Indian Journal of Agronomy **70** (1): 109–112 (March 2025)
DOI: 10.59797/ija.v70.i1.5589

Research Communication

Effect of organic supplements and inorganic nutrients levels on productivity and quality of maize in acidic soil

HUCHCHAPPA JAMAKHANDI[1], SHIVA DHAR[2], S.S. RATHORE[3], LOHIT K. BAISHYA[4], SUNIL MANDI[5], SUDARSHAN S[6], PRAKASH SONNAD[7] AND CHANDRAKANT YADAV[8]

ICAR-Indian Agricultural Research Institute, New Delhi 110 012

Received: September 2024; Revised accepted: January 2025

ABSTRACT

The field experiment was conducted at the experimental farm of ICAR–Indian Agricultural Research Institute, Assam to evaluate the effect of organic supplements and inorganic nutrients levels on growth, productivity and quality of maize in acidic soil of upper Assam during *kharif* season of 2023. The experiment was laid out in split plot design with three replications and consists three organic supplements (Control, FYM @ 10 t/ha and Vermicompost @ 2.5 t/ha) in main plots and four inorganic nutrients levels along with lime @ 300 kg/ha (Control, 50% RDF (NPK), 75% RDF (NPK) and 100% RDF (NPK)) in sub plots. Results indicate that among three organic supplements, application of FYM @10 t/ha showed higher dry matter accumulation (1150.1g/m^2) at 60 DAS, grain (4.47 t/ha), stover (8.18 t/ha) and biological yield (12.54 t/ha), N (1.48% and 0.89%), P (0.27% and 0.17%) and K (0.45% and 1.56%) concentration in grain and stover, respectively and higher crude protein content (9.27%). Among the inorganic nutrients levels, application of 100% RDF(NPK) proved best in respect to dry matter accumulation (1145.1 g/m^2) at 60 DAS, grain yield (4.43 t/ha), stover yield (8.17 t/ha), biological yield (12.6 t/ha) and the N (1.53% and 0.91%), P (0.29% and 0.19%), K (0.44% and 1.56%) concentration in grain and stover, respectively and crude protein content in grain (9.54%).

Key words: Grain yield, Inorganic nutrients, Organic supplements, Quality Protein Maize

Maize (*Zea mays* L.) ranks as the world's third most important cereal crop used as staple food for humans, feed for animals and preparation of diverse industrial products. Maize being a photo-insensitive crop, has better option for adaptation in the changing climatic scenario (Sarangi *et al*., 2017). Along with rice and wheat, maize accounts for at least 30% of the food needs in 94 developing nations (Ray *et al*., 2017). In India and specifically in Assam maize is mainly cultivated for human consumption, but there is a rising demand for it as poultry feed and fodder (Jamakhandi *et al*., 2024). In Assam, the soil and climate conditions are favourable for growing maize. Despite this, the area under maize cultivation and its productivity are relatively low compared to other Indian states, with only about 32,000 hectares in use, an average yield of 3.25 tons/ha, and a total production of 1,05,003 tons.

Maize significantly depletes more soil nutrients compared to other cereals (Sarkar *et al.,* 2018). Proper N management is one of the important factors to sustain higher yield of maize (Sarangi *et al*., 2020). Managing plant nutrition is key to regulating crop yields, but soil fertility varies across different locations and times, from individual fields to entire regions (Kolawole *et al.,* 2018). Therefore, it's essential to develop nutrient management systems that are balanced and tailored to specific locations, ensuring soil health while maintaining crop productivity. Therefore, a field experiment was conducted to evaluate the effect of organic supplements and inorganic nutrients levels on productivity and quality of maize.

