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Effect of nitrogen management on primary nutrients content & uptake by maize (*Zea mays* L.) in typic haplustepts of Rajasthan

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Abstract
In Kharif 2018 and 2019, a field experiment was carried out at the Instructional Farm (Agronomy) of the Rajasthan College of Agriculture in Udaipur, Rajasthan, to assess the impact of various nitrogen sources on NPK content and the uptake by maize. The experiment's 13 treatments, including the control, were replicated three times and was set up using a randomized block design. Maximum nitrogen, phosphorous, and potassium content as well as absorption by maize were seen in the treatment that included 10 tons of FYM and 100% of the authorized dose of nitrogen in chemical fertilizers on Typic Haplustepts soil.

Keywords: Maize, nitrogen management, nutrient content & uptake

Introduction
One of the most significant cereal crops in the world, maize (*Zea mays* L.), is used as food for humans, animals, fodder, and industrial raw materials. In terms of food crops, maize, often known as corn, is a member of the *Gramineae* family and is the fourth most important crop in India after rice, wheat, and sorghum. Because maize is a C4 plant and is particularly effective at turning solar energy into the formation of dry matter, it has a very high productivity. The crop has high genetic yield potential and hence, it is called as Miracle crop and as the "Queen of cereals". In India occupying 10.04 m ha area with production of 33.62 million tones and productivity status of 2575 kg ha^{-1}, respectively (FAI, 2021-22) [4]. In the state of Rajasthan, it covers an area of 0.89 m ha with production and productivity of 1.21 million tones and 1338 kg ha^{-1}, respectively (FAI, 2021-22) [4]. Currently, the use of maize farmed in India includes uses for 52 per cent of it as chicken feed, 24 per cent as human food, 11 per cent as animal feed, 11 per cent as starch, 1 per cent as beer, and 1 per cent as seed. As the demand of dairy and poultry feed is rapidly increasing, the demand for maize is also going up. As per the estimated projection, India may have to produce 55 million tonnes of maize to meet its requirements for human consumption, poultry, piggery, pharma industry (corn syrup, corn starch and corn oil) and fodder by 2030. Therefore, improvement in maize yields is an important guarantee for food security.

Nitrogen is known to be an essential plant nutrient for growth and development. It is the first limiting plant nutrient, has a great influence on crop growth, yield and its quality. Nitrogen fertilizer have great significance to enhance the maize production as nitrogen is a key component in plant metabolism and essential constituent of protein, nucleic acids, ATP, NADH, NADPH, enzymes as well as of cytochrome and chlorophyll (Demari *et al*., 2016) [2]. Nitrogen improve number of nodes, internodes, length of internodes which results in increase in plant height and also enhance leaf area, number of leaf per plant and stem diameter of maize plant (Gasim, 2001) [3]. Nitrogen promote biomass and grain yield, protein quality in grain and also improve the quality of silage (Demari *et al*., 2016) [2].

In integrated nutrient management, organic and inorganic fertilizers are used in conjunction to meet the crop's nutritional needs. Utilizing both organic and inorganic sources of nutrients simultaneously is all that integrated nutrition entails. By increasing the soil's ability to store water and allow for the best possible water consumption, the combined use of organic manures and the best inorganic fertilizers enhances the physical state of the soil. By boosting cation exchange capacity and supplying different hormones and organic acids, which are crucial for soil aggregation and for helpful microorganisms participating in various biological processes and nutrient release, it also enhances the chemical and biological state of soil. For the assurance of food security, the combined use of chemical and organic fertilizer on maize production and yield components is extremely important (Sindhi *et al*., 2018) [9]. According to Sharma *et al*. (2015) [8], applying N and farm yard manure together considerably increases crop output and soil fertility. Unfortunately, intensive farming practices and the careless application of inorganic N fertilizers have a detrimental impact on crop growth. As a result, coordinated N management is crucial for cropping systems both now and in the future (Sarwar *et al*., 2021) [7].

