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Effect of integrated nutrient management on growth and productivity of maize (*Zea mays* L.)

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Abstract
A field experiment was conducted during the kharif season of 2021 at the Research Farm of Raj Mohini Devi College of Agriculture and Research Station, Ambikapur, Chhattisgarh, to evaluate the effect of integrated nutrient management (INM) on growth, yield attributes, yield and economics of maize (*Zea mays* L.). The experiment was laid out in a randomized block design with eight treatments comprising different levels of recommended dose of fertilizers (RDF) applied alone and in combination with farmyard manure (FYM @ 5 t ha^{-1}), replicated three times. Application of 150% RDF resulted in significantly higher growth parameters, yield attributes and yields. Maximum kernel yield (9.42 t ha^{-1}), stover yield (12.66 t ha^{-1}), net return (₹1,53,131 ha^{-1}) and benefit-cost ratio (2.98) were recorded under 150% RDF, which remained statistically at par with 125% RDF and 100% RDF + FYM @ 5 t ha^{-1}. Integrated nutrient management proved to be an effective strategy for sustainable maize production.

Keywords: Maize, integrated nutrient management, RDF, FYM, yield, economics

1. Introduction
Maize (*Zea mays* L.) is one of the most important cereal crops of the world and ranks third after rice and wheat. It is cultivated over a wide range of agro-climatic conditions due to its adaptability, high yield potential and multiple uses as food, feed and industrial raw material. In India, maize plays a significant role in food security and agricultural diversification. However, maize productivity is often constrained by declining soil fertility and imbalanced fertilizer use.
Excessive and indiscriminate use of chemical fertilizers has resulted in deterioration of soil physical, chemical and biological properties. Integrated nutrient management (INM), which involves the combined use of organic and inorganic nutrient sources, is considered a sustainable approach to maintain soil fertility and enhance crop productivity. Farmyard manure improves soil structure, water-holding capacity and microbial activity, while chemical fertilizers ensure immediate nutrient availability. Hence, the present study was undertaken to evaluate the effect of integrated nutrient management on growth, yield attributes, yield and economics of maize under the agro-climatic conditions of northern Chhattisgarh.

2. Materials and Methods
The experiment was conducted during kharif season 2021 at the Research-cum- Instructional Farm of Raj Mohini Devi College of Agriculture and Research Station, Ambikapur, Chhattisgarh. The soil of the experimental field was sandy loam, slightly acidic (pH 5.8), low in available nitrogen, medium in available phosphorus and high in potassium. The experiment was laid out in a randomized block design with eight treatments and three replications.
The treatments comprised 100%, 75%, 50%, 125% and 150% RDF applied through chemical fertilizers and 50%, 75% and 100% RDF combined with FYM @ 5 t ha^{-1}. Maize hybrid NK-30 was sown on 13 July 2021 at a spacing of 75 × 20 cm. Nitrogen was applied in three equal splits while FYM was incorporated before sowing. Growth parameters, yield attributes, yield and economic returns were recorded and analyzed statistically using analysis of variance.

3. Results and Discussion

3.1 Growth Parameters

Growth parameters of maize such as plant height, number of leaves plant^{-1}, dry matter accumulation and crop growth rate were significantly influenced by different nutrient management practices. Application of 150% RDF resulted in significantly higher plant height at all stages of crop growth. This may be attributed to increased availability of nitrogen, which enhanced cell division and elongation. Integrated application of RDF with FYM also improved growth parameters due to improved soil physical condition and nutrient availability.

Number of leaves plant^{-1} increased with increasing fertility levels and was maximum under 150% RDF, followed by 125% RDF and 100% RDF + FYM @ 5 t ha^{-1}. Dry matter accumulation and crop growth rate followed similar trends, indicating better biomass production under higher nutrient supply.

Table 1: Effect of nutrient management on number of leaves plant^{-1}

Treatment	30 DAS	60 DAS	90 DAS	Harvest
50% RDF	6.06	9.33	8.87	8.21
100% RDF	7.51	11.33	10.41	9.72
125% RDF	8.22	12.11	11.33	10.74
150% RDF	9.49	13.14	12.31	11.58
100% RDF + FYM	8.33	12.55	11.85	10.99

Yield Attributes and Yield

Yield attributing characters such as cob length, cob girth, number of kernel rows cob^{-1}, number of kernels row^{-1} and seed index were significantly influenced by nutrient management practices. Application of 150% RDF recorded the highest values for these attributes, which may be attributed to improved nutrient uptake and efficient translocation of photosynthates towards reproductive organs. The highest kernel yield (9.42 t ha^{-1}), cob yield (11.85 t ha^{-1}) and stover yield (12.66 t ha^{-1}) were recorded under 150% RDF. These yields were statistically comparable with 125% RDF and 100% RDF + FYM @ 5 t ha^{-1}.

Table 2: Yield attributes as influenced by nutrient management

Treatment	Cob length (cm)	Kernel yield (t ha^{-1})	Stover yield (t ha^{-1})
50% RDF	15.07	6.11	9.84
100% RDF	16.20	7.88	9.84
125% RDF	17.20	8.45	11.97

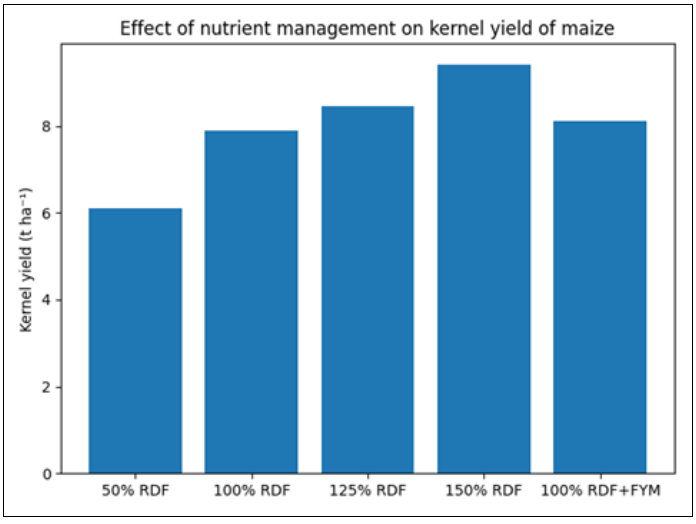

Fig 1: Effect of nutrient management on kernel yield of maize

3.1 Economics

Economic analysis revealed that cost of cultivation increased with higher fertilizer levels. The highest cost of cultivation was recorded under 150% RDF due to increased fertilizer use. However, this treatment also produced the highest gross and net returns due to higher yields. The maximum net return (₹1,53,131 ha^{-1}) and benefit-cost ratio (2.98) were recorded under 150% RDF, followed by 125% RDF and 100% RDF + FYM @ 5 t ha^{-1}.

4. Conclusion

Based on one year of experimentation, it can be concluded that application of 150% RDF produced the highest growth, yield and economic returns of maize. However, integrated application of 100% RDF + FYM @ 5 t ha^{-1} resulted in comparable yields and is recommended for sustainable maize production due to its beneficial effect on soil health.

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