The field experiment was conducted during *Kharif* season of 2023 at the experimental farm of ICAR-Indian Agricultural Research Institute (IARI), Assam, India. The soil of experimental field was sandy loam, comprising 70.5% sand, 11% silt, and 18.4% clay, with an electrical conductivity of 0.12 dS/m, acidic in reaction with a *p*H of 4.84, bulk density (1.31 g/cm^3), high in organic carbon (1.18%), low available nitrogen (197.6 kg/ha) and avail-

Based on a part of M.Sc. Thesis of the first author submitted to the Post Graduate School, ICAR-Indian Agricultural Research Institute, New Delhi in 2024 (unpublished)

[1]Corresponding author's Email: huchchappajamakhandi@gmail.com
[1,8]Ph.D. Student, [2,3]Principal Scientists, [6,7]Ph.D. Scholars Division of Agronomy, ICAR-Indian Agricultural Research Institute, New Delhi 110 012; [4,5]Scientists, Division of Agronomy, IARI, Assam 787 034

able phosphorus (9.26 kg/ha) and moderate in available potassium (121.8 kg/ha). The experiment was conducted in a split-plot design with three organic supplements (Control-no organic supplement, FYM at 10 t/ha and vermicompost at 2.5 t/ha) in main plot and four inorganic nutrients levels (control, 50% RDF(NPK), 75% RDF(NPK) and 100% RDF(NPK) along with 300 kg lime/ha with all levels) in subplot and replicated thrice. The FYM consisted 0.5% N, 0.2% P, and 0.5% K was applied 15 days before sowing. The vermicompost was applied just before sowing consisting 1.5% N, 0.8% P, and 1.5% K. The recommended fertilizer dose of 60:40:40 kg/ha of N, P_2O_5, and K_2O was applied using urea, di-ammonium phosphate (DAP), and muriate of potash (MOP).

Maize hybrid 'LQMH-1' was sown on August 3, 2023, in rows spaced 60 cm apart, with a plant-to-plant distance of 20 cm and a seed rate of 20 kg/ha. The all-other standard agronomic practices were followed as per the recommendation. Key crop parameters were recorded using established methodologies (Rana *et al*., 2014). Soil nutrient levels were determined through standard procedures, *viz*. Subbiah and Asija (1954) for available nitrogen, Bray and Kurtz method for available phosphorus, and Jackson (1973) for available potassium. The collected data were analysed statistically using analysis of variance (ANOVA) with OPSTAT software. The standard error of the mean and least significant difference (LSD) at a 5% significance level were calculated for each treatment, allowing for the comparison of treatment means.

Dry matter accumulation: Data in Table 1 indicate that dry matter accumulation was significantly affected at 30 and 60 days after sowing (DAS) due to organic supplements and inorganic nutrients levels. Significantly higher dry matter accumulation (DMA) (301.1 and 1150.1 g/m^2) was obtained from the application of 10 t FYM/ha as compared to control and vermicompost @ 2.5 t/ha at 60 DAS. However, vermicompost @ 2.5 t/ha (295.2 g/m^2) was at par with FYM @10 t/ha at 30 DAS. The lowest DMA was obtained from control at both stages. It might be due to uniform soil moisture due to high water holding capacity of FYM during crop growth period providing optimum conditions for boosting photosynthesis and increasing plant dry matter accumulation (Kumar *et al*., 2017). DMA was also affected significantly due to inorganic nutrients levels at 30 and 60 DAS. Application of 100% RDF recorded significantly higher DMA (437.1 and 1145.1 g/m^2) as compared to 75% RDF, 50% RDF and control at both the stages. This may be due to progressive increase in canopy development and plant height with the increasing level of nutrients application likely led to greater interception, absorption and utilization of radiant energy, which subsequently improved overall growth, photosynthesis, CGR and RGR, LAI, and ultimately dry matter at successive growth stages. These outcomes consistent with the findings of Suthar *et al.* (2012) and Choudhary *et al*. (2013).

The interaction between organic supplements and inorganic nutrients levels for dry matter accumulation at 60 DAS was significant (Fig 1). The highest DMA (1487.2 g/m^2) was obtained by applying 10 t FYM/ha with 100% RDF, which was significantly higher than the other treatment combinations. This combination was at par with FYM @ 10 t/ha with 75% RDF.

