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Impact of Integrated Nutrient Management on Growth and Yield of Maize

Namde. T.B.[1*], Dalavi. V.M.[2] and Karanjikar P.N.[3]

[*1]Lokmangal College of Agriculture, Wadala, Maharashtra
[2]College of Agriculture, Alani(Gadpati) Dharashiv, Maharashtra
[3]Department of Agronomy, College of Agriculture, Latur-431402 (India)

***Corresponding E. mail:** tushar.namde@gmail.com; vishaldalavi33@gmail.com

Abstract

The field investigation entitled "Productivity of maize (*Zea mays* L.), as influenced by integrated nutrient management" was conducted on Experimental farm of Agronomy Department, College of Agriculture, Latur during kharif season. The field experiments was laid as in randomized block design with nine treatments which treatments includes viz, T_1: 100% NPK kg ha^{-1}, T_2: 100% NPK + Zn @ 3 kg ha^{-1}, T_3 : 100% NPK + S @ 20 kg ha^{-1}, T_4: 100% NPK + Zn @ 3 kg ha^{-1} + S @ 20 kg ha^{-1}, T_5: 100% NPK + Seed treatment with Azotobacter @ 30 g kg ha^{-1}, T_6 : 100% NPK + FYM @ 5 t $^{ha-1}$, T_7 : 125% NPK kg ha^{-1}, T_8 : 75% NPK kg ha^{-1}, T_9 : Control [NO PO KO] and replicated thrice. The highest grain yield (5962 kg ha^{-1}) was recorded with the application of (T_7) 125 % NPK kg ha^{-1}, followed by application of (T_6) 100% NPK + FYM @ 5 t ha^{-1}. Thus, for grain and biological yields were also significantly affected due to various treatments. Maize crop when fertilized with (T_7) 125 % NPK kg ha^{-1} recorded significantly higher grain and biological yields over rest of the treatments and biological yields over rest of the treatments.

Keywords: INM, Growth, Yield, Maize *etc.*

Introduction

Integrated nutrient management is the combined application of chemical fertilizers and organic manures for crop production. Its main aim is the maintenance of soil fertility and the supply of plant nutrients in adequate amounts. It is ecologically, socially and economically viable. The nutrients stored in the soil. The nutrients purchased from outside the farm. Plant nutrients present in crop residues, manures, and domestic wastes. Nutrient uptake by crops at harvest time Dubey *et al.*, (2019).

Maize is considered as the "Queen of Cereals". Being a C4 plant, it is capable to utilize solar radiation more efficiently even at higher radiation intensity. In India, Maize (*Zea mays* L.) is the third most important cereal crop after rice and wheat that provides food, feed, fodder and serves as a sources of basic raw material for the number of industrial products viz., starch, protein, oil, alcoholic beverages, food sweeteners, cosmetics, bio-fuel etc. No other cereal is being used in as many ways as maize. Virtually, every part of the plant has an economic worth. The grain can be consumed as human food, fermented to produce a wide range of food and beverages, feed to live stock and used as industrial input in the production of starch, protein, oil, sugar, ethyl alcohol etc. The leaves, stalks and tassels can be feed to livestock, either green or dried. The roots can be used for mulching, incorporate in to soil to improve the physical structure or dried and burned as fuel. It occupied an important place as a source in a human food (24%), animal feed (11%), poultry feed (52%), starch (11%) and brewery (1%). With the increasing trends of maize production, the projected demand of maize (22.73 Mt) by the end of XI five-year plan (2011-12) will be achieved through improved maize production technologies focused on 'Single Cross Hybrids' Kumar *et al.*, (2019); Verma *et al.*, (2016).

In world, maize is cultivated on an area of 142.3 million hectares with the production of 588 million tonnes of grain with 4132 kg ha^{-1} productivity. In India, maize is cultivated over 8.17 million ha with a production of 19.73 million tonnes having an average productivity of more than 2400 kg ha^{-1} contributing about 8% to the India food basket (DOES, 2010). Maize is cultivated throughout the year in different parts of the country for various purposes including grain, fodder, green cobs, sweet corn, baby corn, popcorn etc. The major maize growing states that contributes more than 80% of the total maize production are Andhra Pradesh (20.9 %), Karnataka (16.5%), Rajasthan (9.9 %), Maharashtra (9.1%), Bihar (8.9%), Uttar Pradesh (6.1 %), Madhya Pradesh (5.7 %), Himachal Pradesh (4.4 %). Hence, maize has emerged as important crop in the non-traditional regions i.e. peninsular India as the state like Andhra Pradesh which ranks 5^{th} in area (0.79 m ha) has recorded highest production (4.14 Mt) and productivity (5.26t ha^{-1}) in the country. Though traditionally, it is a kharif crop from past decades, it is also being cultivated in rabi season because of high yield levels and low cost of production. During the past 10 years, there is an increasing trend for area, production and productivity in maize.

