Original Research Article

Effect of Organic and Inorganic Nitrogen Management and PlantingTechniques on Nutrient uptake by Maize crop

Abstract

Maize production is affected by many factors including climatic and soil parameters. Soil parameters may include nutrient availability and management. Maize crop production may also be highly affected by the planting techniques involved in its cultivation. These may in the long run have an impact on the yield realised from a particular enterprise. A research was conductedat the experimental farm chhapang of Dr. Khem Singh Gill Akal College of Agriculture, Eternal University, Baru Sahib during 2019-20 to assess the effect of organic and inorganic nitrogen management and Planting Techniques on Nutrient uptake of maizecrop. The experiment was laid out in split plot design with three replications of two main plot treatments viz., Flat bed and Raised bed and five sub plot treatments viz.,100% IO, 100% FYM, 50% IO + 50% FYM, 75% IO + 25% FYM, 100% IO + 25% FYM and wereobserved at 25,50 and 75 days after sowing. The results revealed that treatment T_3 (50% IO + 50% FYM)showed highest nutrient uptake by grain and Stover of maize. Hence integration of organic and inorganic in T_3 (50% IO + 50% FYM) with Raised bed resulted in best performance of maize. The combination of Raised bed with 50% IO + 50% FYM can be recommended for sustainable maize growth and appropriate nutrient management.

Keywords: Inorganic fertilizers,integrated nutrient management,Nutrient uptake, Organic manure, Planting techniques.

1. Introduction

Maize (*Zea mays L.*) is known as "Cereal Queen" due to its higher production potential and adoption over large area in the world ( ),both under temperate and tropical regions( ). United States is the largest producer of corn followed by china and Brazil while India comes on 6th position on the list of main corn producing countries of the world( ). On the basis of consumption, maize is third most important cereal after wheat and rice(Majamanda *et al*., 2022a). Apart from human consumption and animal feed(Majamanda *et al*., 2022b)maize also possesses other multiple uses in the form of starch, silage making, oil production and biofuels( ). It also contains ample quantities of vitamins, carbohydrates, dietary fibers and minerals like magnesium, phosphorous, zinc, copper and iron(Majamanda *et al*., 2022b).

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Himachal Pradesh comes next to Karnataka, Telangana and Bihar in the list of corn growing states of India with an area of 294.3 thousand hectares and production of 644.4 thousand tons during the year 2017-18 (NCoMM report,2017). The sirmaur district falls in mid hill region of Himachal Pradesh with its unique climate and agro-ecological situation having direct bearing on productivity of this crop. The soils of thisregion are developed on sandstone with slight acidity to neutral, in reactions. This stretchis also accompanied with frequent showers of rain during kharif season coupled with improper drainage which cause considerable loses of plant nutrients. Otherwise remained available to this nutrient exhaustive crop of the region.

Maize being a C4 plant haspotential to yield more, but due to lack of matching agronomic technologies along with poor technology adoption capacity of the state farmers, yield realisation is low. These bottle necks hinder the potential to achieve higher yields from this crop. Among modern agro-management techniques, raised bed planting has advantages over flat bed sowing by way of easy translocation and conversion of soil nutrient to available plant for its uptake, along with meaningful rain water management( ).Raised bed planting also protect the crop from soil encrusting along with 20-30% saving of irrigation water to attain better growth of the crop( ). In raised bed system water moves horizontally from the furrow to bed surface through capillaries, which otherwise cause an excessive soil moisture impact( ). Maize sown on raised bed trap more solar radiation through crop canopy by border effect along with its additional advantages to prevent the crop from lodging( ).