Table 1. Effect of organic supplements and inorganic nutrients levels on dry-matter accumulation at 30 and 60 DAS, yields (t/ha), harvest index (%), shelling (%), and pH of soil after crop harvest

Treatment	Dry matter accumulation (g/m^2)		Grain yield (t/ha)	Stover yield (t/ha)	Biological yield (t/ha)	Harvest Index (%)	Shelling (%)	*p*H of soil after crop harvest
	30 DAS	60 DAS						
Organic supplements (03)								
Control	224.6	615.1	3.30	6.53	9.83	33.4	67.9	4.89
FYM @ 10 t/ha	301.1	1150.1	4.37	8.18	12.54	34.8	71.5	5.29
Vermicompost @ 2.5 t/ha	295.2	1039.4	4.19	7.90	12.08	34.6	70.8	5.20
SEm±	5.62	22.14	0.05	0.10	0.13	0.42	0.72	0.12
CD (P=0.05)	22.04	86.91	0.21	0.40	0.50	NS	2.82	NS
Inorganic nutrients levels (04)								
Control	184.1	678.9	3.33	6.57	9.90	33.4	68.8	5.06
50% RDF(NPK)	219.3	838.3	3.83	7.53	11.36	33.7	69.9	5.10
75% RDF(NPK)	254.1	1077.2	4.21	7.86	12.08	34.9	70.2	5.14
100% RDF(NPK)	437.1	1145.1	4.43	8.17	12.60	35.1	71.4	5.20
SEm±	7.81	19.19	0.06	0.10	0.12	0.43	1.15	0.14
CD (P=0.05)	23.19	57.03	0.18	0.29	0.37	1.29	NS	NS
Interaction	NS	S	S	S	S	NS	NS	NS

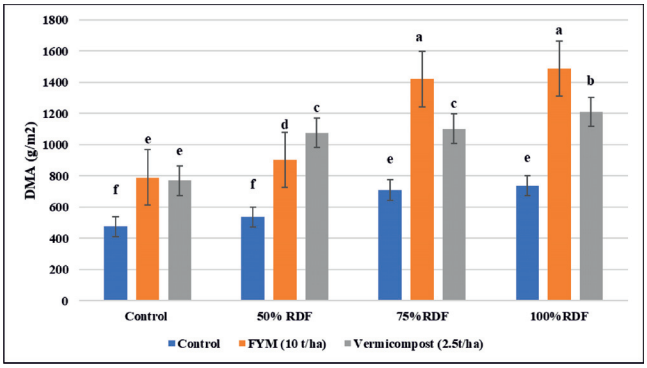

Fig. 1. Interaction effect of organic supplements and inorganic nutrients levels on dry matter accumulation (g/m^2) at 60 DAS

Yields: Grain, stover and biological yield were significantly influenced by organic supplements and inorganic nutrients levels (Table 1). The application of 10 t FYM/ha recorded significantly highest grain (4.37 t/ha), stover (8.18 t/ha) and biological yield (12.54 t/ha) as compared to vermicompost @ 2.5 t/ha and control. However, it was at par with vermicompost @ 2.5 t/ha. The application of 10 t FYM/ha produced 4.29% and 32.42% more grain yield over 2.5 t vermicompost/ha (4.19 t/ha) and control (3.3 t/ha), respectively. This may be attributed to improved soil moisture content, increased nutrient availability, better nutrient uptake, sustained nutrient supply and enhanced protection from erosion compared to the control treatment (Ali *et al.,* 2020). Among the inorganic nutrients levels, 100% RDF(NPK) recorded significantly highest grain yield (4.43 t/ha), stover yield (8.17 t/ha) and biological yield (12.60 t/ha) as compared to 75% RDF(NPK), 50% RDF(NPK) and control. The positive response of QPM varieties to primary nutrient fertilization aligns closely with the findings of Choudhary *et al*. (2013). Application of lime to decrease soil acidity and reduce the harmful levels of manganese (Mn) and aluminium (Al) is crucial for improving crop yields in acidic soils (Mokidul *et al*., 2021).

Harvest index (%): Harvest index (HI) was non-significant with organic supplements while inorganic nutrients management levels recorded significant effect on HI (Table 1). Among organic supplements, the maximum HI was recorded with FYM @ 10 t/ha (34.8%) followed by vermicompost @ 2.5 t/ha (34.6%). Among inorganic nutrients levels, the maximum HI recorded with 100% RDF (NPK) (35.1%).