Materials and Methods

An experiment was carried out on Experimental farm of Agronomy Department, College of Agriculture, Latur during kharif season. Geographically Latur is situated at 18o 5' to 18o 74' North latitude and 76o 25' to 77025' East longitude. Its height above mean sea level is about 633.85 m and has semiarid climate. The climate of Marathwada region on annual basis can be classified as semiarid type. The region experiences hot dry summer (March-May), cold winter (October- February) and wet humid with assured rainfall in monsoon (June-September), but due to vagaries of monsoon the crop production is always risky. The average annual rainfall of Latur is 840 mm which was received mostly from 'South-West monsoon'. Out of the total annual precipitation about 75 per cent is received during the period of June-September and remaining quantity was received during the month of October. The total rainfall received during crop growth season was 679.3 mm and distributed over 29 rainy days during the course of experimentation. The annual mean maximum temperature was 29.910C while mean minimum temperature was 21.280C. The relative humidity percentage during kharif ranged between 64.93 to 77.75 per cent.

Results and Discussion

Crop growth and Development

The beneficial effects of different fertilizer levels on plant height, stem girth, number of functional leaves, leaf area and total dry matter of maize were evident during active growth and maturity.

Treatment 125% NPK kg ha^{-1} (T_7) produced more vegetative growth in early period of crop growth. The plant height was maximum during early growth period up to 90 days. The difference in stem girth between 125% NPK kg ha^{-1} (T_7) and 100% NPK + FYM @ 5 t ha^{-1} (T_6) treatment were marginal at all the crop growth stages but it was maximum as compared to other fertilizer levels. The results are in conformity with those reported by Saragoni and Poss (2018), Pathak *et al.,* (2019), Rameshwar and Singh (2018), Reddy and Reddy (2018).

Evidence of 125% NPK kg ha^{-1} (T_7) fertilizer level on number of functional leaves and leaf area was observed at all the crop growth stages. Treatment 125% NPK kg ha^{-1} (T_7) recorded almost similar magnitude of number of functional leaves and leaf area with 100% NPK + FYM @ 5 t ha^{-1} (T_6) and 100% NPK + Zn @ 3 kg ha^{-1} + S @ 20 kg ha^{-1} (T_4) respectively which was more than remaining fertilizer treatments. The increase in plant height, stem girth, number of functional leaves and leaf area may be attributed to NPK application which by influencing cell division and their enlargement encouraged the production of more carbohydrates. The result also confirms the findings of Singh and Sharma (2016), Pathak *et al.,* (2019), Sutalia and Singh (2019), Singh and Yadav (2016) and Tripathi and Shukla (2018).

Increase in total dry matter was recorded with application of 125% NPK kg ha^{-1} (T_7) fertilizer treatment followed by 100% NPK + FYM @ 5 t ha^{-1} (T_6).The total dry matter was increased due to increasing fertilizer treatment up to 125% NPK kg ha^{-1} (T_7), particularly which influenced plant height, number of functional leaves and leaf area which are of vital part of the plants where the process of photosynthesis takes place and thereby build up more photosynthates, which reflected ultimately on dry matter accumulation. These results are in conformity with those recorded by Rameshwar and Singh (2018), Jamwal (2018).

Yield attributes and yield

It is clearly noted from the data (Table 1) that the application of 125% NPK kg ha^{-1} (T_7) fertilizer treatment was found to be favorable for yield attributes namely grain yield plant-1 (Table 1) and seed index (Table 1).

Application of 125% NPK kg ha-1 (T_7) followed by 100% NPK + FYM @ 5 t ha^{-1} (T_6), produced higher cob girth and cob diameter respectively as compared to other fertilizer treatments. This might be owing to the beneficial effects of FYM on influencing the yield attributes favorably. It confirms the findings of several researchers like Singh and Arya (2016), Balasubramanian *et al.,* (2019), Kumar *et al.,* (2018), Pathak *et al.,* (2018), Kumpawat (2018), Singh and Choudhary (2016) and Kumar *et al.,* (2019).

