Effect of Sowing Time and Integrated Nitrogen Management on Yield and Post-harvest Soil Nutrient Status of Black Glutinous Maize (*Zea mays* L.)

ABSTRACT

Aim: To study the effect of sowing time and integrated nitrogen management on yield and post-harvest soil nutrient status of black glutinous maize (*Zea mays* L.).

Study design: Factorial randomized block design (FRBD)

Place and Duration of Study: Experimental field of College of Agriculture, Central Agricultural University, Imphal, Manipur, pre-*kharif* season of 2018.

Methodology: The treatment consisted of four different integrated nitrogen management practices and three sowing dates.

Results: The result revealed that maximum cob length(16.97cm), cob girth(15.71cm), test weight(257g), grain yield (32.9 q/ha) and shelling % (80.31 %) was observed in the treatment N_3 (RDN- 75% through urea + 25% through FYM) among different integrated nitrogen management practices. The highest yield among different sowing dates was recorded on plants sown on 9th April (28.23 q/ha). The different integrated nitrogen management showed significant difference in residual nutrients and organic carbon in soil. Maximum available nitrogen (275.97 kg/ha), phosphorus (19.21 kg/ha), potassium (210.05 kg/ha) and organic carbon (1.10 %) were observed in treatment N_4 (RDN- 100% through FYM). Lowest values of nutrients under study were observed in treatment N_1 where the crop received only chemical fertilizer.

Key words: Black glutinous maize, sowing time, INM, yield, soil nutrient status.

1. INTRODUCTION

"Maize (*Zea mays* L.) is one of the most important cereal crops in the world's agricultural economy both as food for man and feed for animals. Maize has been an important cereal crop owing to its highest production potential and adaptability to wide range of environment hence called as 'Queen of Cereals' (Choudhari and Channappagouda)" [1]. "It can be grown in *kharif, rabi* and summer seasons.

Over 85 per cent of maize production in country is consumed as a source of human feed. In Manipur, it covers an area of 26.19 thousand hectares with a production of 57.94 million tonnes and productivity of 2240 kg/ha (Anon.,)" [2].

"Local glutinous maize is popular and commonly grown cultivar in Manipur. It has unique characteristic of soft and stickiness of kernel even though it is dried and stored for long time unlike the normal maize. Among the agro-techniques non-monetary inputs like sowing time and nutrient are the two management aspects to be considered for improving the yield of maize. Sowing at the right time will expose the maize crop to suitable weather elements required at different phenological stages resulting in better vegetative growth and yield. Highest productivity of crops in sustainable manner without deteriorating the soil and other natural resources could be achieved only by applying appropriate combination of different organic manures and inorganic fertilizers". [18]

2. MATERIALS AND METHODS

"The field experiment was undertaken during the pre-*kharif* season of 2018 at College of Agriculture, CAU, Imphal, Manipur to study the effect of sowing time and integrated nitrogen management on yield and post-harvest soil nutrient status of black glutinous maize (*Zea mays* L.). The experiment was laid out in factorial randomized block design (FRBD) with 12 treatments and 3 replications. The treatment consisted of four different integrated nitrogen management treatments and three sowing dates. FYM was applied 20 days before sowing as per treatment and well incorporated to the soil". [18]

Treatment details [18]

(a) Sowing time: 3

- S_1 – 1st March
- S_2 – 20th March
- S_3 – 9th April

(b) Nitrogen management: 4

- N_1 – RDN (100 % through urea)
- N_2 – RDN (50 % through urea + 50 % through FYM)
- N_3 – RDN (75 % through urea + 25% through FYM)
- N_4 – RDN (100 % through FYM)

*RDN-recommended dose of nitrogen *FYM-farm yard manure

3. RESULTS AND DISCUSSION

3.1 Effect of sowing time and integrated nitrogen management on yield and yield contributing factors of local glutinous maize

Integration of inorganic fertilizer and FYM influenced the cob length, cob girth, test weight, grain yield and shelling % and are presented in Table 1. The mean cob length (16.97 cm), cob girth (15.71 cm) and test weight (257g) were maximum and significantly more when crop was fertilized with RDN-75% through urea + 25% through FYM (N_3). The results are in accordance with the earlier finding of Rajeshwari *et al.* [3] and Jadhav [4]. "Owing to higher values yield attributes, the maximum grain yield (32.9 q/ha) was obtained in treatment N_3. The improved physical properties like water holding capacity and moisture retention provided a desirable soil condition for the root development, enhanced crop growth and yield" (Selvi *et al.*) [5]. The highest shelling % was recorded in treatment N_3 (80.31 %) and it was significantly superior to rest of the other treatments. The results are in agreement with the earlier findings of Zakkam [6]. "The highest mean cob length (15.5 cm) and cob girth (14.87 cm) was recorded in the plants sown on 9th April (S_3). Such variation among different sowing time" was also reported by Keerthi *et al.* [7]. Sowing at different time could not bring significant effect on test weight. Among the sowing dates, it could be seen from Table 1 that though sowing on 9th April (S_3) recorded the maximum grain yield (28.23 q/ha), however it remained at par to sowing on 20th March (S_2) but was significantly superior over sowing on 1st March (S_1). The grain yield improvement in third (S_3) and second sowing (S_2) may be attributed due to favourable climatic effect, specially temperature and rainfall as expressed in increase growth characters which resulted in more cob length, cob girth and test weight which ultimately significant increase in yield. The variation in among different sowing time was also supported by Verma [8] and Sulochana *et al.* [9].