Materials and Methods

At the Instructional Farm of the Rajasthan College of Agriculture in Udaipur, Rajasthan (24.340 N, 73.420 E, and 579.5 m above mean sea level), a field experiment was carried out during the kharif season of 2018 and 2019. The soil used for the experiment had the texture and reactivity of clay loam. There were 13 treatments *viz*. Control, 75% Recom. N over CF + 25% Recom. N over FYM, 75% Recom. N over CF + 25% Recom. N over Enriched Compost, 75% Recom. N over CF + 25% Recom. N over Poultry Manure, 75% Recom. N over CF + 25% Recom. N over Vermicompost, 50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over Enriched Compost, 50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over Poultry Manure, 50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over Vermicompost, 50% Recom. N over CF + 25% Recom. N over Enriched Compost + 25% Recom. N over Poultry Manure, 50% Re commended N over CF + 25% Recom. N over Enriched Compost + 25% Recom. N over Vermicompost, 50% Recom. N over CF + 25% Recom. N over Vermicompost + 25% Recom. N over Poultry Manure, 100% Recom. N over CF + FYM (10 t ha^{-1}) & 100% Recom. N over CF respectively. The maize var. PEHM-2 was taken as test crop and sown in lines 60 cm apart manually by 'Kera methods'. The Recom. Nitrogen dose (120 kg ha^{-1}) was applied in two equal portions, the first half as basal and the second half as top dressing at the time of first irrigation. The organic source (FYM, enriched compost, poultry manure, and vermicompost) were applied in the field as per treatments and thoroughly mixed at the time of sowing. Urea was used to provide the base dosage after diammonium phosphate was used to modify the amount supplied. Prior to sowing, the whole amount of phosphorus (60 kg ha^{-1}) over diammonium phosphate and the entire amount of potassium (30 kg ha^{-1}) over muriate of potash were drilled as basal doses at 8–10 cm depth.

The chemical fertilizer sources used for applying N, P and K were urea, diammonium phosphate and muriate of potash, respectively. The organic sources of nutrients were farm yard manure, enriched compost, poultry manure and vermicompost. The nutrient composition of organic manures is given in Table 1.

Table 1: Composition of organic manures

Nutrient	FYM (%)	Enriched compost (%)	Poultry manure (%)	Vermicompost (%)
N	0.49	1.2	1.4	1.6
P_2O_5	0.25	2.1	1.0	1.3
K_2O	0.48	0.9	1.1	1.2

Results & Discussions

Nitrogen content in grain and stover

It is clear from the data in Table 2 that the different treatment combination of organic N fertilizer with inorganic N fertilizer proved significant effect on nitrogen content in grain and stover of maize over control during both the years as well as on pooled basis. The maximum nitrogen content in grain (1.612, 1.628 and 1.620%) of maize was observed with application of T_{11} (100% RDN over chemical fertilizer +FYM @10t ha^{-1}) followed by T_3 (75% RDN over chemical fertilizer +25% RDN over poultry manure), T_2 (75% RDN over chemical fertilizer + 25% RDN over enriched compost), T_4 (75% RDN over chemical fertilizer + 25% RDN over vermicompost) and T_{12} (100% RDN over chemical fertilizer) during both years and in pooled mean, respectively. The minimum nitrogen content in grain (1.245, 1.251 and 1.248%) of maize was recorded under control (T_0) during both years and in pooled mean, respectively. The data further revealed that the per cent increase in nitrogen content in grain of maize were in order of 29.81, 29.13, 28.97, 27.45 and 27.30 in pooled analysis due to application of T_{11}, T_3, T_2, T_4 and T_{12} as compared to control (T_0), respectively.

Data presented in the Table 2 also showed that the nitrogen content in stover of maize was significantly increased due to combined application of nitrogen fertilizer and organic manure over control during 2018, 2019 and in pooled mean. The maximum nitrogen content in stover (0.767, 0.777 and 0.772%) of maize was observed with application of T_{11} (100% RDN over chemical fertilizer +FYM @10t ha^{-1}) followed by T_3 (75% RDN over chemical fertilizer +25% RDN over poultry manure), T_2 (75% RDN over chemical fertilizer + 25% RDN over enriched compost), T_4 (75% RDN over chemical fertilizer + 25% RDN over vermicompost) and T_{12} (100% RDN over chemical fertilizer) during 2018, 2019 and in pooled mean, respectively. The minimum nitrogen content in stover (0.559, 0.569 and 0.564%) of maize was recorded under control (T_0) during 2018, 2019 and in pooled mean, respectively. The data further revealed that the per cent increase in nitrogen content in stover of maize were in order of 36.89, 34.79, 34.40, 30.86 and 30.32% in pooled analysis due to application of T_{11}, T_3, T_2, T_4 and T_{12} as compared to control (T_0), respectively.

