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Effect of organic and inorganic nutrient sources on yield and yield attributes of *kharif* maize

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Abstract

A field experiment was conducted at Agricultural College Farm, Bapatla to study the effect of integrated use of organics and inorganics on yield and yield attributes of maize during *kharif* 2024 and 2025 on clay soil. The experiment was laid out in randomized block design with nine treatments and consists of T₁- Absolute control, T₂- 100% RDN, T₃- 125% RDN T₄- 100% RDN + 25% N through FYM, T₅- 100% RDN + Biofertilizers (*Azospirillum* + PSB + KRB), T₆- 100% RDN + 25% N through FYM + Biofertilizers (*Azospirillum* + PSB + KRB), T₇- 75% RDN + 25% N through FYM, T₈- 75% RDN + Biofertilizers (*Azospirillum* + PSB + KRB) and T₉- 75% RDN + 25% N through FYM + Biofertilizers (*Azospirillum* + PSB + KRB) and replicated thrice. The application of 100% RDN + 25% N through FYM+ Biofertilizers (*Azospirillum* + PSB + KRB) (T₆) recorded significantly higher dry matter production (6749, 13921 kg ha⁻¹ and 7006, 14057 kg ha⁻¹) at tasseling and harvest, cob weight per plant (130.7 g and 132.0 g), kernel yield (5324 kg ha⁻¹ and 5515 kg ha⁻¹) and stover yield (8224 kg ha⁻¹ and 8346 kg ha⁻¹) which was on par with treatments T₄, T₃, T₉ and T₅ during *kharif*, 2024 and 2025, respectively.

Keywords: FYM, biofertilizers, yield

Introduction

Maize (*Zea mays* L.) is the third most cereal crop in the world after rice and wheat, often referred to as the "Queen of cereals." In India, maize was sown approximately 108.87 lakh hectares during 2023-24, an increase from 105.24 lakh hectares in the previous year. Over 78.8 percent (85.79 lakh hectares) of the maize crop was cultivated during the *kharif* season, with 23.08 lakh hectares grown during *rabi*. There was a 3.8% increase in the *kharif* maize area and a 2.1% increase in the *rabi* maize area compared to the previous year. Among the maize producing states, Andhra Pradesh ranks 13th in cultivation area with 2.91 lakh hectares and is estimated to produce 19.04 lakh tonnes, contributing 5.34% to India's total production, with a productivity of 6543 kg/hectare in 2023-24 (Maize crop outlook report of Andhra Pradesh, 2024) [6].

Nutrient management through appropriate application of organic and inorganic sources is essential to ensure optimal crop output. Chemical fertilisers can alter soil pH, disrupt beneficial microbial ecosystems, increase pest incidence, and possibly contribute to greenhouse gas emissions. Moreover, non-judicious application of chemical fertilizers in intensive cropping systems is the main reason for stagnation in productivity, insecurity in food and environmental hazards. In this context, judicious use of integrated nutrient management is one of the best options for ensuring long-term crop productivity, while maintaining soil fertility in maize and other cereal-based cropping systems. (Garima and Pant, 2018) [3].

Materials and Methods

A field experiment was carried out during *kharif* of 2024 and 2025 at Agricultural College Farm, Bapatla, geographically located at an altitude of 5.49 m above mean sea level, 15°54' North latitude, 80°30' East longitude and about 8 km away from Bay of Bengal. It is located in Krishna Agro-Climatic Zone of Andhra Pradesh. The soil of experimental site was clay in texture, slightly alkaline in reaction (pH 7.72), non-saline (0.35 dS m⁻¹), low in organic carbon (4.60 g kg⁻¹), low in available nitrogen (215 kg ha⁻¹), medium in available phosphorus (42.6 kg ha⁻¹), high in available potassium (332 kg ha⁻¹).

The experiment was laid out in randomized block design during *kharif* with three replications and nine treatments. The treatments consists of T₁- Absolute control, T₂- 100% RDN, T₃- 125% RDN, T₄- 100% RDN + 25% N through FYM, T₅- 100% RDN + Biofertilizers (*Azospirillum* + PSB + KRB), T₆- 100% RDN + 25% N through FYM + Biofertilizers (*Azospirillum* + PSB + KRB), T₇- 75% RDN + 25% N through FYM, T₈- 75% RDN + Biofertilizers (*Azospirillum* + PSB + KRB) and T₉- 75% RDN + 25% N through FYM + Biofertilizers (*Azospirillum* + PSB + KRB) and imposed to maize crop. Fertilizers were applied as per the treatments through Urea, SSP and MOP. Maize hybrid variety (Pioneer P-3396) was chosen for the study. Fully mature and developed cobs from randomly selected five plants from each plot were plucked and number of seeds were counted. After threshing and winnowing the weight of seeds and also stover for each net plot area was recorded in kg per plot and then converted to kg ha⁻¹. Statistical analysis of the experimental data was carried out as per the methods suggested by Gomez and Gomez (1984) [5].

