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Effect of organic manures, micronutrients and graded levels of N fertigation on growth, yield and nutrient uptake of maize (*Zea mays* L.)

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Abstract

A field study was carried out to study the effect of organic manures, micronutrients and various levels of N fertilizer in fertigation process on growth and yield of hybrid maize (*Zea mays* L.) at farmer's land of Kovakkulam village, Karur district from January to April, 2023. This experimentconducted in randomized block design with eleven treatments and replicated thrice.The treatments comprise of implementing 100% RDF, 125% RDN, and 150% RDN through fertigation as well as a basal application of 25 kg ha^{-1} of a micronutrient mixture and two distinct organic manures, namely vermicompost and pressmud, as well as a control that receives no fertilizer. The findings indicated the application of 150% RDN by employing drip fertigation along with soil application of vermicompost @ 5 tha^{-1} and mixture of micronutrients @ 25 kg ha^{-1} (T_{10}) had better outcomes of growth parameters, such as plant height at harvest (247.95 cm), LAI at 60 DAS (6.93), leaf area duration at 30 to 60 DAS (161 days), DMP during 60 DAS (11810 kg ha^{-1}),DMP at harvest (17676 kg ha^{-1}), CGR values of 28.87and 19.55 g m^{-2} day^{-1}during 30 to 60 DAS and 60 to harvest, respectively. AGRvalues of 3.39and 2.91 cm plant^{-1} day^{-1} during 30 to 60 DAS and 60 to harvest, respectively. Yield attributes *viz.,*total number of grains cob^{-1} (381.80), cob weight (106.61 g), grain yield (7628 kg ha^{-1}) and stover yield (11576 kg ha^{-1}) recorded also higher in the same treatment. Higher nutrient intakesof nitrogen (205.04 kg ha^{-1}), phosphorus (26.51 kg ha^{-1}) and potassium (182.06 kg ha^{-1}) were also recorded in this treatment. This treatment was comparable with application of 125% RDN by drip fertigation + Vermicompost @ 5 tha^{-1} + Micronutrient mixture @ 25 kg ha^{-1} (T_6). Lower growth components, yield traits, grain yield, stover yieldand nutrient absorption rate of NPK were recorded in control treatment (T_1).

Key words : Fertigation, RDN, Vermicompost, Pressmudand micronutrient mixture.

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One of the main crops of cereals, maize (*Zea mays* L.), is a remarkably adaptable plant that has numerous uses for people. According to the Food and Agriculture Organization, it is a versatile crop that is in third place in terms of global output after rice and wheat[15]. As stated by[2], maize accounts for 22 to 25% of the the globe's cereal production as well as area. It is grown on 203.89 million hectares of land worldwide, produce of 1210.45 million tonnes and yield 5.94 tonnes ha^{-1}. Its area in India is 9.9 million hectares, and in 2021–2022, its production was 32.50 MT with an output of 3.28 t ha^{-1}[18]. It is growing in Tamil Nadu on an area of land 0.33 M haalongside a production and productivity of 2.61 MT and 7.83 tonnes ha^{-1}, correspondingly. Fortunately poor nutrient management strategies were the major contributing factor in yield declines. The process of fertigation enables the consistent passage of fertilizers nutrients, and it additionally permits for a decrease in chemical fertilizers, improving the efficiency of both fertilizer as well as water consumption while accelerating crop development and production. Nitrogen plays a significant role in numerous physiological reactions in plants and composed in the substances like protein, nucleic acid and chlorophyll. It is especially crucial for the effective absorption and utilization of solar energy. Evaluation focusing on the ideal nitrogen level, nitrogen management and possibilities for increased yields with drip system irrigation in the north-east region of China[20]. Vermicompost has a significant number of plant-derived nutrients that are readily accessible by crops and can be used to make organic amendments for the soil that are totally stabilized and have a lower C:N ratio[8]. Vermicompost contains high particle surface regions that provide opportunities for microbes to thrive and retention of nutrient, thereby enhancing crop development and production. Compost made from Pressmudcan be used as an essential source of organic manure, a different way to supply crop nutrients, and a way to improve the soil fertility.

Micronutrients are essential to increase plant development and production as well as the amount of crude fibre and protein in the crops. Application of micronutrients along with macro nutrients may result in a significant impact on the crop's development, production, and quality.The chlorophyll is primarily formed by the action involving zinc. Zinc activates the enzyme that is responsible for creating proteins, carbohydrate production, promotes in the transformation of starch towards sugar, regulates auxins, and supports with adaptability to stress[6]. In order to boost output on a long-term basis, therefore critical to employ organic manures in together withchemical-based fertilizers in the right quantity and proportion[3]. By considering the aforementioned findings, The present inquiry has been done to determine the impact of varying levels of N with fertigation basal applications of a micronutrient blend, and different types of organic manures on the growth and yield of maize hybrid COH(M)8.