Phosphorus content in grain and stover

It is inferred from the data (Table 3) that the integrated application of nitrogen though chemical fertilizer and organic manure significantly influenced the phosphorus content in grain and stover of maize over control during 2018, 2019 and on pooled basis. The highest phosphorus content in grain (0.418, 0.428 and 0.423%) and stover (0.213, 0.223 and 0.218%) of maize was recorded with the application of T_{11} (100% RDN over chemical fertilizer + FYM @10t ha^{-1}) followed by T_3 (75% RDN over chemical fertilizer +25% RDN over poultry manure), T_2 (75% RDN over chemical fertilizer + 25% RDN over enriched compost), T_4 (75% RDN over chemical fertilizer + 25% RDN over vermicompost) and

T_{12} (100% RDN over chemical fertilizer) during 2018, 2019 and on pooled basis, respectively. However the lowest phosphorus content in grain (0.299, 0.309 and 0.304%) and stover (0.146, 0.156 and 0.151%) of maize was recorded under control (T_0). The application of T_{11}, T_3, T_2, T_4 & T_{12} significantly increased the phosphorus content in grain and stover of maize to the tune of 39.18, 32.91, 30.60, 28.96 & 20.07 per cent and 44.40, 37.11, 35.79, 35.12 & 31.15 per cent in pooled analysis over control (T_0), respectively.

Potassium content in grain and stover

It is seen from the data in Table 4 that the effect of nitrogen management over organic and inorganic fertilizers showed significant response in potassium content in grain and stover of maize over control during both the years and in pooled mean. The significantly maximum potassium content in grain (0.506, 0.518 and 0.512%) stover (1.496, 1.530 and 1.513%) of maize was observed under combined application of FYM and chemical fertilizer of nitrogen as in T_{11} (100% RDN over chemical fertilizer +FYM @10t ha^{-1}) over control (T_0) during both the years and in pooled mean, respectively. Whereas, the minimum potassium content in grain (0.392, 0.404 and 0.398%) stover (1.152, 1.163 and 1.157%) of maize was observed under control (T_0) during both the years and in pooled mean, respectively. The data further revealed that the increase in potassium content in grain and stover of maize in pooled analysis was obtained to the extent of 28.64 and 30.74 per cent with the application of T_{11} over control (T_0), respectively.

Nitrogen uptake by grain and stover

It is obvious from the data present in Table 5 shows that nitrogen application of organic–inorganic amendments significantly affected the nitrogen uptake by grain and stover of maize during both the years and in pooled mean. The highest nitrogen uptake by grain (70.67, 73.51 and 72.09 kg ha^{-1}) and stover (50.62, 54.69 and 52.65 kg ha^{-1}) of maize was recorded with the application of T_{11} (100% RDN over chemical fertilizer +FYM @10t ha^{-1}) followed by T_3 (75% RDN over chemical fertilizer +25% RDN over poultry manure), T_2 (75% RDN over chemical fertilizer + 25% RDN over enriched compost), T_4 (75% RDN over chemical fertilizer + 25% RDN over vermicompost) and T_{12} (100% RDN over chemical fertilizer) during both the years and in pooled mean, respectively. The lowest value of nitrogen uptake by grain (23.98, 25.14 and 24.56 kg ha^{-1}) and stover (20.20, 21.30 and 20.75 kg ha^{-1}) of maize was recorded with the application of T_0 (Control) during both the years as well as in pooled mean, respectively. Data further revealed that the application of T_{11}, T_3, T_2, T_4 & T_{12} significantly increased nitrogen uptake by grain and stover of maize to the extent of 193.53, 179.52, 177.39, 155.51 & 153.93 and 153.75, 138.45, 135.95, 102.78 & 80.58 per cent in pooled analysis as compared to control (T_0), respectively.