Maize is very nutrient-intensive crop (150-200 Kg N ha-^{1}) and requires a relatively large amount of fertilizer to meet the crop needs( ). The resource poor farmers, dependent on corn farming, prefer to use the integration of nutrient (inorganic+ organic) to cut down its cost of cultivation through reduction in use of expensive inorganic fertilizers( ). The use of locally available organic with inorganics as applied nutrient sources along with inherent fertility status of soil helps to meet the harvest needs of the crop for nutrition at relatively lower costs ( ). Through this mechanism of mixing organic and inorganic fertilizers, the sustainability of crop production is maintained for longer time and the soil fertility is improved through its complimentary effects (Ponnusamy *et al*., 2017). It is therefore imperative to ameliorate the hard and compact soils of this region with proportionate use of organic manures (Farm Yard Manure) along with inorganic fertilizers. The use of farm yard manure not only improves the physio-chemical properties of the soil but also act as vulnerable amendments to replace the excessive use of chemical fertilizer.

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2. Materials and methods

The studywas conducted during *kharif* seasonof 2019 at Chhpang Research Farm of Dr Khem Singh Gill Akal Collage Agriculture, Buru Sahib. The variety that was used was Shakti 1001, QPM variety rich in lysine and methionine and was sown on soil with clay loam texture and slightly acidic in nature (pH 6.34). The trial had 2 main plot treatments and 5 sub-plot treatments with 3 replications and treatments were designed under split plot design. The treatment detail includes raised bed and flat beds on integration combinations as follows: - T_1= 100% N by Urea, T_2=100%Nvia.FYM, T_3=50%N via.Urea+ 50%Nvia.FYM, T_4= 75%Nvia.Urea+ 25%Nvia.FYM, T_5= 100%NviaUrea25%N viaFYM. From this experimental set up, data was collected and recorded after harvesting the grains and straw.

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3. Results and discussions

Table 1: Shows effect of integrated nutrient management with planting techniques on Nutrient uptake bymaize straw.

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T. No.	Treatments	N%	P%	K%
	Main Plot Treatment			
P_1	Flat Bed	1.15	0.15	1.05
P_2	Raised Bed	1.16	0.16	1.07
Sem±		0.005	0.003	0.005
CD(0.05)		NS	NS	NS
	Sub Plot Treatment			
T_1	100% IO	1.16	0.16	1.08
T_2	100% FYM	1.16	0.16	1.06
T_3	50% IO + 50% FYM	1.18	0.18	1.07
T_4	75% IO + 25% FYM	1.16	0.15	1.05
T_5	100% IO + 25% FYM	1.13	0.14	1.06
Sem±		0.011	0.008	0.008
CD(0.05)		NS	NS	NS

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Organic matter applied in addition to RDF on raised bed of maize crop had positive effects which improved nutrient uptake from soil. Nutrient uptake refers to the total amount of nutrient taken up by the crop during the growing period. Nutrient removal by crops depends on the plant parts harvested, their composition and their share in total dry matter production. As shown in table 1, removal of the maize straw in **T_3**, would mean removal higher content of N and P. Actual removal will vary with crop yield, crop variety, soil fertility and level of management. Intake values would therefore provide a reliable estimate of nutrient requirement under varying soil and climatic condition. However, precise samples can only be determined by laboratory analysis. In general, nutrient uptake by maize increases with increasing nutrient levels applied through integration of organic and inorganic fertilizers (Prajapati *et al.*,2015). Prajapati *et al.*2015, from their research reported that highest nutrient uptake of N, P_2O_5 and K_2O was observed under treatment where integration of organic and inorganic source is applied i.e. 25% RDF + 50% FYM + Bio fertilizer over sole application of either organic or inorganic material.