Results and Discussion

Dry matter production (kg ha⁻¹)

Among the treatments, significantly higher dry matter production of maize (6749, 13921 kg ha⁻¹ and 7006, 14057 kg ha⁻¹) was recorded in the treatment T₆ i.e., 100% RDN + 25% N through FYM+ Biofertilizers (*Azospirillum* + PSB + KRB) and it was on par with the treatments T₄ i.e., 100% RDN + 25% N through FYM (6737, 13544 kg ha⁻¹ and 6971, 13933 kg ha⁻¹), T₃ (125% RDN) (6432, 13318 kg ha⁻¹ and 6701, 13630 kg ha⁻¹), T₉ (75% RDN + 25% N through FYM+ Biofertilizers (*Azospirillum* + PSB + KRB) (6369, 13190 kg ha⁻¹ and 6596, 13408 kg ha⁻¹) and T₅ i.e., 100% RDN + Biofertilizers (*Azospirillum* + PSB + KRB) (6307, 13148 kg ha⁻¹ and 6541, 13399 kg ha⁻¹) at tasseling and harvest of maize crop during *kharif*, 2024 and 2025, respectively. The lowest dry matter production was recorded in the treatment T₁ i.e., control (2785, 7122 kg ha⁻¹ in 2024 and 3340, 7195 kg ha⁻¹ in 2025) at tasseling and harvest of maize crop (Table 1).

The increase in dry matter production with the application of FYM and biofertilizers along with inorganic fertilizers, which might be attributed to improvements in soil physical properties and increased the organic carbon of the soil thereby providing a more conducive rhizosphere for maize crop, higher rate of aeration, increased the soil microbial activity as well as mineralisation of nutrients and the sufficient supply of nutrients (Sahoo *et al.*, 2021) [8] and biofertilizers have the capacity to reduce the leaching losses by fixation of nutrients and converts the unavailable nutrient forms to available forms and increases nutrient availability to plants which has positive influence on dry matter accumulation in plant (Gite *et al.*, 2025) [4].

Cob weight per plant

Among the treatments, significantly highest cob weight per plant

was recorded in the treatment T₆ i.e., 100% RDN + 25% N through FYM+ Biofertilizers (*Azospirillum* + PSB + KRB) (130.7 g and 132.0 g) and it was on par with the treatments T₄ i.e., 100% RDN + 25% N through FYM (128.1 g and 130.3), T₃ (125% RDN) (125.2 g and 127.0 g), T₉ (75% RDN + 25% N through FYM+ Biofertilizers (*Azospirillum* + PSB + KRB) (121.0 g and 123.5 g) and T₅ i.e., 100% RDN + Biofertilizers (*Azospirillum* + PSB + KRB) (118.5 g and 122 g) at harvest of maize crop in *kharif*, 2024 and 2025, respectively. The lowest cob weight per plant was recorded with the treatment T₁ i.e., control (82.8 g in 2024 and 86.7 g in 2025) at harvest of maize crop. The addition of either inorganics alone or in combination with FYM and biofertilizers had no significant effect on 100-kernel weight of maize during *kharif*, 2024 and 2025 (Table 2). The increase in cob weight per plant might be due to more amount of nitrogen available through FYM, biofertilizers along with inorganics (Manjhi *et al.*, 2016) [7].

Yield

The application of 100% RDN + 25% N through FYM+ Biofertilizers (*Azospirillum* + PSB + KRB) i.e., T₆ recorded significantly higher kernel yield (5324 kg ha⁻¹ and 5515 kg ha⁻¹) and stover yield (8224 kg ha⁻¹ and 8346 kg ha⁻¹) and it was on par with the treatments T₄ i.e., 100% RDN + 25% N through FYM (5316 kg ha⁻¹ and 5497 kg ha⁻¹) (8219 kg ha⁻¹ and 8289 kg ha⁻¹), T₃ (125% RDN) (5287 kg ha⁻¹ and 5471 kg ha⁻¹) (7848 kg ha⁻¹ and 7969 kg ha⁻¹), T₉ (75% RDN + 25% N through FYM+ Biofertilizers (*Azospirillum* + PSB + KRB) (5127 kg ha⁻¹ and 5203 kg ha⁻¹) (7544 kg ha⁻¹ and 7601 kg ha⁻¹) and T₅ i.e., 100% RDN + Biofertilizers (*Azospirillum* + PSB + KRB) (5063 kg ha⁻¹ and 5168 kg ha⁻¹) (7495 kg ha⁻¹ and 7564 kg ha⁻¹) at harvest of maize crop during *kharif*, 2024 and 2025, respectively. The lower kernel yield (2517 kg ha⁻¹ in 2024 and 2550 kg ha⁻¹ in 2025) and stover yield (4127 kg ha⁻¹ in 2024 and 4179 kg ha⁻¹ in 2025) at harvest of maize crop was recorded in the treatment T₁ i.e., control (Table 3).