• The effect of organic manures, micronutrients and various level of N fertilizer fertigation on growth and yield of maize hybrid COH(M)8 had been the focus of a field investigation that was done in a farmer's field at Kovakkulam village, Karur district. A spacing of 60*20 cm was adopted. The study has been adopted by randomized block design and comprises eleven treatments with three replications and the plot dimension was used 7 *4m. The treatments are composed with various level of nitrogen fertilizer through the fertigation process *i.e.,* of 100% RDF, 125% RDN, 150% RDN in addition to base application of micronutrient mixture 25 kg ha^{-1}, different organic manures *viz.,* Vermicompost @ 5 tha^{-1} and Pressmud @ 5 tha^{-1}, as well as control didn't receive fertilizer. The experimental farm situated at 10^o.96' North latitude, 78^o.08' East longitude with an altitude of 126 m above MSL. The soil texture of the experimental field is sandy clay loam. The nutrient status of the experimental field soil was low in available N (195.41 kg ha^{-1}), medium in available P (20.60 kg ha^{-1}) and medium in K (266.53 kg ha^{-1}). In the trial field, a system of drip irrigation was set up for fertigation process. On alternate basis, the fertigation was carried through the following three stages: Stage I, from establishment to vegetative growth (6-25 DAS), Stage II, from vegetative growth to flowering (26-60 DAS), and Stage III, from blooming to maturity (61-75 DAS). Fertilizers like urea, DAP, and MOP were supplied to deliver NPK by fertigation process. The total amount of micronutrients and organic manures, including pressmudand vermicompost, were applied as basal. Other agronomic procedures were carried out in accordance with the advice. The crop's growth and yield characteristics were noted at the intervals of 30 DAS, 60 DAS, and harvest.

Growth characters :

The growth components of maize wereprofoundly influenced by the application of various organic manures, micronutrients along with higher levels of nitrogen fertigation (Table-1).

Plant height :

The time of application and the effect of graded levels N fertigation had a big impact on the growth metrics. A direct indication of a plant's growth and vigour is its height. Application of 150% RDN by employing drip fertigation together with vermicompost @ 5 t ha^{-1} and mixture of micronutrients @ 25 kg ha^{-1} (T_{10}) had the taller plants of 247.95 cm at harvest. This treatment was closeapplication of 125% RDN using drip fertigation + vermicompost @ 5 t ha^{-1} and mixture of micronutrients @25 kg ha^{-1} (T_6). Thismay be due to the proportion of nitrogen in the soil solution greater as a direct result of nitrogen fertigation using its more readily accessible forms at at greater intervals, especially during the vegetative phase, and to greater absorption beneath the plant. This might have culminated in tissue with meristematic properties synthesizing more nucleic acids, amino acids, and amide materials, which would have enhanced cell division and ultimately increased plant height[5]. Lower plant height of 80.69 cm during at harvesting stages was occurred in control (T_1).

Leaf area index (LAI) and Leaf area duration (LAD) :

Fertigation of an augmented N dose turned out to be highly significant both LAI and LAD. The treatment (T_{10}) had the largest LAI during the 60 DAS (6.93) (Fig. 1),expand application of 150% RDN through drip fertigation in addition to vermicompost@ 5 t ha^{-1} and micronutrients @ 25 kg ha^{-1}. This treatment was close to 125% RDN using drip fertigation along with vermicompost @ 5 t ha^{-1} and mixture of micronutrients @ 25 kg ha^{-1} (T_6). This might be due tomacronutrients which influence physiological and metabolic processes. An appropriate nitrogen supply is essential for improving hybrid maize yield qualities. It may be due to the enhanced nitrogen application under drip fertigation, which enhanced nutrient uptake, increased the rate of photosynthetic activity, and consequently improved height of plants, LAI, and DMP. It might additionally be due to the supply of sufficient water across the period of growth. The result of the study validates the recommendations proposed by[11] with increased dose of nitrogen application in maize. The treatment control (T_1), without fertilizer application had lower LAI at 60 DAS (4.33).