Remarkable improvement in seed yield per plant (107.73 g) and seed yield (5962 kg ha^{-1}) was noticed due to 125% NPK kg ha^{-1} (T_7) fertilizer treatment. This improvement may be the reflection of higher seed index. Treatment 125% NPK kg ha^{-1} (T_7) played a major role in furnishing the needs of maize crop to attain its maximum yield potential. The results of present investigation indicating positive response of various yield parameters to balanced and higher level of fertilization corroborates findings of several researchers Kumar *et al.,* (2016), Pathak *et al.,* (2019), Kumpawat (2018), Singh and Choudhary (2016).

Biological yield (19,565 kg ha^{-1}) was appreciably improved due to 125% NPK kg ha^{-1} (T_7) fertilizer treatment. The results are in close agreements with the findings of Patanshetti *et al.,* (2018), Sankhyan *et al.,* (2017), Kumar *et al.,* (2017), Karki *et al.,* (2019), Pathak *et al.,* (2019), Kumar *et al.,* (2019), Haque *et al.,* (2019).

Pronounced increase in harvest index (30.47 percent) due to application of 125% NPK kg ha^{-1} (T_7) treatment was noticed during the course of investigation. This may attribute to the increase of improvement in grain yields due to balanced fertilization. This finding confirms to those reported by Sharma and Gupta (2018) and Dubey *et al.,* (2019).

Conclusions

Integrated Nutrient Management (INM) plays a vital role in sustaining soil fertility and enhancing crop productivity by combining chemical fertilizers with organic sources like manures, crop residues, and domestic waste. In the context of maize cultivation—often referred to as the “Queen of Cereals” due to its versatility and economic significance—INM is particularly beneficial. Maize's high nutrient demand and diverse uses in food, feed, fuel, and industry make it essential to adopt sustainable nutrient management practices. By ensuring a balanced and efficient nutrient supply, INM not only supports higher maize yields but also promotes environmental sustainability, resource conservation, and long-term agricultural viability. Therefore, adopting INM strategies is crucial for meeting the growing demand for maize while maintaining the health of our agro-ecosystems.

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Table 1: An extract of relevant information showing effect of different treatments on growth and yield attributes in maize crop

Sr. No.	Particulars	Treatments								
		T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
1.	Mean plant height at harvest (cm)	242.17	248.13	244.47	248.17	246.23	252.80	259.20	230.03	189.67
2.	No. of functional leaves per plant at 75 DAS	14.80	15.07	14.93	15.73	15.00	16.00	17.10	14.63	11.37
3.	Leaf area per plant at 75 DAS (dm^2)	883.70	922.03	917.20	943.87	918.08	953.33	1082.90	795.13	503.1
4.	Mean plant stem girth (cm) at harvest	10.67	11.30	10.80	11.30	10.87	11.83	12.87	10.77	7.97
5.	Mean total dry matter (g) at harvest	175.30	177.67	175.63	178.20	177.60	178.30	207.80	173.43	121.53
6.	Diameter of cob (cm) at harvest	3.67	3.90	3.74	4.01	3.84	4.09	4.25	3.67	3.07
7.	Girth of cob (cm) at harvest	15.26	15.73	15.32	15.75	15.68	15.83	16.33	14.92	14.65
8.	Length of cob (cm) at harvest	20.14	20.59	20.42	20.73	20.43	20.74	22.12	19.88	17.80
9.	100 grain weight (g)	32.03	32.43	32.27	32.87	32.37	34.57	34.77	30.93	28.30
10.	Weight of cob (g) at harvest	116.17	124.00	120.07	127.89	120.83	130.53	144.39	109.20	79.42
11.	Weight of stover $plant^{-1}$ (g) at harvest	291.47	301.67	295.70	306.09	298.43	308.13	352.19	282.63	200.9
12.	Husk yield $plant^{-1}$ (g) at harvest	6.00	6.75	6.20	7.00	6.39	7.09	7.50	5.50	3.00
13.	Grain yield $plant^{-1}$ (g) at harvest	86.31	90.51	88.66	93.95	88.76	95.82	107.73	80.08	60.48
14.	Grain yield kg ha^{-1}	4794	5028	4925	5219	4931	5323	5962	4488	3359
15.	Biological yield kg ha^{-1}	16192	16759	16427	17004	16579	17157	19565	15701	11163

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