The improvement in yield and yield traits under integrated use of fertilizers with biofertilizers might be due to highest absorption of nutrients responsible for increased photosynthate accumulation and high biomass production and finally resulting in increase in the yield and yield components (Ahirwar *et al.*, 2025) [2]. Combined application of organics and inorganics was beneficial in reducing the fixation or precipitation of nutrients with those of soil components and played a complementary role to boost the crop yield (Abirami *et al.*, 2024) [1] and improves the soil physical properties and showed a beneficial effect on the physiological process of plant metabolism and growth, thereby led to highest seed yield and the sufficient supply of nutrients from FYM and inorganic fertilizers (Susmita *et al.*, 2024) [9].

Table 1: Effect of organic and inorganic nutrient sources on dry matter production (kg ha⁻¹) at tasseling and harvest of maize (*kharif*, 2024 and 2025)

Treatments	Kharif (2024)		Kharif (2025)	
	Tasseling	Harvest	Tasseling	Harvest
T ₁ : Absolute control	2785	7122	3340	7195
T ₂ : 100% RDN	5716	12022	5955	12090
T ₃ : 125% RDN	6432	13318	6701	13630
T ₄ : 100% RDN + 25% N through FYM	6737	13544	6971	13933
T ₅ : 100% RDN + Biofertilizers (<i>Azospirillum</i> + PSB + KRB)	6307	13148	6541	13399
T ₆ : 100% RDN + 25% N through FYM+ Biofertilizers (<i>Azospirillum</i> + PSB + KRB)	6749	13921	7006	14057
T ₇ : 75% RDN + 25% N through FYM	5791	12115	6164	12236
T ₈ : 75% RDN + Biofertilizers (<i>Azospirillum</i> + PSB + KRB)	5675	11392	5881	11453
T ₉ : 75% RDN + 25% N through FYM+ Biofertilizers (<i>Azospirillum</i> + PSB + KRB)	6369	13190	6596	13408
SEm (±)	308	557	249	589
CD (P=0.05)	922	1671	746	1766
CV (%)	9.1	7.9	7.0	8.2

Table 2: Effect of organic and inorganic nutrient sources on 100-kernel weight (g) and cob weight per plant (g) of maize (*kharif*, 2024 and 2025)

Treatments	<i>kharif</i> (2024)		<i>kharif</i> (2025)	
	100-kernel weight (g)	Cob weight per plant (g)	100-kernel weight (g)	Cob weight per plant (g)
T ₁ : Absolute control	24.2	82.8	23.7	86.7
T ₂ : 100% RDN	25.3	112.1	25.3	113.7
T ₃ : 125% RDN	25.7	125.2	25.8	127.0
T ₄ : 100% RDN + 25% N through FYM	25.3	128.1	25.3	130.3
T ₅ : 100% RDN + Biofertilizers (<i>Azospirillum</i> + PSB + KRB)	25.6	118.5	25.7	122.0
T ₆ : 100% RDN + 25% N through FYM+ Biofertilizers (<i>Azospirillum</i> + PSB + KRB)	26.2	130.7	26.3	132.0
T ₇ : 75% RDN + 25% N through FYM	25.6	113.6	25.7	114.1
T ₈ : 75% RDN + Biofertilizers (<i>Azospirillum</i> + PSB + KRB)	25.5	110.9	25.6	112.9
T ₉ : 75% RDN + 25% N through FYM+ Biofertilizers (<i>Azospirillum</i> + PSB + KRB)	25.5	121.0	25.7	123.5
SEm (±)	1.1	4.8	1.1	4.7
CD (P=0.05)	NS	14.3	NS	14.0
CV (%)	7.4	7.1	7.6	6.9

Table 3: Effect of organic and inorganic nutrient sources on kernel and stover yield (kg ha⁻¹) of maize (*kharif*, 2024 and 2025)

Treatments	<i>kharif</i> (2024)		<i>kharif</i> (2025)	
	Kernel yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)	Kernel yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)
T ₁ : Absolute control	2517	4127	2550	4179
T ₂ : 100% RDN	4475	6717	4621	6887
T ₃ : 125% RDN	5287	7848	5471	7969
T ₄ : 100% RDN + 25% N through FYM	5316	8219	5497	8289
T ₅ : 100% RDN + Biofertilizers (<i>Azospirillum</i> + PSB + KRB)	5063	7495	5168	7564
T ₆ : 100% RDN + 25% N through FYM+ Biofertilizers (<i>Azospirillum</i> + PSB + KRB)	5324	8224	5515	8346
T ₇ : 75% RDN + 25% N through FYM	4535	7248	4663	7263
T ₈ : 75% RDN + Biofertilizers (<i>Azospirillum</i> + PSB + KRB)	4415	6564	4583	6571
T ₉ : 75% RDN + 25% N through FYM+ Biofertilizers (<i>Azospirillum</i> + PSB + KRB)	5127	7544	5203	7601
SEm (±)	182	280	189	302
CD (P=0.05)	545	838	565	907
CV (%)	6.7	6.8	6.8	7.3

Conclusion

It can be concluded that combined application of inorganics, FYM and Biofertilizers in *kharif* improved dry matter production, cob weight per plant, kernel yield and stover yield of maize.

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