Better leaf area duration was detected with the intervals of 30 to 60 DAS (161 days) under the treatment, application of 150% RDN using drip fertigation along with vermicompost @ 5 t ha^{-1} and mixture of micronutrients@ 25 kg ha^{-1} (T_{10}). This might to be because of sufficient photosynthesis, crop development, and leaf durability under ideal moisture levels, which is associated with a higher LAD. Water utilization and the duration of green leaf area were linearly connected. Higher plant growth and photosynthetic leaf area could have been produced in these treatments due to the provision of sufficient nitrogen and ideal soil moisture conditions[7,21]. Lower leaf area duration appeared in the treatment control (T_1) at 30 to 60 DAS (88 days).

Dry matter production (DMP) :

According to this experiment discoveries, higher nitrogen concentration under fertigation dramatically boosted maize DMP across various phases of development.

Maximum DMP was found in the treatment, which implemented drip fertigation combined alongside vermicompost @ 5 t ha^{-1} + mixture of micronutrients @ 25 kg ha^{-1} and application of 150% RDN(T_{10}). The treatment possessed a greater amount of dry matter production at 60 DAS (11810 kg ha^{-1}) and harvest (17676 kg ha^{-1}) (Fig. 2). This treatment was analogous to the application of 125% RDN via drip fertigation + Vermicompost @ 5 t ha^{-1} + Micronutrient mixture @ 25 kg ha^{-1} (T_6). This might be due to consequence of the enhanced height of the plant's leaf surface area, LAI, and LAD which may have contributed to an upsurge in the build-up of photosynthesis. $ZnSO_4$, $FeSO_4$, and Boron would be the substances supplied from micronutrients, which would have improved the production of auxins inside crops. Higher surface area of leaves would result in more nutrients being available to plants, which would improve plant development through absorption and the addition of additional carbohydrate within the maize crop being grown. The constant distribution of nutrients under fertigation to the soil was facilitated by the injection of organic manures and excess nitrogen at a subsequent developmental stage of the crop, and this could result in a greater amount of assimilates. This could be another reason why maize has a higher DMP when there is adequate fertigation processes with nitrogen treatments[10,16]. Lower DMP was recorded control treatment (T_1) during 60 DAS (6814 kg ha^{-1}) and harvest (6314 kg ha^{-1}).

Table-1. Effect of organic manures, micronutrients and graded levels of N fertigation on growth components of maize at harvest stage

Treatments	Plant height (cm)	LAI 60 (DAS)	LAD (Days) 30 to 60 DAS	DMP (kg ha^{-1})	
				60 DAS	Harvest
T_1 – Control with drip irrigation	80.69	4.33	88	4258	6814
T_2 – 100% RDF through drip fertigation + Vermicompost @ 5 t ha^{-1}	190.53	5.57	125	10101	14977
T_3 – 100% RDF through drip fertigation + Pressmud @ 5 t ha^{-1}	186.41	5.54	124	10025	14842
T_4 – 125% RDN through drip fertigation + Vermicompost @ 5 t ha^{-1}	211.85	6.04	137	10689	15896
T_5 – 125% RDN through drip fertigation + Pressmud @ 5 t ha^{-1}	208.27	6.01	136	10677	15803
T_6 – T_4 + Micronutrient mixture @ 25 kg ha^{-1}	245.43	6.91	160	11789	17639
T_7 – T_5 + Micronutrient mixture @ 25 kg ha^{-1}	231.34	6.50	149	11265	16801
T_8 – 150% RDN through drip fertigation + Vermicompost @ 5 t ha^{-1}	229.77	6.48	149	11233	16753
T_9 – 150% RDN through drip fertigation + Pressmud @ 5 t ha^{-1}	226.61	6.46	148	11197	16701
T_{10} – T_8 + Micronutrient mixture @ 25 kg ha^{-1}	247.95	6.93	161	11810	17676
T_{11} – T_9 + Micronutrient mixture @ 25 kg ha^{-1}	232.49	6.51	149	11290	16845
SEd	4.63	0.19	3.37	237.44	372.76
CD (p=0.05)	9.63	0.40	7.00	493.87	775.34

Crop growth rate (CGR) and Absolute crop growth rate (AGR) :

The increase in dry matter result produced by a crop per unit land area per unit time is expressed by CGR. AGR can be used to calculate the increase in plant size throughout a certain period of time (Table-2). Among the treatments, application of 150% RDN using drip fertigation along with vermicompost @ 5 t ha^{-1} and combination of micronutrients @ 25 kg ha^{-1} (T_{10}) observed higher growth analysis metrics, including crop growth rate during 30 to 60 DAS (28.87 g m^{-2} day^{-1}), 60 DAS to harvest (19.55g m^{-2} day^{-1}), and absolute crop

Table-2. Effect of organic manures, micronutrients and graded levels of N fertigationon growth indices of maize

