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## Effect of integrated nutrient management in maize

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### Abstract

A field trial was conducted at Krishi Vigyan Kendra, Anand Agricultural University, Dahod during the years 2020-21 and 2021-22 to study the effect of integrated nutrient management in maize-groundnut cropping sequence. The treatment consisted of integrated nutrient management *viz.*, M<sub>1</sub>: 100% RDN through inorganic fertilizer (150:40:00 N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O kg/ha), M<sub>2</sub>: 75% RDN through inorganic fertilizer + 25% RDN through FYM, M<sub>3</sub>: 75% RDN through inorganic fertilizer + 25% RDN through vermicompost, M<sub>4</sub>: 75% RDN through inorganic fertilizer + 25% RDN through FYM + Bio NPK consortium and M<sub>5</sub>: 75% RDN through inorganic fertilizer + 25% RDN through vermicompost + Bio NPK consortium to maize in *rabi* season as main plot treatments replicated four times in randomized block design. The results summarized that significantly higher grain and straw yields were recorded with an application 75% RDN through inorganic fertilizer + 25% RDN through vermicompost + Bio NPK consortium (M<sub>5</sub>) but it was at par with (M<sub>4</sub>) in two years in pooled data. Same trend was observed in nitrogen, phosphorus and potassium uptake of grain and straw of maize. On the basis of two years average, maximum net returns and BCR was recorded with the treatment 75% RDN through inorganic fertilizer + 25% RDN through vermicompost + Bio NPK consortium (M<sub>5</sub>) followed by (M<sub>4</sub>), (M<sub>1</sub>) and (M<sub>3</sub>).

**Keywords:** Maize, INM, grain yield and Nutrient uptake

### Introduction

Globally, maize is cultivated on an area of 195 million ha with production of 1100 million tonnes having a productivity of 5632 kg/ha. In India, maize is cultivated on 9.07 million ha land with a production of 23.83 million tonnes and productivity of 2627 kg/ha. India stands sixth in world with respect to maize production. The Cultivation of maize is mostly confined to the states of Rajasthan, Maharashtra, Gujarat, Uttar Pradesh, Karnataka, Madhya Pradesh, Andhra Pradesh and Jammu - Kashmir. Gujarat occupies an area of 0.40 million ha with a production of 0.71 million tonnes and productivity of 1775 kg/ha (Anon., 2018) <sup>[1]</sup>.

Chemical fertilizers plays a significant role in providing readily available nutrients to crops, including maize and groundnut, and can greatly enhance yield potential. Maize is particularly responsive to chemical fertilizers and their application often leads to increased productivity. However, relying solely on chemical fertilizers have adverse effects on soil health over time. To maintain soil fertility and sustainability, a balanced approach that integrates organic manures, such as farmyard manure (FYM) or urban compost becomes essential. Integrated nutrient management (INM) is also one such important approach for marginal farmers who cannot afford to supply crop nutrients through costly chemical fertilizers.

### Materials and Methods

The field experiment was conducted at Krishi Vigyan Kendra, Anand Agricultural University, Muvaliya Farm, Dahod in block - C, Plot No. - 21 during *rabi* seasons of 2020-21 and 2021-22. The soil of experimental field was clayey in texture, low in available nitrogen (271 kg/ha), medium in organic carbon (0.51%) and available phosphorus (39.25 kg/ha) wherever high in available potash (341.21 kg/ha). The treatment consisted of integrated nutrient management *viz.*, M<sub>1</sub>: 100% RDN through inorganic fertilizer (150:40:00 N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O kg/ha), M<sub>2</sub>: 75% RDN through inorganic fertilizer + 25% RDN through FYM, M<sub>3</sub>: 75% RDN through inorganic fertilizer + 25% RDN through vermicompost, M<sub>4</sub>: 75% RDN through inorganic fertilizer + 25% RDN through FYM + Bio NPK consortium and M<sub>5</sub>: 75% RDN through inorganic fertilizer + 25% RDN through vermicompost + Bio NPK consortium to maize in *rabi* season as main plot treatments replicated four times in randomized block design. The experiment was conducted on same site without changing randomization of treatments for successive year.

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The test variety of maize cultivar GAWMH 2 with spacing of 75 x 20 cm was adopted. Nitrogen was applied through urea (46% N) whereas phosphorus was applied through single superphosphate (16% P<sub>2</sub>O<sub>5</sub>). The 50% dose of nitrogen and full dose of phosphorus were applied at the time of sowing, remaining half dose of nitrogen was top dressed through urea as per treatment. In case of phosphorus fertilizer, the quantity of phosphorus from vermicompost and FYM was counted and deducted from the quantity of recommended dose of phosphorus and remaining phosphorus was applied through Signal Super Phosphate (SSP).