Shelling (%): Shelling (%) was significantly influenced due to organic supplements while inorganic nutrients levels recorded non-significant effect (Table 1). Although the highest shelling (%) was recorded with FYM @ 10 t/ha in main plots and 100% RDF(NPK) in sub plots.

pH of soil after crop harvest: pH was not significantly influenced by organic supplements and inorganic nutrients management levels (Table 1). The application of 10 t FYM/ha recorded the highest pH (5.29) as compared to vermicompost @ 2.5 t/ha and control. Among the inorganic nutrients management levels, 100% RDF with lime @ 300 kg/ha recorded highest pH (5.2) as compared to 75% RDF with lime @ 300 kg/ha, 50% RDF with lime @ 300 kg/ha and control with lime @ 300 kg/ha.

N, P, K concentration and crude protein content: Nitrogen, phosphorous and potassium concentration in grain and stover was significantly influenced by organic supplements

Table 2. Effect of organic supplements and inorganic nutrients levels on N, P and K concentration in grain and stover and crude protein content in grain (%)

Treatment	N concentration (%)		P concentration (%)		K concentration (%)		Crude protein content in Grain (%)
	Grain	Stover	Grain	Stover	Grain	Stover	
Organic supplements (03)							
Control	1.34	0.79	0.242	0.168	0.34	1.41	8.39
FYM @ 10 t/ha	1.48	0.89	0.271	0.176	0.45	1.51	9.27
Vermicompost @ 2.5 t/ha	1.43	0.87	0.263	0.174	0.42	1.56	8.95
SEm±	0.05	0.02	0.005	0.003	0.01	0.02	0.31
CD (P=0.05)	NS	0.06	0.022	NS	0.05	0.10	NS
Inorganic nutrients levels (04)							
Control	1.32	0.78	0.231	0.158	0.37	1.40	8.23
50% RDF(NPK)	1.38	0.83	0.245	0.161	0.39	1.48	8.65
75% RDF(NPK)	1.45	0.88	0.269	0.177	0.41	1.53	9.05
100% RDF(NPK)	1.53	0.91	0.289	0.195	0.44	1.56	9.54
SEm±	0.04	0.03	0.007	0.004	0.01	0.04	0.27
CD (P=0.05)	0.13	0.08	0.021	0.01	0.03	0.11	0.81

and inorganic nutrients levels (Table 2). Among organic supplements, the application of 10 t FYM/ha recorded significantly higher nitrogen concentration in grain (1.48%) and stover (0.89%), higher phosphorous concentration in grain (0.27%) and stover (0.18%), higher potassium concentration in grain (0.45%) and stover (1.56%) and higher crude protein content in grain (9.27%) as compared to vermicompost @ 2.5 t/ha and control. However, it was at par with vermicompost @ 2.5 t/ha. These findings are consistent with the observations of Yadav *et al*. (2013), who concluded that the application of organic manures significantly improved N, P, and K content and uptake. Among the inorganic nutrients levels, 100% RDF (NPK) recorded significantly higher nitrogen concentration in grain (1.53%) and stover (0.91%), higher phosphorous concentration in grain (0.289%) and stover (0.195%), higher potassium concentration in grain (0.44%) and stover (1.56%) and higher crude protein content in grain (9.54%) as compared to 75% RDF (NPK), 50% RDF (NPK) and control. It was at par with 75% RDF (NPK). The control recorded the significantly lowest nitrogen, phosphorous and potassium concentration in grain and stover. The application of 100% RDF (NPK) resulted in 15.9% more protein content in grain over control. The notable improvement in the nutritional status of grain and stover can be attributed to the increased availability of nutrients in the soil, along with their enhanced extraction and translocation within the plant system. These findings are in line with the work of Dhaka *et al*. (2014).

The findings suggested that application of 10 tonne FYM/ha and 100% RDF (NPK) could significantly enhance maize growth and yield in the acidic soil.