Treatments	Crop growth rate ($g\ m^{-2}\ day^{-1}$)		Absolute crop growth rate ($cmplant^{-1}\ day^{-1}$)	
	30-60 DAS	60 DAS-harvest	30-60 DAS	60 DAS-harvest
T_1 – Control with drip irrigation	10.45	8.52	1.21	0.66
T_2– 100% RDF through drip fertigation + Vermicompost @ 5 t ha^{-1}	25.20	16.25	2.64	2.20
T_3– 100% RDF through drip fertigation + Pressmud @ 5 t ha^{-1}	25.00	16.06	2.60	2.15
T_4 – 125% RDN through drip fertigation + Vermicompost @ 5 t ha^{-1}	26.45	17.36	2.94	2.49
T_5 – 125% RDN through drip fertigation + Pressmud @ 5 t ha^{-1}	26.30	17.25	2.87	2.44
T_6– T_4 + Micronutrient mixture @ 25 kg ha^{-1}	28.83	19.50	3.38	2.90
T_7 – T_5 + Micronutrient mixture @ 25 kg ha^{-1}	27.69	18.45	3.21	2.71
T_8 – 150% RDN through drip fertigation + Vermicompost @ 5 t ha^{-1}	27.62	18.40	3.19	2.70
T_9 – 150% RDN through drip fertigation + Pressmud @ 5 t ha^{-1}	27.54	18.35	3.13	2.67
T_{10} – T_8 + Micronutrient mixture @ 25 kg ha^{-1}	28.87	19.55	3.39	2.91
T_{11} – T_9 + Micronutrient mixture @ 25 kg ha^{-1}	27.75	18.52	3.22	2.73
SEd	0.49	0.42	0.06	0.07
CD (p=0.05)	1.02	0.87	0.13	0.15

growth rate during 30 to 60 DAS(3.39 cm $plant^{-1}$ day^{-1}), 60 DAS to harvest (2.91cm $plant^{-1}$ day^{-1}). This treatment was comparable to the which had a 125% RDN through drip fertigation + vermicompost @ 5 t ha^{-1} andmi-cronutrient @ 25 kg ha^{-1} blend (T_6). Increasing the amount of nitrogen during fertigation methods, in conjunction with organic manures for vermicompost as well as incorporation of micronutrient mixtures, will accelerate the growth of crops. This happened due to nitrogen participation in the manufacturing as well as movement of cytokinins from the root system to the stems. Therefore, higher nitrogen delivery speeds up splitting of cells and promotes crop growth[17]. Crop growth indices, including the CGR from 30 to 60 DAS (10.45 g m^{-2} day^{-1}), 60 DAS to until harvesting (8.52 g m^{-2} day^{-1}), and the AGR between 30 and 60 DAS (1.21 cm $plant^{-1}$ day^{-1}), 60 DAS to until harvesting (0.66 cm $plant^{-1}$ day^{-1}) were all poorer in the treatment control.

Table-3. Effect of organic manures,micronutrients and graded levels of N fertigation yield parameters and yield of maize

Treatments	Number of grains cob^{-1}	Cob weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T_1 – Control with drip irrigation	131.62	35.03	2368	4266
T_2– 100% RDF through drip fertigation + Vermicompost @ 5 t ha^{-1}	320.05	87.09	6263	9837
T_3– 100% RDF through drip fertigation + Pressmud @ 5 t ha^{-1}	318.58	85.70	6191	9740
T_4 – 125% RDN through drip fertigation + Vermicompost @ 5 t ha^{-1}	338.47	93.63	6774	10505
T_5 – 125% RDN through drip fertigation + Pressmud @ 5 t ha^{-1}	337.56	92.64	6706	10407
T_6– T_4 + Micronutrient mixture @ 25 kg ha^{-1}	379.57	105.74	7614	11559
T_7 – T_5 + Micronutrient mixture @ 25 kg ha^{-1}	358.82	99.84	7221	11060
T_8 – 150% RDN through drip fertigation + Vermicompost @ 5 t ha^{-1}	358.03	99.47	7203	11040
T_9 – 150% RDN through drip fertigation + Pressmud @ 5 t ha^{-1}	356.96	99.03	7170	10997
T_{10} – T_8 + Micronutrient mixture @ 25 kg ha^{-1}	381.80	106.61	7628	11576
T_{11} – T_9 + Micronutrient mixture @ 25 kg ha^{-1}	360.00	100.37	7235	11075
SEd	8.16	2.48	173.20	227.85
CD (p=0.05)	16.98	5.16	360.25	473.93

Yield parameters :

The yield parameter of maize was considerably affected by the application to different organic manures, micronutrients and increased levels of nitrogen fertigation (Table 3).