## Results and Discussion

### Growth attribute

From Table 1, it can be seen that plant height of maize was increased with an advancement of crop age during both the years of investigation and reached maximum at harvest. It was also observed that an increase in plant height was found more pronounced during 60 DAS to till harvest. The difference in

plant height among different treatments did not exert their significant effect at 30 DAS. The difference in plant height among different treatments were significant at 60 DAS and at harvest stages of crop growth. At 60 DAS, significantly taller plants were observed in treatment M<sub>5</sub> (75% RDN through inorganic fertilizer + 25% RDN through vermicompost + Bio NPK consortium) whereas it was at par with treatment M<sub>4</sub> (75% RDN through inorganic fertilizer + 25% RDN through FYM + Bio NPK consortium) in two years of pooled data. Similar trend was observed at harvesting stage. All the stages of crop growth exhibited significantly lower values of plant height in two years pooled data recorded in 100% RDN through inorganic fertilizer (150 kg N/ha) (M<sub>1</sub>), at 60 DAS and harvest stages. The enhanced growth with different levels of fertilizer and organic source treatments was also reported by Kannan *et al.* (2013)<sup>[5]</sup>, Shinde *et al.* (2014)<sup>[7]</sup>, Singh *et al.* (2017)<sup>[8]</sup>, Jadav *et al.* (2018)<sup>[3]</sup>, Jeevabharathi *et al.* (2020)<sup>[4]</sup> as well as Vaghela *et al.* (2020)<sup>[10]</sup> in *rabi* maize.

**Table 1:** Periodical plant height of maize crop as influenced by integrated nutrient management (Pooled data of 2 years)

Treatment Details	Plant height at 30 DAS (cm)	Plant height at 60 DAS (cm)	Plant height at harvest (cm)
M <sub>1</sub> : 100% RDN (150 kg N/ha)	45.15	113.85	175.63
M <sub>2</sub> : 75% RDN + 25% RDN through FYM	43.38	113.78	175.25
M <sub>3</sub> : 75% RDN + 25% RDN through vermicompost	44.52	118.38	178.13
M <sub>4</sub> : 75% RDN + 25% RDN through FYM + Bio NPK consortium	46.16	129.88	198.00
M <sub>5</sub> : 75% RDN + 25% RDN through vermicompost + Bio NPK consortium	46.39	138.05	203.25
S.Em.±	1.20	3.55	4.54
C.D. at 5%	NS	10.29	13.17
C.V. %	7.82	8.71	7.28
Interaction (Y × M)	NS	NS	NS

**Yield attribute and yield:** The magnitude of expression of yield attributes like cob length, cob girth, Number of cobs per plant, number of grains per cobs, grain weight per cob, seed index, shelling percentage, grain and straw yields were significantly influenced by INM treatments. Significantly higher grain and straw yields of 3819, 4080 & 3950 and 5682, 6114 & 5898 kg/ha, respectively were recorded with an application 75% RDN through inorganic fertilizer + 25% RDN through vermicompost + Bio NPK consortium (M<sub>5</sub>) but it was at par with (M<sub>4</sub>) in two years of pooled data. (Table 2) These findings are in close agreement with the results obtained by Kannan *et al.* (2013)<sup>[5]</sup>, Shinde *et al.* (2014)<sup>[7]</sup>, Pandey and Avasthi (2014)<sup>[6]</sup>, Singh *et al.* (2017)<sup>[8]</sup>, Jadav *et al.* (2018)<sup>[3]</sup>, Jeevabharathi *et al.* (2020)<sup>[4]</sup>, Vaghela *et al.*

(2020)<sup>[10]</sup>, Chauhan *et al.* (2022)<sup>[2]</sup> and Yadav *et al.* (2022)<sup>[12]</sup> in *rabi* maize. Owing to their addition, applied NPK through FYM or by vermicompost and by release of nutrients from native sources in soil due to their high biological activity particularly under an application of organic and inorganic fertilizers resulted in high dry matter production as indicated by plant height, number of leaves per plant and high leaf area which ultimately increased the straw yield of maize in above treatments except for chemical fertilizers. It may be also due to application of 75 percent NPK fertilizers along with organic manures and bio fertilizer which lead to improvement in soil fertility due to increase in population of beneficial micro-flora in soil improving the physical properties of the soil.