Phosphorus uptake by grain and stover

After analyzing the data presented in Table 6, it is observed that the application of nitrogen though organic amendments in combination with inorganic fertilizers significantly improved the phosphorus uptake by grain and stover over control during 2018, 2019 and in pooled mean. The maximum phosphorus uptake by grain (18.32, 19.33 and 18.82 kg ha^{-1}) and stover (14.06, 15.69 and 14.87 kg ha^{-1}) of maize was found under T_{11} (100% RDN over chemical fertilizer +FYM @10t ha^{-1}) which was significantly superior over all the treatments and control during 2018, 2019 and in pooled mean, respectively. However, the minimum phosphorus uptake by grain (5.77, 6.21 and 5.99 kg ha^{-1}) and stover (5.27, 5.83 and 5.55 kg ha^{-1}) of maize was found under control (T_0) during 2018, 2019 and in pooled mean, respectively. The increased in phosphorus uptake by grain and stover of maize was 214.29, 187.45, 180.70, 158.35 & 140.04 and 167.84, 142.56, 138.56, 109.53 & 81.87 per cent in pooled analysis due to application of T_{11}, T_3, T_2, T_4 & T_{12} when compared to control (T_0), respectively.

Potassium uptake by grain and stover

An assessment of data (Table 7) shows that the nitrogen management over integrated use of organic and inorganic nitrogen sources showed significant results on potassium uptake by grain and stover of maize during both the years of experiment and in pooled mean. The highest potassium uptake by grain (22.15, 23.40 and 22.78 kg ha^{-1}) and stover (98.73, 107.72 and 103.22 kg ha^{-1}) of maize was recorded under T_{11} (100% RDN over chemical fertilizer +FYM @10t ha^{-1}) followed by T_3 (75% RDN over chemical fertilizer +25% RDN over poultry manure), T_2 (75% RDN over chemical fertilizer + 25% RDN over enriched compost), T_4 (75% RDN over chemical fertilizer + 25% RDN over vermicompost) and T_{12} (100% RDN over chemical fertilizer) during both years of experiment and in pooled mean. The lowest value of potassium uptake by grain (7.54, 8.12 and 7.83 kg ha^{-1}) and stover (41.63, 43.50 and 42.57 kg ha^{-1}) of maize was recorded under control (T_0) during both the years of experiment and in pooled analysis. The data further revealed that the increase in potassium uptake by grain and stover of maize in pooled mean were in order of 190.98, 171.01, 165.05, 144.38 & 141.85 and 142.49, 128.76, 124.57, 97.95 & 74.02 per cent with the application of T_{11}, T_3, T_2, T_4 & T_{12} as compared to control (T_0), respectively.

The highest NPK content and uptake by grain and stover of maize was recorded with application of chemical nitrogen fertilizers plus farmyard manure (100% RDN over chemical fertilizer +FYM @10t ha^{-1}) during both the years and in pooled analysis. The significant increase in nitrogen, phosphorus, and potassium content and uptake by grain and stover with the Recom dose of N along with FYM may be attributed to the possibility that the concentration of these nutrients in the soil solution is sufficiently high. Additionally, a proliferous root system was developed as a result of the balanced application of these nutrients with the integrative system of nutrient management, which helped in absorption and efficient translocation of nutrients to the plant. (Shekhawat *et al.* 2021) [10]. According to Kumar *et al*. (2020) [5], the concentration of nutrients at the root surface and the quantity of fertilizer used are the two main factors that affect how much is assimilated by plants. It is possible that more nutrients were produced and accumulated in different plant sections as a result of the increased availability of these nutrients in the root zone and enhanced metabolic activity at the cellular level (Biswas, 2011; Shekhawat *et al*., 2021) [1, 10]. As a result, crops supplied with the application of both organic manure and chemical fertilizers used more nutrients than crops given with the application of chemical fertilizers or manure alone (Shekhawat *et al*., 2021) [10].

The authors claim that this shows slowly released organically bound nitrogen in manure with a high C/N ratio is not easily accessible to plants during the early development phases. By increasing the supply of nutrients for the microorganisms involved in the decomposition of the manure, the application of mineral fertilizer along with manure speeds up the process and increases the availability and uptake of the nutrients (Safiullah *et al*., 2018, Zhang *et al*., 2020) [6, 14]. Therefore, by adding mineral fertilizer to the manure, nutrient mineralization in FYM, vermicompost, chicken manure, and enrich compost may be accelerated. According to Sofyan *et al*. (2019) [13], the higher absorption of nitrogen, phosphorous, and potassium by grain and stover is likely caused by the fact that nutrient uptake is a function of biomass and nutrient concentration. Therefore, larger levels of nitrogen, phosphorous, and potassium in grain and Stover may encourage maize to absorb more of these nutrients.

