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STUDIES ON THE EFFECT OF MOISTURE CONSERVATION TECHNIQUES AND INTEGRATED NUTRIENTS MANAGEMENT IN *KHARIF* MAIZE (*Zea mays* L.)

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ABSTRACT

A field experiment was carried out during *kharif* season of 2024 and 2025 at Student Instructional Farm (SIF) of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.), India. The soil of experimental field was silt loam in texture, slightly saline in reaction, low in available nitrogen and organic carbon, medium in available phosphorus, potassium and zinc. The experiment was comprised of three moisture conservation practices viz., no mulch (M_1), dust mulching (M_2) and crop stubble mulching @ 15 ton ha^{-1} (M_3) in main plots and five treatments of nutrient management of soil and foliar applied RDF (150kg N, 60kg P_2O_5, 40kg K_2O) + 25kg $ZnSO_4$ (N_1), 75% RDF + 2.5t FYM + 25kg $ZnSO_4$ (N_2), 75% RDF + 2.5t FYM + Zn spray 2% (N_3), 75% RDF + 1.5t vermicompost (N_4) and 75% RDF + 1.5t vermicompost + Zn spray 2% (N_5) in sub plots. The experiment was laid out in split plot design with tree replication. The result revealed that the application of crop stubble mulch @ 15 t/ha along with 75% RDF + 2.5t FYM + 25kg $ZnSO_4$ (N_2) recorded significantly higher quality parameters and yield as compared to control during both the years.

Keyword **:** Moisture conservation practices, Nutrient management, FYM, Vermicompost, RDF.

Introduction

Maize (*Zea mays* L.) is one of the most important cereal crops belonging to the grass family Poaceae with its origin in Central America. Maize is a versatile crop grown over a range of agro climatic conditions. In fact, the suitability of maize to diverse environments is unmatched by any other crop. At present, nearly 1147.7 million MT of maize is being produced together by over 170 countries from an area of about 193.7 million ha with average productivity of 5.75 t/ha (FAOSTAT, 2021). Over 70% of *kharif* maize area is grown under the rainfed condition with a prevalence of many biotic and abiotic stresses. Moisture conservation practices have been widely used as an important management tool in which, application of organic residues helps in improving the proper growth and development of crops due to conserving the soil moisture and also the enhanced productivity of the crop (Singh *et al*., 2012 and Tetarwal *et al*., 2012). Moisture conservation could be greatly increased by imposition of mulches on soil surface (Singh *et al*., 2014). For increasing moisture conservation and yield, mulching is the appropriate agronomic management practice. There is need to adopt agronomic management practices that limit evaporation losses, reduce runoff and weed growth, increase infiltration, soil moisture content, organic matter content, facilitate nutrients availability in soil, higher crop productivity and water use efficiency.

Materials and Methods

A field experiment was carried out during *kharif* season of 2024 and 2025 at Student Instructional Farm (SIF) of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.), India. The soil of experimental field was silt loam in texture, slightly saline in reaction, low in available nitrogen (215 and 220 kg/ha) and organic carbon (0.60 and 0.62%), medium in available phosphorus (20.5 and 21.6 kg/ha), potassium (201 and 202 kg/ha) and zinc (0.711 and 0.714 mg/ha). The main-plot treatment consisted of 3 moisture conservation practices viz., no mulch, dust mulching and crop stubble mulching @ 15 ton ha^{-1}. The sub plots treatment also consisted of 5 doses of nutrient management of soil and foliar applied RDF (150kg N, 60kg P_2O_5, 40kg K_2O) + 25kg $ZnSO_4$, 75% RDF + 2.5t FYM + 25kg $ZnSO_4$, 75% RDF + 2.5t FYM + Zn spray 2%, 75% RDF + 1.5t vermicompost and 75% RDF + 1.5t vermicompost + Zn spray 2%. The maize variety Dharti was used as a test crop which with a dose of 25 kg/ha sown in line mark at 60 cm row to row and 20 cm of plant to plant distance. A common dose of 150 kg N, 60 kg P_2O_5, and 60 kg K_2O/ha was applied in the form of urea, DAP and murate of potash, respectively. All other agronomic practices were applied equally to each experimental plot except mulching practices and nutrient management and foliar application during both the years. Three irrigations were applied to each treatment.