REFERENCES

Ali, N., Khan, M.N., Ashraf, M.S., Ijaz, S., Saeed-ur-Rehman, H., Abdullah, M., and Farooq, M. 2020. Influence of different organic manures and their combinations on productivity and quality of bread wheat. *Journal of Soil Science and Plant Nutrition* **20**: 1,949–1,960.

Chaudhary, R., Singh, D. and Nepalia, V. 2013. Productivity and economics of quality protein maize (*Zea mays*) as influenced by nitrogen levels, its scheduling and sulphur application. *Indian Journal of Agronomy* **58**(3): 340–343.

Dhaka, S.K. 2014. Performance of sweet corn *(Zea mays. L.* Ssp. Saccharata*)* varieties at varying fertility levels (Doctoral dissertation, MPUAT, Udaipur).

Jamakhandi, H., Dhar, S., Rathore, S.S., Mandi, S., Baishaya, L.K., Sudarshan, S and Sonnad, P. 2024. Response of maize to nutrients sources in acidic soil of Upper Assam. *Annals of Agricultural Research* **45**(3): 219–223.

Kolawole, G.O., Eniola, O. and Oyeyiola, Y.B. 2018. Effects of nutrients omission on maize growth and nutrient uptake in three dominant soil types of southwestern Nigeria. *Journal of Plant nutrition* **41**(15): 1,903–1,915.

Kumar, S.S., Prasad, P. and Rajak, D. 2017. Integrated nutrient management on productivity and profitability of maize. *International Journal of Current Microbiology and Applied Sciences* **6**: 3,878–3,882.

Mokidul, I. and Munda, G.C. 2012. Effect of organic and inorganic fertilizers on growth, productivity, nutrient uptake and economics of maize (*Zea mays* L.) and *toria* (*Brassica campestris* L.). *Agricultural Science Research Journal* **2**: 470–479.

Rana, K.S., Choudhary, A.K., Sepat, S., Bana, R.S. and Dass, A. 2014. Methodological and Analytical Agronomy, pp. 276. Post Graduate School, Indian Agricultural Research Institute, New Delhi, India.

Ray, K., Banerjee, H., Bhattacharyya, K., Dutta, S., Phonglosa, A., Pari, A and Sarkar, S. 2017. Site-specific nutrient management for maize hybrids in an inceptisol of West Bengal, *Indian Journal of Experimental Agriculture* **54**: 874–887.

Sarangi, S.K., Maji, B., Mandal, U.K., Mandal. S. and Sharma, P.C. 2017. Effect of establishment methods in rainy season (*kharif*) and tillage practices in winter season (*rabi*) on yield and economics of rice (*Oryza sativa*)–maize (*Zea mays*) cropping system under coastal saline ecosystem. *Indian Journal of Agronomy* **62**(4): 407–416.

Sarangi, S.K., Singh, S., Srivastava, A.K., Choudhary, M., Mandal, U.K., Lama, T.D., Mahanta, K.K., Kumar, V., Sharma, P.C. and Ismail, A.M. 2020. Crop and residue management improves productivity and profitability of rice–maize system in salt-affected rainfed lowlands of East India. *Agronomy* 10, 2019, DOI: 10.3390/agronomy10122019.

Sarkar, D., Baishya, L.K., Meitei, C.B., Naorem, G.C., Thokchom, R.C., Singh, J., Bhuvaneswari, S., Batabyal, K., Das, R. and Padhan, D., 2018. Can sustainability of maize-mustard cropping system be achieved through balanced nutrient management. *Field Crops Research* **225**: 9–21.

Suthar, M. 2012. Performance of sweet corn *(Zea mays. L. ssp. Saccharata)* varieties at varying fertility levels (Doctoral dissertation, MPUAT, Udaipur).

Yadav, S.K., Yogeshwar, S., Yadav, M.K., Subhash, B. and Kalyan, S. 2013. Effect of organic nitrogen sources on yield, nutrient uptake and soil health under rice (*Oryza sativa*) based cropping sequence. *Indian Journal of Agricultural Sciences* **83**(2): 170–175