Table 2: Effect of nitrogen management on nitrogen content in grain and stover of maize

Symbol	Treatments	Nitrogen content (%)					
		Grain			Stover		
		2018	2019	Pooled	2018	2019	Pooled
T_0:	Control	1.245	1.251	1.248	0.559	0.569	0.564
T_1:	75% Recom. N over CF + 25% Recom. N over FYM	1.564	1.575	1.570	0.725	0.735	0.730
T_2:	75% Recom. N over CF + 25% Recom. N over Enriched Compost	1.604	1.615	1.610	0.753	0.763	0.758
T_3:	75% Recom. N over CF + 25% Recom. N over Poultry Manure	1.606	1.617	1.612	0.755	0.766	0.760
T_4:	75% Recom. N over CF+ 25% Recom. N over Vermicompost	1.585	1.596	1.591	0.733	0.743	0.738
T_5:	50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over Enriched Compost	1.398	1.409	1.403	0.682	0.694	0.688
T_6:	50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over Poultry Manure	1.436	1.447	1.441	0.685	0.695	0.690
T_7:	50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over Vermicompost	1.385	1.396	1.390	0.671	0.681	0.676
T_8:	50% Recom. N over CF + 25% Recom. N over Enriched Compost + 25% Recom. N over Poultry Manure	1.484	1.495	1.489	0.718	0.728	0.723
T_9:	50% Recom. N over CF + 25% Recom. N over Enriched Compost + 25% Recom. N over Vermicompost	1.438	1.449	1.443	0.698	0.708	0.703
T_{10}:	50% Recom. N over CF + 25% Recom. N over Vermicompost + 25% Recom. N over Poultry Manure	1.443	1.454	1.448	0.709	0.719	0.714
T_{11}:	100% Recom. N + FYM (10 t/ha)	1.612	1.628	1.620	0.767	0.777	0.772
T_{12}:	100% Recom. N over CF	1.583	1.594	1.589	0.730	0.740	0.735
	SEm±	0.026	0.030	0.020	0.012	0.016	0.010
	CD (P=0.05)	0.076	0.087	0.056	0.036	0.048	0.029

Recom. N over – Recommended N through

Table 3: Effect of nitrogen management on phosphorous content in grain and stover of maize

Symbol	Treatments	Phosphorus content (%)					
		Grain			Stover		
		2018	2019	Pooled	2018	2019	Pooled
T_0:	Control	0.299	0.309	0.304	0.146	0.156	0.151
T_1:	75% Recom. N over CF + 25% Recom. N over FYM	0.356	0.366	0.361	0.192	0.203	0.197
T_2:	75% Recom. N over CF + 25% Recom. N over Enriched Compost	0.392	0.402	0.397	0.200	0.210	0.205
T_3:	75% Recom. N over CF + 25% Recom. N over Poultry Manure	0.399	0.409	0.404	0.202	0.212	0.207
T_4:	75% Recom. N over CF+ 25% Recom. N over Vermicompost	0.387	0.397	0.392	0.199	0.209	0.204
T_5:	50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over Enriched Compost	0.336	0.346	0.341	0.170	0.180	0.175
T_6:	50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over Poultry Manure	0.341	0.351	0.346	0.173	0.183	0.178
T_7:	50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over Vermicompost	0.330	0.340	0.335	0.168	0.178	0.173
T_8:	50% Recom. N over CF + 25% Recom. N over Enriched Compost + 25% Recom. N over Poultry Manure	0.350	0.360	0.355	0.185	0.195	0.190
T_9:	50% Recom. N over CF + 25% Recom. N over Enriched Compost + 25% Recom. N over Vermicompost	0.345	0.355	0.350	0.178	0.188	0.183
T_{10}:	50% Recom. N over CF + 25% Recom. N over Vermicompost + 25% Recom. N over Poultry Manure	0.348	0.358	0.353	0.182	0.192	0.187
T_{11}:	100% Recom. N + FYM (10 t/ha)	0.418	0.428	0.423	0.213	0.223	0.218
T_{12}:	100% Recom. N over CF	0.360	0.370	0.365	0.193	0.203	0.198
	SEm±	0.007	0.007	0.005	0.003	0.006	0.003
	CD (P=0.05)	0.021	0.020	0.014	0.008	0.017	0.009

Table 4: Effect of nitrogen management on potassium content in grain and stover of maize