Table 2: Shows effect of integrated nutrient management with planting techniques on Nutrient uptake by maize

T. No.	Treatments	N %	P %	K%
	Main Plot Treatment			
P_1	Flat Bed	1.24	0.2	0.53
P_2	Raised Bed	1.33	0.21	0.54
Sem±		0.041	0.005	0.005
CD(0.05)		NS	NS	NS
	Sub Plot Treatment			
T_1	100% IO	1.32	0.2	0.53
T_2	100% FYM	1.3	0.22	0.54
T_3	50% IO + 50% FYM	1.35	0.22	0.55
T_4	75% IO + 25% FYM	1.24	0.19	0.54
T_5	100% IO + 25% FYM	1.23	0.19	0.54
Sem±		0.059	0.02	0.011
CD(0.05)		NS	NS	NS

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The data in table 2 revealed that there was significant effect of varioussource of nutrients on treatment T3 (50%N via.Urea+ 50%Nvia.FYM) on the nutrient uptake of maize, similar data were observed in the experiment of Krishnakhi *et al*. (2018), that higher nutrient uptake was found in case of INM treatment (50% RDF + 50% N via compost) as compared to RDF treatment solely. Highest uptake of N,$P_2O_5$and K_2O wasobserved in application of T3 (50%N via.Urea+ 50%Nvia.FYM). In case of N uptake treatment T1 and T2were at par with T3 (50%N via.Urea+ 50%Nvia.FYM). The uptake of N, P_2O_5 and K_2O was found higher to the tune of 1.35, 0.22 and 7.0 % in application of T3(50%N via.Urea+ 50%Nvia.FYM). This might be due to combined effect and rapid release of nutrient by decomposition of FYM and also due to availability of N and P_2O_5 which was added in soil through organic and inorganic resources by urea, SSP. Satish *et al*. (2011) also reported that the combination of organic and inorganic fertilizer showed increased uptake valuesof all three nutrients, which is in close conformity with the result obtained in present investigation.Muhammad *et al*., (2012) also reported same results in their study on maize productivity and nutrient uptake, that highest N uptake was observed with 50% + 50% (chemical fertilizer + FYM) as compared to sole application of organic or mineral fertilizer.

Significantly higher values of organic carbon percent, available N, P_2O_5 and K_2O content in soil were recorded in application of T3 (50%N via.Urea+ 50%Nvia.FYM) table 2. FYM was rich source of organic carbon, nitrogen,phosphorous and some other micronutrients. All these sourcesof organic fertilizers were found to be effective for addition of various nutrients into the soil in available forms. The percentage availability of organic carbon, N, P_2O_5 and K_2O under T3 treatment was found higher. The lowest availability of these nutrients was observed in treatment T5(100%IO+25%FYM). Similar effects of different organic and inorganic source of nutrients on the nutrient status of soil after harvesting the crop were revealed by Tetarwal*et al*.(2011), in rainfed maize. The numerical data in table 2 revealed that, application of 50% N via IO + 50% N via organic made maximum addition amongst all the other treatments of available N & P_2O_5 by over the initial status of soil available nutrients.Dasog*et al*. (2011),reported similar results, in their study ofnutrientmanagement practise on soil fertility that nutrient uptake of N, P and K was highest under treatmentwhereorganic andinorganicfertilizerswere applied in combination,thisisdue toadditionalnutrientsprovidedbyFYMatsteadysupplythroughouttheseason. Highest decrease values in organic carbon and soil available N, P_2O_5 and K_2O over initial soil status were

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recorded in T5 which were 1.23, 0.19 and 0.54 respectively. Quansah (2010), in his study reported that higher NPK uptake was observed when poultry manure (60kg/ha N) is applied with NPK (60-40-40 kg/ha) fertilizer ratherthan sole application ofeitherfertilizer or manure. Results showed that integrating both organic and inorganic source resulted highnutrientuptakevalue.

4. Conclusion

Looking at the results from this study, it can therefore be concluded that integrated nutrient management improve nutrient soil quality and help in easy and fast nutrient supply to plants, it also manages the balanced supply of nutrients throughout the growing season.

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Recommendations

This study there recommends that there must be proper integrated nutrient management coupled with recommend planting techniques if higher yield is to be realised in maize crop production enterprise. It can further be recommended that studies of nutrient management and planting techniques should be conducted in other crops to better inform farmers on the best practices.

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