Figure 1. View of cobs in treatment S_3N_3

Table 1. Effect of sowing time and integrated nitrogen management on yield and yield contributing factors of local glutinous maize

Treatment	Cob length (cm)	Cob girth (cm)	Test weight (g)	Grain yield (q/ha)	Shelling %
S: Sowing time					
S_1	14.60	13.61	247.08	25.65	77.52
S_2	15.20	14.51	250.17	27.49	78.55
S_3	15.50	14.87	253.08	28.23	79.22
SE d (±)	0.23	0.35	2.31	0.38	0.48
CD (P=0.05)	0.48	0.72	NS	0.78	1.00
N management					
N_1	14.75	13.91	248.00	24.67	77.82
N_2	15.91	14.80	253.89	30.15	79.04
N_3	16.97	15.71	257.00	32.90	80.31

N_4	12.76	12.89	241.56	20.78	76.53
SE d (±)	0.27	0.40	2.67	0.44	0.56
CD (P=0.05)	0.56	0.83	5.53	0.91	1.16

3.2 Effect of sowing time and integrated nitrogen management on post-harvest nutrient status of the soil

The different integrated nitrogen management showed significant difference in residual nutrients and organic carbon in soil as shown in Table 2. Maximum available nitrogen (275.97 kg/ha), phosphorus (19.21 kg/ha), potassium (210.05 kg/ha) and organic carbon (1.10 %) were observed in treatment N_4 (RDN- 100% through FYM). Lowest values of nutrients under study were observed in treatment N_1 where the crop received only chemical fertilizer. The increased in residual nutrients and organic carbon may be attributed to the contribution of nutrients from the organic pool. The benefit of organic manures on post-harvest available nutrients was also reported by Tetarwal *et al*. [10] and Ahmad *et al.* [11]. Though the residual available nutrients in soil was recorded highest in 9th April sowing but different sowing dates of maize could not bring significant effect in available nutrients of soil after the harvest of the crop. Interaction between sowing time and integrated nitrogen management could not show significant effect on the residual available nutrients and organic carbon content in the soil.

Table 2. **Residual available nutrient (kg/ha) and organic carbon (%) in soil as influenced by sowing time and integrated nitrogen management**

Treatments	**Available N (kg/ha)**	**Available P_2O_5 (kg/ha)**	**Available K_2O (kg/ha)**	**Organic carbon (%)**
S: Sowing time				
S_1	252.45	18.47	198.57	0.97
S_2	257.67	18.64	200.24	0.98
S_3	262.38	18.74	201.88	0.99
SE.d (±)	5.23	0.14	1.79	0.01
C.D. (P=0.05)	NS	NS	NS	NS
N management				
N_1	239.73	18.05	186.84	0.82
N_2	264.12	18.78	204.21	1.03
N_3	250.18	18.41	199.81	0.96
N_4	275.97	19.21	210.05	1.10
SE.d (±)	6.03	0.17	2.06	0.02
CD (P=0.05)	12.51	0.34	4.28	0.03

Integrated nitrogen management, which includes the use of both chemical fertilizers and organic sources of nitrogen, has been shown to improve the yield and post-harvest soil nutrient status of black glutinous maize. The use of organic sources of nitrogen, such as compost or livestock manure, can help to improve soil fertility and promote the growth of microorganisms that aid in nutrient uptake by the plant [12]. Chemical fertilizers, on the other hand, can provide a quick release of nitrogen, which is essential for the growth and development of the plant [13,14]. However, an excessive use of chemical fertilizers can lead to nutrient imbalance in the soil and result in poor post-harvest soil nutrient status. Therefore, an integrated nitrogen management approach that balances the use of chemical fertilizers and organic sources of nitrogen is recommended for black glutinous maize cultivation [15,16,17].

In conclusion, sowing time and integrated nitrogen management are two important factors that affect the yield and post-harvest soil nutrient status of black glutinous maize. Early sowing and an integrated nitrogen management approach that balances the use of chemical fertilizers and organic sources of nitrogen are recommended for optimal crop production. Further research is needed to determine the best sowing time and integrated nitrogen management practices for black glutinous maize cultivation in specific regions of India.

4. CONCLUSION

In conclusion, sowing time and integrated nitrogen management are two important factors that affect the yield and post-harvest soil nutrient status of black glutinous maize. Sowing at right time and an integrated nitrogen management approach that balances the use of chemical fertilizers and organic sources of nitrogen are recommended for optimal crop production. Further research is needed to determine the best sowing time and integrated nitrogen management practices for black glutinous maize cultivation in specific regions of India.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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