Total number of grains cob^{-1} :

The number of grain row cob^{-1}, number of grains row^{-1} and total number of grain cob^{-1} all revealed to be noticeably different when compared among the treatments used in the research study. Number of grain rows cob^{-1} (14.92), number of grains row^{-1} (25.59) and total number of grains cob^{-1} (381.80) were found to be more yield attributes produced by theapplication of 150% RDN using drip fertigation along with vermicompost @ 5 t ha^{-1} and combination of micronutrients @ 25 kg ha^{-1} (T_{10}). This treatment was close to the application of 125% RDN using drip fertigation and vermicompost at @ 5 t ha^{-1} + micronutrient @ 25 kg ha^{-1} blends (T_6). Due to using fertilizer

Table-4. Effect of organic manures, micronutrients and graded levels of N fertigationon NPK uptake (kg ha^{-1}) by maize

Treatments	N	P	K
T_1 – Control with drip irrigation	76.32	10.22	70.18
T_2 – 100% RDF through drip fertigation + Vermicompost @ 5 t ha^{-1}	173.73	22.47	154.26
T_3 – 100% RDF through drip fertigation + Pressmud @ 5 t ha^{-1}	172.17	22.26	152.87
T_4 – 125% RDN through drip fertigation + Vermicompost @ 5 t ha^{-1}	184.39	23.84	162.73
T_5 – 125% RDN through drip fertigation + Pressmud @ 5 t ha^{-1}	183.31	23.70	162.77
T_6 – T_4 + Micronutrient mixture @ 25 kg ha^{-1}	204.61	26.46	181.68
T_7 – T_5 + Micronutrient mixture @ 25 kg ha^{-1}	194.89	25.20	172.05
T_8 – 150% RDN through drip fertigation + Vermicompost @ 5 t ha^{-1}	194.33	25.13	172.56
T_9 – 150% RDN through drip fertigation + Pressmud @ 5 t ha^{-1}	193.73	25.05	172.02
T_{10} – T_8 + Micronutrient mixture @ 25 kg ha^{-1}	205.04	26.51	182.06
T_{11} – T_9 + Micronutrient mixture @ 25 kg ha^{-1}	195.40	25.27	173.50
SEd	4.31	0.52	3.77
CD (p=0.05)	8.97	1.09	7.85

Table-5. Effect of organic manures,micronutrients and graded levels of N fertigation on Agronomic Efficiency and Apparent Nutrient Recovery of maize

Treatments	AE (kg ha^{-1})	ANR (%)
T_1 – Control with drip irrigation	-	-
T_2 – 100% RDF through drip fertigation + Vermicompost @ 5 t ha^{-1}	13.91	34.79
T_3 – 100% RDF through drip fertigation + Pressmud @ 5 t ha^{-1}	17.22	43.17
T_4 – 125% RDN through drip fertigation + Vermicompost @ 5 t ha^{-1}	13.88	34.04
T_5 – 125% RDN through drip fertigation + Pressmud @ 5 t ha^{-1}	16.72	41.23
T_6 – T_4 + Micronutrient mixture @ 25 kg ha^{-1}	16.52	40.41
T_7 – T_5 + Micronutrient mixture @ 25 kg ha^{-1}	18.70	45.69
T_8 –150% RDN through drip fertigation + Vermicompost @ 5 t ha^{-1}	13.62	33.24
T_9 – 150% RDN through drip fertigation + Pressmud @ 5 t ha^{-1}	16.17	39.53
T_{10} – T_8 + Micronutrient mixture @ 25 kg ha^{-1}	14.82	36.26
T_{11} – T_9 + Micronutrient mixture @ 25 kg ha^{-1}	16.39	40.09

(*statistically not analyzed)

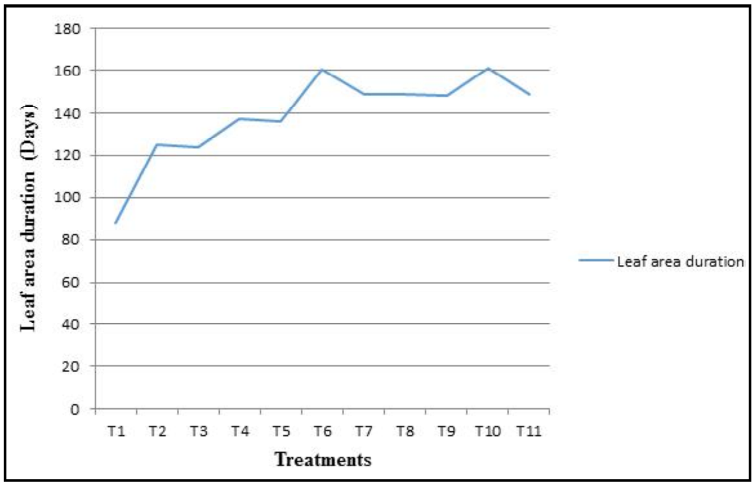

Fig. 1. Effect of organic manures, micronutrients and graded levels of N fertigationon leaf area duration (Days).

