrigation water) (Ghimire *et al.*, 2015). Based on SSNM principles, a dynamic nutrient management tool, Nutrient Expert® (NE), was developed that can generate farm-specific fertilizer recommendation for maize (Majumdar *et al.*, 2014).

Many researches concerning about SSNM has been carried out around the globe. Similarly, Nutrient Expert has been tested earlier in India (Majumdar *et al.*, 2014), Indonesia and Philippines (Pampolino *et al.*, 2014) and found valid. But, In Nepal, limited research has been carried out concerning about SSNM and Nutrient Expert. Therefore, the present investigation is planned, executed and accomplished with the objective of assessing yield and yield attributing characters of maize using Nutrient Expert®-Maize.

II. MATERIALS AND METHODS

The study was carried out at two sites of Jhapa district viz. Damak and Gauradaha from November 2015 to May 2016. The experiment was laid out in single factorial Randomized Completely Block Design consisting two treatments viz. NE (Nutrient Expert recommendation) and FFP (Farmer's Fertilizer Practice) in twenty farmer's field, considering one farmer as one replication. The gross plot and net plot size for each treatment was maintained 100 m^2 and 10 m^2 , respectively. The NE plot consist the cultivation of maize under Nutrient Expert- Maize

recommended spacing, seed rate, fertilizer dose and other factors of production. FFP plot consist of maize cultivation under farmer's own practice of spacing, seed rate, fertilizer dose and other factors of production. Data of observations on yield attributing characters, grain yield and stover yield were recorded from net plot. These recorded data were tabulated in MS-Excel which was subjected to ANOVA (Gomez and Gomez, 1984), after analysis through GENSTAT-C, computer based program at 5% significance level. The grain yield was adjusted at 14% moisture level.

III. RESULTS AND DISCUSSION

3.1 Grain yield

The grain yield of maize was highly influenced by nutrient management practices (Table 1). The grain yield of maize under Nutrient Expert (NE) (9.22 t ha^{-1}) was highly significant than grain yield of maize under farmer's fertilizer practice (FFP) (4.94 t ha^{-1}). The significant increase in yield attributing characters under NE (Table 2) might be mainly responsible for obtaining the higher grain yield of maize under NE. The increase in grain yield of maize under SSNM based practices and NE was also reported in previous experiments (Kumar *et al.*, 2014; Majumdar *et al.*, 2014; Pampolino *et al.*, 2014; Chauhan, 2015; Kumar *et al.*, 2015a; Vikram *et al.*, 2015; Sinha, 2016). Further, it was revealed that NE produced 86.6% more grain yield than farmer's fertilizer practice. Similar results were also reported by previous researchers in their studies (Kumar *et al.*, 2015b; Pooniya *et al.*, 2015; Sinha, 2016).

Table.1: Grain yield and stover yield of maize as affected by nutrient management practices at Damak and Gauradaha, Jhapa, Nepal, 2015/16

Treatment	Grain Yield (t ha^{-1})	Stover Yield (t ha^{-1})	Biological yield (t ha^{-1})
NE	9.22	12.70	21.92
FFP	4.94	8.62	13.55
SEm (\pm)	0.14	0.24	0.28
LSD ($_{0.05}$)	0.413	0.699	0.827
P-value	<.001	<.001	<.001
CV (%)	8.8	9.9	7.0
Grand Mean	7.08	10.66	17.74

The higher yields in NE may be ascribed to efficient adjustments in applying nutrients to accommodate field specific needs of the crops for supplementing plant nutrients (Pooniya *et al.*, 2015). The increased availability of nutrients at critical physiological phases results in better translocation of photosynthates from source to sink, resulting better growth and yield attributing characters, and finally increasing the grain yield (Vikram *et al.*, 2015).

Similarly, broadcasting of seed in FFP had caused patchy growth of crop, characterized by improper spacing. This led to increased incidence of insect, pest and diseases in FFP, which also led to reduced grain yield.

3.2 Stover and biological yields

The stover yield was highly influenced by nutrient management practices (Table 1). The stover yield under NE was found to be 12.7 t ha^{-1} , which was highly significant than stover yield under farmer's practice (8.62 t ha^{-1}). Inadequate supply of nutrients in farmer's practice might have led to reduced plant height, leaf area, etc. due to improper growth and development, which in turn results the lower stover yield of maize. Higher stover yield of maize under SSNM based practice was also agreed by earlier experiments (Kumar *et al.*, 2015a; Kumar *et al.*, 2015b; Vikram *et al.*, 2015).

Similarly, the biological yield of maize under NE practice (21.92 t ha^{-1}) was significantly higher than farmer's practice (13.55 t ha^{-1}). The higher biological yield under NE practice was due to dynamic adjustment of fertilizer application rates based on crop requirement. Further, the judicious nutrient management under NE based nutrient management practice has led to the higher grain, stover and biological yield over farmer's practice of nutrient management and has clearly indicated its benefit. Higher biological yield under SSNM based practice was also reported by Kumar *et al.* (2015b).

3.3 Yield attributing characters

The result showed that yield attributing characters viz. average plant number per m^2 , average cob number per m^2 , average kernel row per cob, average kernel number per row, average kernel number per cob and test weight were highly influenced by nutrient management practices (Table 2). The average plant number per m^2 (7.6), average cob number per m^2 (8.2), average kernel row per cob (14.2), average kernel number per row (42.4), average kernel number per cob (589.9) and test weight (361.4 g) under NE practice was found to be highly significant than the farmer's fertilizer practice. Optimum plant population was found under NE due to recommendation from nutrient expert with proper spacing, whereas lower plant population in FFP was due to improper spacing and seed rate. The higher cob number per m^2 in NE practice was due to higher number of plants per m^2 . The difference in kernel number in row and cob under NE and FFP, although there is no difference in cob length (Table 2), suggest us that there was better translocation and assimilation of photosynthates from source to sink in NE practice. Further, it suggests us that lower kernel number in row and cob in FFP might be due to incomplete grain filling in the rows and cob under farmer's fertilizer

practice. Similar results were also obtained by various researchers in their experiments (Kumar *et al.*, 2014;

Chauhan, 2015; Kumar *et al.*, 2015a; Vikram *et al.*, 2015 and Sinha, 2016).

Table.2: Yield attributes of maize as affected by nutrient management practices at Damak and Gauradaha, Jhapa, Nepal, 2015/16

Treatment	Avg. Plant no. m ⁻²	Avg. Cob no. m ⁻²	Avg. Kernel row cob ⁻¹	Avg. Kernels no. row ⁻¹	Avg. Kernels no. cob ⁻¹	Test Weight (g)	Avg. Cob length (cm)
NE	7.6	8.2	14.2	42.4	589.9	361.4	18.1
FFP	5.5	5.8	13.4	38.6	502.4	310.4	17.3
SEm (±)	0.15	0.15	0.13	0.54	10.58	4.15	0.71
LSD (0.05)	0.431	0.446	0.378	1.601	31.310	12.270	ns
P-value	<.001	<.001	<.001	<.001	<.001	<.001	0.433
CV (%)	10	9.6	4.1	6	8.7	5.5	18
Grand Mean	6.51	7.01	13.82	40.47	546.1	335.9	17.67

IV. CONCLUSION

Indiscriminate use of fertilizer and lack of site specific nutrient management technology is the main cause of low maize productivity in Nepal. Therefore, nutrient management is always the major concern in maize for increasing production in Nepal. The productivity of maize was increased under NE based nutrient management practice. Thus, NE based practice can be adopted for obtaining higher productivity in eastern terai region and similar agro-climatic condition of Nepal.

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