Effect of Organic and Inorganic Nitrogen Management and Planting Technique on Nutrient Uptake by Maize crop

Abstract

Maize production is affected by many factors including climate 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 conducted at the experimental farm Chhapang of Dr. KSG 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 maize crop. The experiment was laid out in split plot design with three replications of 2 main plot treatments viz., Flat bed and Raised bed and 5 subplot treatments viz., 100% IO, 100% FYM, 50% IO + 50% FYM, 75% IO + 25% FYM, 100% IO + 25% FYM and were observed at 25, 50 and 75 days after sowing. The results revealed that treatment T_3 (50% IO + 50% FYM) showed the highest nutrient uptake by grain and stover of maize. Hence the integration of organic and inorganic in T_3 (50% IO + 50% FYM) with Raised bed resulted in the 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 and Planting techniques.

Introduction

Maize (*Zea mays L.*) is known as the "Cereal Queen" because of its higher production potential and adoption over a large area of the world (Shirk, 2007), both under temperate and tropical regions. The 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 (K Ullah, 2015). On the basis of consumption, maize is the third most important cereal after wheat and rice (Majamanda *et al*., 2022a). The maize, apart from human consumption and animal feed (Majamanda *et al*., 2022b), 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).

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 hactares 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 agroecological situation

having a direct bearing on the productivity of this crop. The soils of the region are developed on sandstone with slightly acidic to neutral reactions. The tract is also accompanied by a frequent showers of rain during kharif season coupled with improper drainage which causes considerable losses of plant nutrients, otherwise remaining available to this nutrient-exhausted crop of the region.

Maize is a C4 plant that has the potential to yield more but due to the lack of matching agronomic technologies along with poor technology adoption capacity of the state farmers are some of the bottlenecks to achieving higher yield 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 nutrients to available plant nutrients for its uptake, along with meaningful rain water management. Raised bed planting also protects the crop from soil encrusting along with 20-30% saving of irrigation water to attain better growth of the crop. In a raised bed system water moves horizontally from the furrow to the 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 a 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 nutrients (inorganic + organic) to cut down the cost of cultivation through the reduction in the use of expensive inorganic fertilizers. The use of locally available organic with inorganics as applied nutrient sources along with the inherent fertility status of soil helps to meet the harvest needs of the crop for nutrition at relatively lower costs. With this mechanism of mixing organic and inorganic fertilizers, the sustainability of crop production is maintained for a longer time, and the soil fertility is improved through its complementary 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 acts as a vulnerable amendment to replace the excessive use of chemical fertilizer.

MATERIALS AND METHODS

The study was conducted during the kharif season of 2019 at Chhpang Research Farm of Dr Khem Singh Gill Akal College 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 subplot treatments with 3 replications and treatments were designed under split plot design. The treatment detail includes raised beds and flatbeds on integration combinations as follows:- T_1= 100% N by Urea, T_2= 100% N via. FYM, T_3= 50% N via. Urea + 50% N via.FYM, T_4= 75% N via. Urea + 25% N via.FYM, T_5= 100% N via Urea 25% N via FYM. From this experimental set up, data was collected and recorded after harvesting of grains and straw.

RESULT AND DISCUSSION

Organic matter applied in addition to RDF(Recommended Dose of Fertilizer) on raised beds of maize crop had positive effects, which improves nutrient uptake from soil. Nutrient uptake refers to the total amount of nutrients 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 requirements under varying soil and climatic conditions. However, precise samples can only be determined by laboratory analysis. In general, nutrient uptake by maize increases with increasing nutrient levels applied through the integration of organic and inorganic fertilizers (Prajapati *et al*.,2015). Prajapati *et al*.2015, from their research reported that the 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.

The data in table 1 revealed that there was a significant effect of various sources of nutrients on treatment T3 (50% N via. Urea + 50% N via.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(Integrated Nutrient Management) treatment (50% RDF + 50% N via compost) as compared to RDF treatment solely. The highest uptake of N,

P_2O_5, and K_2O was observed in the application of T3 (50% N via. Urea + 50% N via.FYM). In the case of N uptake treatment T1 and T2 were found at par with T3 (50% N via. Urea + 50% N via.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 % N via.FYM). This might be due to the combined effect and rapid release of nutrients by decomposition of FYM and also due to the availability of N, and P_2O_5 which are added in soil through organic and inorganic resources by urea, SSP(Single Super Phosphate). Satish et al. (2011) has been also reported that the combination of organic and inorganic fertilizers showed increased uptake values of all three nutrients, which is in close conformity with the result obtained in the present investigation. Even Muhammad et al., (2012) also reported the same results in their study on maize productivity and nutrient uptake that the highest N uptake was observed with 50% + 50% (chemical fertilizer + FYM) as compared to the sole application of organic or mineral fertilizer.

Effect of nutrient uptake on the soil after harvest:-

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% N via.FYM). FYM was a rich source of organic carbon, nitrogen, phosphorous and some other micronutrients also. All these sources of organic fertilizers were found to be effective for the addition of various nutrients to the soil in available form. 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). The similar effects of the different organic and inorganic sources of nutrients on the nutrient status of soil after harvest at the crop were revealed by Tetarwal et al., (2011) in rainfed maize. The numerical data in Table 1 reveals that, the 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 of nutrient management practises on soil fertility that nutrient uptake of N, P, and K was highest under treatment where organic and inorganic fertilizers were applied combination, this is due to additional nutrients provided by FYM at steady supply throughout the season. Highest decrease values in organic carbon and soil available N, P_2O_5, and K_2O over initial soil status were 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 (60 kg/ha N) is

applied with NPK (60-40-40 kg/ha) fertilizer rather than sole application of either fertilizer or manure. Results showed that integrating both organic and inorganic sources resulted in high nutrient uptake value.

CONCLUSION

Looking at the result from this study, it can therefore be concluded that integrated nutrient management improves 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.

Table 1: Shows effect of integrated nutrient management with planting techniques on Nutrient Uptake of maize.

T. No.	Treatment	N %	P %	K%
Main Plot Treatment				
P_1	Flat Bed	1.24	0.20	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	0.20	0.53
T_2	100% FYM	1.30	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	0.020	0.011
CD(0.05)		NS	NS	NS

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

T. No.	Treatment	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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