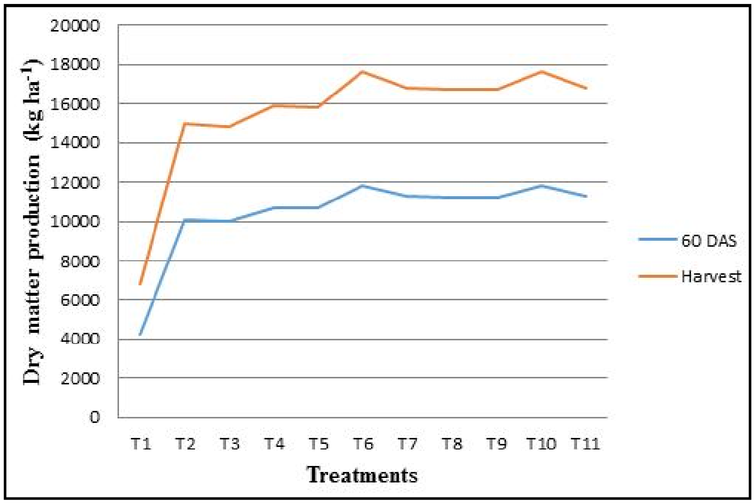

Fig. 2. Effect of organic manures, micronutrients and graded levels of N fertigation on dry matter production (kg ha^{-1}) of maize.

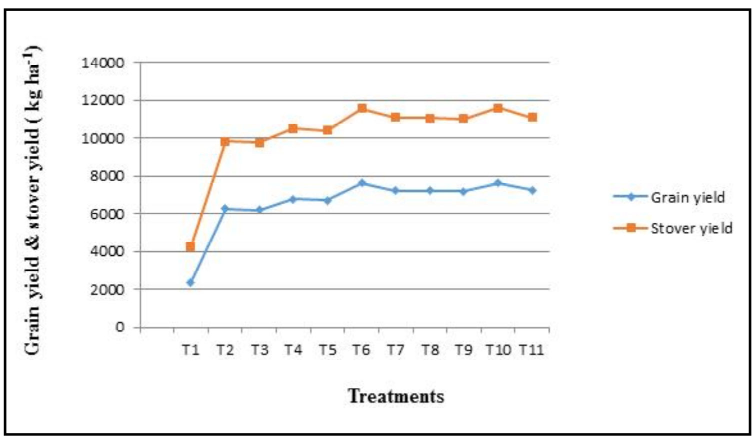

Fig. 3. Effect of organic manures, micronutrients and graded levels of N fertigation on grain yield (kg ha^{-1}) and stover yieldof maize.

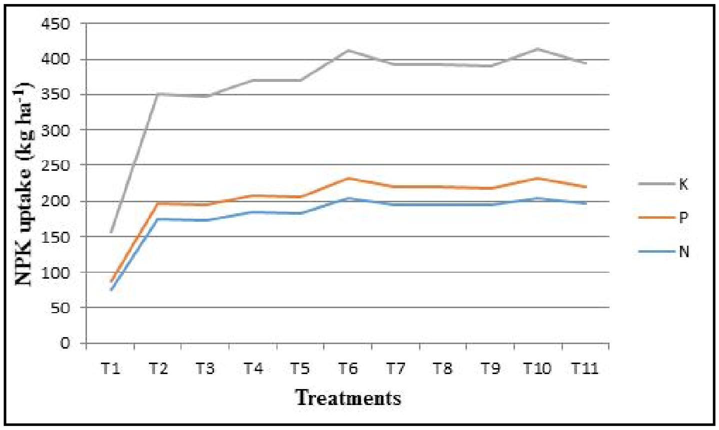

Fig. 4. Effect of organic manures, micronutrients and graded levels of N fertigationon NPK nutrient uptake by maize.

by way of the fertigation process diminished the leakage of nutrients from the roots zone and bumped the utilization of nutrients by plants that were developing. Fertigation of the nitrogen in the most easily obtainable form and at greater frequency brought about in improved accessibility of nitrogen in the soil solution, which subsequently in turn commanded to larger growth, intake and enhanced assimilates movement between sources to the sinking stage, resulting in improved yields[19]. They concluded that the addition of micronutrients containing magnesium may have improved yield attributes because grain number is a direct indicator of pollen viability[12]. The control treatment (T_1) acquired decreased yield characteristics, including the number of grain rows cob^{-1} (8.08), number of grain rows cob^{-1} (16.29) and total number of grains cob^{-1} (131.62).