**Table 2:** Yield attribute of maize as influenced by integrated nutrient management (pooled data of 2 years)

Treatment Details	Cob length (cm)	Cob girth (cm)	Number of cobs per plant	Number of grains per cob	Grain weight per cob (g)	Shelling percentage (%)	Grain yield (kg/ha)	Straw yield (kg/ha)
M <sub>1</sub>	14.88	12.69	1.23	321	81.13	76.26	3008	4668
M <sub>2</sub>	15.04	13.69	1.23	342	84.50	75.61	3234	4784
M <sub>3</sub>	15.73	13.97	1.25	351	86.88	76.73	3317	4970
M <sub>4</sub>	18.04	15.23	1.43	404	99.00	78.84	3757	5609
M <sub>5</sub>	19.48	16.88	1.55	410	101.38	80.07	3950	5898
S.Em.±	0.63	0.52	0.04	14.21	2.94	0.69	119	170
C.D. at 5%	1.83	1.53	0.13	41.18	8.54	2.00	347	492
C.V. %	11.20	11.05	10.14	11.87	9.94	2.63	10.60	9.98
Interaction (Y × M)	NS	NS	NS	NS	NS	NS	NS	NS

### Nutrient uptake

It can be interred from table 3 that, nitrogen uptake by maize was found significant due to effect of different treatments.

Significantly higher nitrogen uptake by maize grain (Table 3) was recorded with an application of 75% RDN through inorganic fertilizer + 25% RDN through vermicompost + Bio

NPK consortium (M<sub>5</sub>), while it was at par with treatment 75% RDN through inorganic fertilizer + 25% RDN through FYM + Bio NPK consortium (M<sub>4</sub>) in two years of pooled data. Significantly, lower nitrogen uptake by maize was recorded under 100% RDN through inorganic fertilizer (150 kg N/ha). Same trend was observed in phosphorus and potassium uptake of maize grain and straw. Nutrients uptake (N, P and K) are vital in enhancing yield and nutrient content. Considerable increase in either nutrient content or in yield may increase

nutrient uptake. The uptake of any nutrient is the function of its content and dry matter production by the crop. Higher nutrient content of produce and higher biomass production of maize might be the pertinent reason for higher uptake of nutrients. These findings are in close agreement with the results reported by Pandey and Avasthi (2014)<sup>[6]</sup>, Subbaiah and Ram (2019)<sup>[9]</sup> and Verma and Bindra (2019)<sup>[11]</sup> in *rabi* maize.

**Table 3:** N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O uptake by grain and straw of maize as influenced by integrated nutrient management (pooled data of 2 years)

Treatment Details	N uptake by grain (kg/ha)	N uptake by straw (kg/ha)	P <sub>2</sub> O <sub>5</sub> uptake by grain (kg/ha)	P <sub>2</sub> O <sub>5</sub> uptake by straw (kg/ha)	K <sub>2</sub> O uptake by grain (kg/ha)	K <sub>2</sub> O uptake by straw (kg/ha)
M <sub>1</sub>	44.61	23.80	8.72	7.63	12.96	41.11
M <sub>2</sub>	48.30	24.54	9.64	7.82	13.86	42.75
M <sub>3</sub>	50.18	25.93	10.40	8.28	14.41	44.24
M <sub>4</sub>	59.37	30.55	12.00	9.79	16.82	50.99
M <sub>5</sub>	63.39	34.61	12.95	10.52	18.33	54.80
S.Em.±	2.02	1.08	0.45	0.30	0.58	1.79
C.D. at 5%	5.86	3.14	1.31	0.90	1.68	5.20
C.V. %	11.63	11.78	12.82	10.66	11.54	11.68
Interaction (Y × M)	NS	NS	NS	NS	NS	NS

### Economics

On the basis of average, the economics of maize crops as INM for 2020-21 and 2021-22 is illustrated in table 4, the maximum net returns of 38939 ₹/ha was recorded with the treatment receiving 75% RDN through inorganic fertilizer +

25% RDN through vermicompost + Bio NPK consortium (M<sub>5</sub>) followed by (M<sub>4</sub>), (M<sub>1</sub>) and (M<sub>3</sub>). Application of 100% RDN through inorganic fertilizer recorded maximum BCR of 1.96 followed by (M<sub>4</sub>).

**Table 4:** Economics of maize as influenced by integrated nutrient management (Average 2020-21 and 2021-22 years)

Treatment Details	Yield (kg/ha)		Gross returns (₹/ha)	Cost of cultivation (₹/ha)			Net Returns (₹/ha)	BCR
	Grain	Straw		Fix	Variable	Total cost		
M <sub>1</sub>	3008	4668	65959	29573	4130	33703	32256	1.96
M <sub>2</sub>	3234	4784	70562	29573	13811	43384	21177	1.63
M <sub>3</sub>	3317	4970	72468	29573	17155	46728	25739	1.55
M <sub>4</sub>	3757	5609	82051	29573	14411	43984	38066	1.87
M <sub>5</sub>	3950	5898	86267	29573	17755	47328	38939	1.82

Selling price: Maize grain: 19.6 ₹/kg, Maize Straw: 1.5 ₹/kg

### Conclusion

From the results obtained for two year of experiment, it can be concluded that to obtain a higher profitable yield of *rabi* maize, as well as to increase the uptake of nutrient the crop should be fertilized with 75% RDN through inorganic fertilizer + 25% RDN through vermicompost + Bio NPK consortium (M<sub>5</sub>).

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