Grain yield (t/ha)

Produce of net plot were sun dried threshed, cleaned and weighed in kilograms. The yield thus recorded was standardizing to 14% moisture and then converted into t/ha. A comprised diplomat sample of 500 g grains were taken and dried at 65 ± 2 0C in hot air drier to find out moisture content and do moisture adjustment accordingly.

Stover yield (t/ha)

The maize stalks of the net plot were cut close to the ground with the help of sickle and weight of stover obtained from the net plot area was recorded in kilograms. Finally, the stover yield was computed on hectare basis using the dry matter content on oven dry weight basis and expressed in t/ha.

Protein content and yield

The crude protein content in maize grains were calculated by multiplying the nitrogen percentage in grains with a factor 6.25 as,

Grains protein content (%) = Nitrogen content in grains (%) x 6.25

Protein yield was computed by using following formula:

Protein yield (kg/ha) = Protein content (%) x Grain yield (q/ha) 100

Results and Discussion

Quality parameters

Quality parameters viz., protein content (%) and protein yield significantly influenced by moisture conservation practices and soil applied nutrient management along with foliar application both years. Among moisture conservation practices, application of crop stubble mulch (M_3) @ 15 t/ha was recorded significantly maximum protein content (10.03 and 10.05 %) and protein yield (464.39 and 467.63 kg/ha) followed by dust mulch (M_2) during first and second year, respectively. Although these treatments remained on par to each other produced significantly more quality parameters as compared to no mulch (M_1). However, the significantly lowest protein content (9.89 and 9.91%) and protein yield (433.48 and 436.54 kg/ha) was recorded with no mulch (M_1) during 2024 and 2025, respectively. In the current study, an enhancement in protein content was noted due to higher N content in grain, which is related to elevated nitrogen availability in the soil due to crop residue decomposition. Although, nitrogen is a fundamental component of amino acids, which form the basis of protein, increased nitrogen levels in the seed are directly responsible for higher protein levels. Soil applied nutrient (kg/ha) along with foliar caused significant variation in protein content (%) and protein yield (kg/ha) in maize during both the years. The average protein content and protein yield varied from 9.89 to 10.45 and 9.91 to 10.52, 433.48 to 646.75 and 436.54 to 657.82 kg/ha, respectively, being highest with the application N_2 followed by N_5 during both the years. Although, these treatments remained at par to each other produces significantly more protein content and protein yield as compared to control (N_1) during both the years.

Yield

It is obvious from the data that the moisture conservation practices affected the grain and stover yield significantly during both the years. The highest grain (4630 and 4653 kg/ha) and stover yield (8339 and 8344 kg/ha) was recorded under crop stubble mulch (M_3) which superior over no mulch (M_1) during both the years. However, the minimum grain (4383 and 4405 kg/ha) and stover yield (80489 and 8073 kg/ha) was recorded in no mulch (M_1) during first and second year, respectively. The increased grain yield with crop

stubble mulch could be attributed to increased moisture availability and the addition of organic matter. Rapid decomposition of organic residues increased the nutrient availability, leading to an improvement in growth and yield attributes, better translocation of photosynthates toward sink and source ultimately grain and stover yield/ha.

Among the nutrient management practices, significantly maximum grain yield (6,189 and 6,253 kg/ha) and stover yield (10,227 and 10,289 kg/ha) were recorded with treatment (N_2) during 2024 and 2025, respectively. This treatment proved significantly superior to all other treatments, including (N_5), across both years. Conversely, the minimum grain yield (5,384 and 5,395 kg/ha) and stover yield (9,487 and 9,508 kg/ha) were recorded under (N_4).

Regarding quality parameters (N_2) also recorded the highest protein content (10.45% and 10.52%) and protein yield (646.75 and 657.82 kg/ha). While (N_2) was significantly superior to all treatments for protein content, it was statistically on par with (N_5) (628.49 and 633.31 kg/ha) for protein yield during both years. The lowest quality values were consistently recorded under (N_4).

The enhancement in yield and quality with balanced nutrient management (N_2) might be due to the synergistic effect of nitrogen and zinc, which enhances chlorophyll synthesis, metabolic activities, and nutrient uptake, ultimately resulting in better carbohydrate synthesis and higher protein accumulation in maize grains.