Cob weight :

As the chemical fertilizer dosage (RDN%) was increased during fertigation, the cob weight expanded correspondingly. The treatment with application of 150% RDN using drip-fertigation technique coupled with vermicompost @ 5 tha^{-1} andmixture of micronutrients @25 kg ha^{-1} (T_{10}) noticed bigger cob weight (106.61 g). This treatment was comparable to treatment (T_6) which had a 125% RDN by employing drip fertigation and vermicompost at @ 5 tha^{-1} plus the micro nutrients mixture @ 25 kg ha^{-1}. This might be responsible to the rapid dissolution of mineral components that were made simple to get and then received by those who received plants, contributing to an increase in outstanding photosynthetic production and effective transmission for the formation of the reproductive parts, bringing to a more expansive quantity of baby corn[13]. By treatment control, a reduction in cob weight (35.03 g) was noted.

Grain yield and stover yield :

Diverse organic manure sources, micronutrients and graded levels of nitrogen used in fertigation techniques showed substantial effects on the crop yield of maize (Table-3) (Fig. 3).

During fertigation, the grain yield

increased in a direct relationship to the dosage (RDN%) of chemical fertilizer. Grater grain yield (7628 kg ha^{-1}) and stover yield (11576 kg ha^{-1}) occurred that applied 150% RDN implementing the drip-fertigation approach in conjunction with vermicompost@ 5 tha^{-1} and mixture of micronutrients @ 25 kg ha^{-1} (T_{10}). This treatment was similar to the application of 125% RDN by drip fertigation and vermicompost @ 5 tha^{-1} plus micronutrient @ 25 kg ha^{-1} blend (T_6). This could be as a result of the crop's active roots area receiving regular nutrient supplies. Regular drip fertigation applications of water and nutrients kept in close association with the plant's root tissue with very little leaching loss[4]. According to the author, increased growth parameters that include height of plants, amount of leaves, leaf area, LAI, and DMP might have been to accuse for maize's more substantial grains and the stover yield[1]. Micronutrient fertilization is also credited with improving the manufacturing of carbohydrate and bringing them to the site for grain production. Grain yield (2368 kg ha^{-1}) and stover yield (4266 kg ha^{-1}) wereall lower control without fertilizer application (T_1).

Nutrient uptake :

Addition of organic manures, micronutrients with enhanced N levels during fertigation significantly impacted the amount of nutrients that maize absorbed (Table-4) (Fig. 4).

Greater nutrients absorption rate of N (205.04 kg ha^{-1}), P (26.51 kg ha^{-1}) and K (182.06 kg ha^{-1}) was occurred the treatment applied 150% RDN implementing the drip fertigation approach in conjunction with vermicompost @ 5 tha^{-1} and mixture of micronutrients @25 kg ha^{-1} (T_{10}). This treatment was comparable to the application of 125% RDN through drip fertigation and vermicompost @ 5 tha^{-1} plus micronutrient @ 25 kg ha^{-1} blend (T_6). The results might due to be combining chemical fertilizer to organic manures additionally increases the yield of crops nevertheless improves the natureof soil and boosts intake of NPK nutrients[9]. The lower nutrient absorption rate of N (76.32 kg ha^{-1}), P (10.22 kg ha^{-1}) and K (70.18 kg ha^{-1}) was foundin the treatment control (T_1).

Agronomic efficiency and Apparent N recovery :

Among the treatments, application of 125 % RDN + Pressmud@ 5 t ha^{-1} + Micronutrient mixture @ 25 kg ha^{-1} (T_7) was noted maximum Agronomic use efficiency (18.70 kg kg^{-1}) and apparent N recovery (45.69 %). This might due to be the frequency of fertigation had minimal impact on AE and ANR This is brought on by variations in grain yield. Depending on the fertigation level, rate of fertigation had a direct effect on the AE and ANR of all administered nutrients, leading to a higher recovery of nutrients than all other less frequencies (Table-5). The leastranges of AE and ANR registered under the treatment 150 % RDN through drip fertigation + vermicompost @ 5 t ha^{-1} (T_8)[14].