Symbol	Treatments	Potassium content (%)					
		Grain			Stover		
		2018	2019	Pooled	2018	2019	Pooled
T_0:	Control	0.392	0.404	0.398	1.152	1.163	1.157
T_1:	75% Recom. N over CF + 25% Recom. N over FYM	0.472	0.482	0.477	1.433	1.444	1.438
T_2:	75% Recom. N over CF + 25% Recom. N over Enriched Compost	0.485	0.495	0.490	1.475	1.486	1.480
T_3:	75% Recom. N over CF + 25% Recom. N over Poultry Manure	0.493	0.503	0.498	1.491	1.502	1.497
T_4:	75% Recom. N over CF+ 25% Recom. N over Vermicompost	0.480	0.490	0.485	1.473	1.484	1.478
T_5:	50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over Enriched Compost	0.458	0.468	0.463	1.262	1.273	1.267
T_6:	50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over Poultry Manure	0.460	0.470	0.465	1.268	1.279	1.273
T_7:	50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over Vermicompost	0.455	0.465	0.460	1.233	1.244	1.238
T_8:	50% Recom. N over CF + 25% Recom. N over Enriched Compost + 25% Recom. N over Poultry Manure	0.469	0.479	0.474	1.371	1.382	1.376
T_9:	50% Recom. N over CF + 25% Recom. N over Enriched Compost + 25% Recom. N over Vermicompost	0.461	0.471	0.466	1.358	1.370	1.364
T_{10}:	50% Recom. N over CF + 25% Recom. N over Vermicompost + 25% Recom. N over Poultry Manure	0.464	0.474	0.469	1.365	1.376	1.370
T_{11}:	100% Recom. N + FYM (10 t/ha)	0.506	0.518	0.512	1.496	1.530	1.513
T_{12}:	100% Recom. N over CF	0.476	0.486	0.481	1.448	1.459	1.453
	SEm±	0.008	0.008	0.006	0.027	0.028	0.019
	CD (P=0.05)	0.024	0.023	0.016	0.078	0.082	0.055

Table 5: Effect of nitrogen management on nitrogen uptake by grain and stover of maize

Symbol	Treatments	Nitrogen uptake (kg ha^{-1})					
		Grain			Stover		
		2018	2019	Pooled	2018	2019	Pooled
T_0:	Control	23.98	25.14	24.56	20.20	21.30	20.75
T_1:	75% Recom. N over CF + 25% Recom. N over FYM	55.99	57.91	56.95	36.31	37.97	37.14
T_2:	75% Recom. N over CF + 25% Recom. N over Enriched Compost	67.01	69.24	68.12	47.85	50.07	48.96
T_3:	75% Recom. N over CF + 25% Recom. N over Poultry Manure	67.47	69.82	68.65	49.54	49.42	49.48
T_4:	75% Recom. N over CF+ 25% Recom. N over Vermicompost	61.71	63.79	62.75	40.50	43.65	42.08
T_5:	50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over Enriched Compost	50.99	52.77	51.88	32.20	33.74	32.97
T_6:	50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over Poultry Manure	53.21	55.06	54.13	32.83	34.38	33.61
T_7:	50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over Vermicompost	49.75	51.50	50.62	31.18	32.67	31.93
T_8:	50% Recom. N over CF + 25% Recom. N over Enriched Compost + 25% Recom. N over Poultry Manure	57.30	59.26	58.28	35.87	37.52	36.70
T_9:	50% Recom. N over CF + 25% Recom. N over Enriched Compost + 25% Recom. N over Vermicompost	54.17	56.04	55.11	34.06	35.65	34.86
T_{10}:	50% Recom. N over CF + 25% Recom. N over Vermicompost + 25% Recom. N over Poultry Manure	55.43	57.34	56.39	35.35	36.98	36.16
T_{11}:	100% Recom. N + FYM (10 t/ha)	70.67	73.51	72.09	50.62	54.69	52.65
T_{12}:	100% Recom. N over CF	61.33	63.40	62.36	36.63	38.31	37.47
	SEm±	1.77	1.92	1.31	1.27	1.59	1.02
	CD (P=0.05)	5.18	5.60	3.72	3.70	4.63	2.89

Table 6: Effect of nitrogen management on phosphorus uptake by grain and stover of maize