Table 1: Effect of moisture conservation practices and soil applied zinc on yield and quality parameters of maize during 2024 and 2025

Treatments	Grain yield (kg/ha)		Stover yield (kg/ha)		Protein content (%)		Protein yield Kg/ha	
	2024	2025	2024	2025	2024	2025	2024	2025
Moisture conservation practices								
M_1	4383	4405	8048	8073	9.89	9.91	433.48	436.54
M_2	4410	4485	8082	8220	9.91	9.93	437.03	445.36
M_3	4630	4653	8339	8344	10.03	10.05	464.39	467.63
SEm±	11.14	12.67	1.99	2.13	0.04	0.05	10.81	10.34
CD (P=0.05)	32.44	31.76	5.79	6.82	0.12	0.17	25.43	27.29
Nutrient management								
N_1	5586	5619	9760	9733	10.25	10.26	572.57	576.51
N_2	6189	6253	10227	10289	10.45	10.52	646.75	657.82
N_3	5861	5950	9894	10001	10.27	10.30	601.92	612.85
N_4	5384	5395	9487	9508	10.14	10.14	545.94	547.05
N_5	6090	6113	10063	10101	10.32	10.36	628.49	633.31
SEm±	14.38	13.84	2.56	2.75	0.06	0.06	9.45	10.15
CD (P=0.05)	41.88	39.36	7.48	8.96	0.14	0.16	29.48	28.62

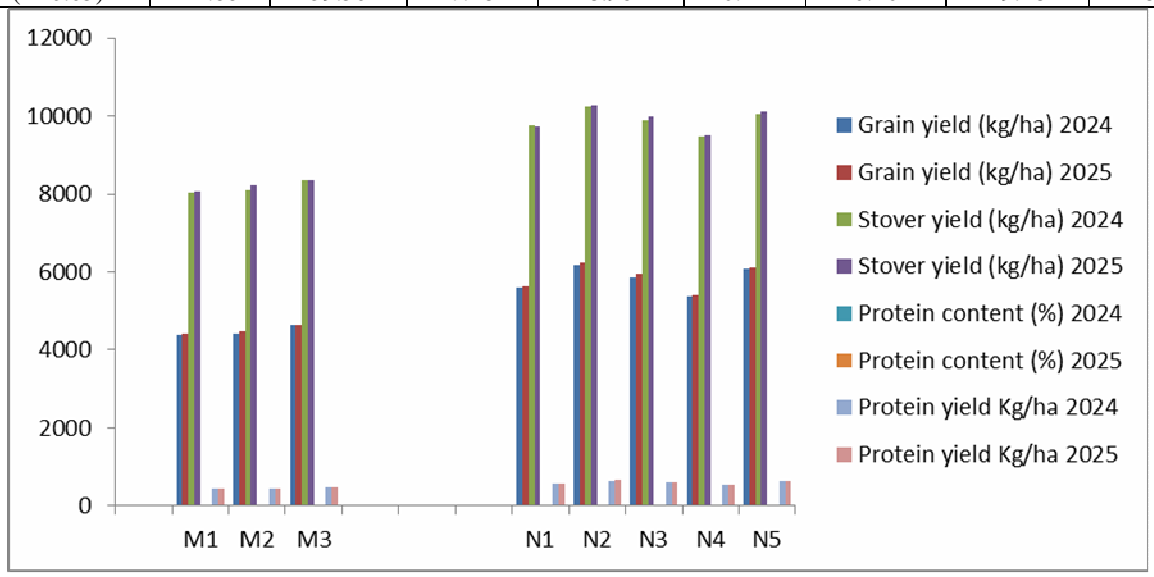

Fig. 1: Effect of moisture conservation practices and soil applied zinc on yield and quality parameters of maize during 2024 and 2025

Conclusion

On the basis of two-year experimentation, it may be concluded that the application of crop stubble mulch @ 15.0 t/ha along with nutrient management practice 75% RDF + 2.5t FYM + 25kg $ZnSO_4$ (N_2) is the most effective strategy for maize cultivation, as it consistently recorded the highest grain yield, stover yield, and protein content across both years. While 75% RDF + 2.5t FYM + 25kg $ZnSO_4$ (N_2) significantly outclassed all other options in biomass production, it was statistically on par with 75% RDF + 1.5t vermicompost + Zn spray 2% regarding total protein yield, making both treatments excellent choices for quality improvement. Conversely, treatment 75% RDF + 1.5t vermicompost proved to be the least effective, yielding the poorest results in both productivity and quality. Therefore, to maximize maize crop yield and grain quality parameters, the adoption of nutrient management protocol 75% RDF + 2.5t FYM + 25kg $ZnSO_4$ (N_2) is highly recommended for hot semi-arid climate of central U.P. region.

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