In this presence study effect of organic manures, micronutrient mixture and different levels of enhanced N under fertigation techniques by 150% RDN through fertigation + Vermicompost @ 5 tha^{-1} + micronutrient mixture @ 25 kg ha^{-1} (T_{10}) was noted higher growth attributes *i.e.,* plant height, LAI, LAD, DMP, CGR, AGR and yield attributes *viz.*, total number of grains cob^{-1}, cob weight, grain yield, stover yieldand nutrient absorption rate compared to 100 % recommended dose of RDF. It has been determined that this enhanced N fertilizer fertigation method, in combination with the addition of vermicompost and micronutrient mixture might be a practical method in maize for enhancing growth characters, yield characters, and grain production, as well as potentially being profitable for maize growers.

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Conflicts of interest

The authors report no conflicts of interest in this work.

Ethical approval

This study does not involve any experiments on human or animal subjects.

Data availability

All data generated and analysed or included with in the research.

References :

1. Adarsha, G.S., H. Veeresh, K. Narayanarao, A. K. Gaddi and M. A. Basavanneppa. (2019). *J. Farm Sci, 32*(2), 162-166.
2. Anonymous, (2015). The current status published on website – *http: //www.fau. usda.gov/psdonline.*
3. Biswasi, S. K., A. K. Barik, D. K. Bastia, B. Dalei, L. Nayak and M. Ray. (2020). *International Journal of Bio-resource and Stress Management*, *11*(5): 465-471.
4. Brar, N. S., B. Kumar, J. Kaur, A. Kumar, H.K. Verma, R. Singh and P. Singh (2019). *Range Management and Agroforestry*, *40*(2): 306-312.
5. Dharaiya, B. K., R. M. Solanki, D. A. Jadav, N. N. Damor, and K. V. Malam. (2022). *Journal of Pharmacognosy and Phytochemistry*, *10*(2): 1546-1550.
6. Hafeez B, Y. Khanif and M. Saleem. (2013). *Journal of Experimental Agriculture International,* 374-391.
7. Halli, H.M., S. Angadi, A. Kumar, P. Govindasamy, R. Madar, V. D. C. Baskar, H. O Elansary, N. Tamam, A. M. M. Abdelbacki and S. A. M. Abdelmohsen. (2021). *Plants. 10:* 1094.
8. Jeevabharathi, S., G. Srinivasan and S. Krishnaprabu. (2020). *International Journal of Chemical Studies, 8*(4): 3877-3880.
9. Raddy, G., H. Jayadeva, D. Hanumantappa, B. Lalitha, G. Kadalli and C. Ramachandra (2022). *Mysore Journal of Agricultural Sciences, 56*(4).
10. Raghuramakrishnan, M., V. M. Sankaran, E. Somasundaram and P. T. Ramesh. (2021). *The Pharma Innovation Journal*, *10*(11): 251-255.
11. Ramachandiran, K., and S. Pazhanivelan. (2016). Abiotic factors (nitrogen and water) in maize: A review. *Agricultural Reviews*, *37*(4):
12. Ramanjineyulu, M., M. S. Reddy and Kavitha (2016). Effect of secondary and micronutrients on yield and yield forming

characters of maize. (*zea mays* l.).

13. Sale, M. N. A., G. Singh, S. Menon, and J. Yomso. (2023). *Journal of Applied Biology and Biotechnology*.
14. Sampathkumar, T and B.J. Pandian (2010). *Madras Agricultural Journal*, *97*(7-9): 245-48.
15. Singh, S., T. S. Patil, P. Tekade, M. B. Gawande and A. N. Sawarkar (2021). *Science of the Total Environment, 783:* 147004.
16. Stesi, S., R. Karthikeyan, R. Sivakumar and N. Maragatham (2020). *Journal of Pharmacognosy and Phytochemistry, 9*(1): 196-199.
17. Swarna Ronanki and U.K. Behera (2018). *International Journal of Current Microbiology & Applied Sciences 7*(1): 845-858.
18. USDA-UnitedStates Departmentof Agriculture, GlobalMarketAnalysis-2022.
19. Vineela K., K. Chandrasekhar, S. Prathibha, G. Lakshmi, and N. Lakshmi. (2021). *International Journal of Chemical Studies. 9*(1): 105-108.
20. Wu, D., X. Xu, Y. Chen, H. Shao, and E. Sokolowski (2019). *Agricultural Water Management*, *213*: 200-211.
21. Xiaolong, W., T. Ye, T.A.U.K. Syed, Y. Zhu, L. Liu, W. Cao and T. Tang (2017). *Frontiers in Plant Science. 8:* 1517.