Symbol	Treatments	Phosphorus uptake (kg ha^{-1})					
		Grain			Stover		
		2018	2019	Pooled	2018	2019	Pooled
T_0:	Control	5.77	6.21	5.99	5.27	5.83	5.55
T_1:	75% Recom. N over CF + 25% Recom. N over FYM	12.69	13.40	13.04	9.61	10.33	9.97
T_2:	75% Recom. N over CF + 25% Recom. N over Enriched Compost	16.38	17.24	16.81	12.71	13.78	13.25
T_3:	75% Recom. N over CF + 25% Recom. N over Poultry Manure	16.76	17.66	17.21	13.25	13.69	13.47
T_4:	75% Recom. N over CF+ 25% Recom. N over Vermicompost	15.07	15.87	15.47	11.00	12.27	11.63
T_5:	50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over Enriched Compost	12.26	12.96	12.61	8.03	8.77	8.40
T_6:	50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over Poultry Manure	12.64	13.36	13.00	8.30	9.05	8.67
T_7:	50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over	11.84	12.55	12.20	7.83	8.55	8.19

	Vermicompost						
T8:	50% Recom. N over CF + 25% Recom. N over Enriched Compost + 25% Recom. N over Poultry Manure	13.51	14.27	13.89	9.24	10.04	9.64
T9:	50% Recom. N over CF + 25% Recom. N over Enriched Compost + 25% Recom. N over Vermicompost	12.99	13.73	13.36	8.68	9.46	9.07
T10:	50% Recom. N over CF + 25% Recom. N over Vermicompost + 25% Recom. N over Poultry Manure	13.38	14.13	13.75	9.07	9.86	9.46
T11:	100% Recom. N + FYM (10 t/ha)	18.32	19.33	18.82	14.06	15.69	14.87
T12:	100% Recom. N over CF	13.99	14.76	14.38	9.69	10.51	10.10
SEm±		0.41	0.39	0.28	0.34	0.38	0.25
CD (P=0.05)		1.18	1.13	0.80	0.99	1.11	0.72

Table 7: Effect of nitrogen management on potassium uptake by grain and stover of maize

Symbol	Treatments	Potassium uptake (kg ha^{-1})					
		Grain			Stover		
		2018	2019	Pooled	2018	2019	Pooled
T0:	Control	7.54	8.12	7.83	41.63	43.50	42.57
T1:	75% Recom. N over CF + 25% Recom. N over FYM	16.82	17.65	17.23	71.77	74.56	73.17
T2:	75% Recom. N over CF + 25% Recom. N over Enriched Compost	20.26	21.23	20.75	93.74	97.45	95.60
T3:	75% Recom. N over CF + 25% Recom. N over Poultry Manure	20.71	21.72	21.21	97.80	96.96	97.38
T4:	75% Recom. N over CF+ 25% Recom. N over Vermicompost	18.68	19.58	19.13	81.38	87.15	84.26
T5:	50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over Enriched Compost	16.72	17.56	17.14	59.58	61.99	60.78
T6:	50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over Poultry Manure	17.04	17.89	17.47	60.78	63.23	62.01
T7:	50% Recom. N over CF + 25% Recom. N over FYM + 25% Recom. N over Vermicompost	16.35	17.17	16.76	57.29	59.64	58.47
T8:	50% Recom. N over CF + 25% Recom. N over Enriched Compost + 25% Recom. N over Poultry Manure	18.12	19.00	18.56	68.50	71.19	69.85
T9:	50% Recom. N over CF + 25% Recom. N over Enriched Compost + 25% Recom. N over Vermicompost	17.37	18.23	17.80	66.22	68.95	67.59
T10:	50% Recom. N over CF + 25% Recom. N over Vermicompost + 25% Recom. N over Poultry Manure	17.87	18.74	18.31	68.05	70.73	69.39
T11:	100% Recom. N + FYM (10 t/ha)	22.15	23.40	22.78	98.73	107.72	103.22
T12:	100% Recom. N over CF	18.48	19.38	18.93	72.67	75.49	74.08
	SEm±	0.54	0.57	0.39	2.52	3.18	2.03
	CD (P=0.05)	1.58	1.66	1.11	7.36	9.28	5.77

Conclusion
Hence, N, P & K content and uptake in grain and stover of maize were found significantly higher under the treatment supplied with 100% nitrogen over chemical fertilisers along with FYM (10 t/ha). So, it can be concluded that the application of chemical fertilizers along with organic manures may increase primary nutrient content in grain and stover and their uptake as well.

Conflict of interest
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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