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Effects of Organic and Inorganic Nitrogen Management and Planting Techniques on the Growth of Maize (Zea Mays)

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Abstract

The experiment was laid out at the experimental farm chhapang of Dr. Khem Singh Gill Akal College of Agriculture, Eternal University, Baru Sahib during 2019-20 to evaluate the effect of organic and inorganic nitrogen management and Planting Technique on Growth of maize. 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 were observed at 25, 50 and 75 days after sowing. The results revealed that treatment T_3 (50% IO + 50% FYM) gave maximum plant height, number of leaves per plant, fresh weight per plant, dry weight per plant. Whereas, the minimum days of 50% tasseling was observed under treatment T_1 (100% IO). Hence integration of organic and inorganic in T_3 (50% IO + 50% FYM) with Raised bed resulted in good growth performance of maize. The combination of Raised bed with 50% IO + 50% FYM can be recommended for sustainable maize growth.

Keywords: Integrated nutrient management; Organic and inorganic fertilizers; Growth parameters; Planting techniques

Introduction

Maize (*Zea mays L.*) [2] 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. The maize apart from human consumption and animal feed also possesses other multiple uses in the form of starch, silage making, oil production and biofules. It also contains ample quantities of vitamins, carbohydrates, dietary fibers and minerals like magnesium, phosphorous, zinc, copper and iron.

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) [3]. 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 soil of region are developed on sandstone with slight acidic to neutral in reactions. The tract is also accompanied with frequent shower of rain during kharif season coupled with improper drainage which cause considerable losses of plant nutrients, otherwise remained available to this nutrient exhaustive crop of the region.

Maize being C4 plant have 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 bottle necks to achieve 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 nutrient to available plant nutrient 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 organics 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. 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) [4]. 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.

Materials and Methods

The trial was conducted during *kharif* season 2019 at Chhpang Research Farm of Dr Khem Singh Gill Akal Collage Agriculture, Buru Sahib. Variety 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 treatment 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% 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. The data were recorded at 25, 50 and 75 DAS (Days After Sowing) from five randomly selected plants which were tagged from each plot and average of every parameter was recorded at different stages i.e., plant height, number of leaves per plant, fresh weight , dry weight, Days of 50% tasseling.

Result and Discussion

The effect of integrated organic and inorganic nitrogen source provide better in increasing plant growth phase, with respect to plant height of maize. Treatment (T3) where 50 % N via IO + 50% N via FYM applied on raised bed found significantly superior to all other treatments for longer plant height at all three stages of 25, 50 and 75 DAS (57.83 cm, 79.89 cm, 103.83 cm). Similar results were reported by Kesarwani et al., (2017) [2] that the growth parameters (plant height and leaf area) were found to be highest under INM (Integrated Nutrient Management) of poultry manure (PM) or farm yard manure (FYM) and recommended dose of fertilizers (RDF). The same applies to the re-

sult of Raman and Suganya (2018) [5], that the maximum plant height (170.49 cm) was observed when press mud with RDF was applied. The organic matter content affects nutrient accumulation and promotes plant growth, resulting in larger plant height. However the minimum plant height observed were (44.23 cm, 65.72 cm, 95.33 cm) at 25, 50 ,75 DAS with treatment T_5 (100% N via IO + 25% N via FYM).

More number of leaves per plant was observed under T_3 treatment (50 % N via IO + 50% N via FYM) with raised bed at 25, 50, 75 DAS which were (10.02, 11.83, 12.72) compared to rest of treatments. The higher number of leaves per plant was resultant of integration of organics with inorganic fertilizers which attributed to the east availability of nutrients during the growth phase of plant. Similarly Amanullah et al., (2016) observed maximum number of leaves with different organic carbon sources (animal manures and plant residues) plus bio fertilizers (beneficial microbes) and Singh et al., (2017) [6] concluded that the experiment had eight integrated nutrient management treatments. T2 – 100 % RDF + vermicompost (5t ha^{-1}) and T4- 75 % RDF + vermicompost (5t ha^{-1}) statically gave the best result in terms of growth

Fresh weight and dry weight are observed highest in T3 treatment where 50% N was applied via. RDF and 50 % N via. FYM at raised bed followed by treatment T1 where 100% N via RDF applied. This might be due to favourable condition during plant growth period and slow release of nutrients associated with FYM, which could have resulted in higher nutrient concentration in plant cells, resulting in higher fresh weight and dry weight Verma et al., (2018) [7] reported that increase in fresh weight and dry weight were found with combined application of both RDF and FYM in treatment (T4) where 25% N (FYM) + 75% N (Fertilizer).

Data indicated that 100% sole application of inorganic fertilizer (100% N via.IO) T1, or organic manure (100% N via. FYM) T2 hasten the tasseling in comparison to INM techniques. Bilal et al., (2017) [1] showed in their results that the application of 100% inorganic fertilizer reported the minimum days to tassel formation (50 days) and an increase in the nitrogen content leads to a decrease in tassel days. Hence, the study concluded that the treatment T3 comprising 50% N via. IO + 50% N via.FYM gave significantly better result with raised bed treatment in terms of growth attributes of maize. INM also enhanced the soil structure and gave better environment for plant to grow as compared to sole inorganic or organic treatment. Application of balanced INM leads to higher nutrients uptake and raised bed planting technique gave effective management to sustain resources. Therefore, for getting proper growth combination of raised bed treatment with T3 (50% N via.IO + 50% N via.FYM) was found to the best among other treatment combinations.

Table 1: Effect of integrated nutrient management on plant height and no. of leaves of maize

T. No.	Treatment	Plant Height (cm)			No. of leaves per plant		
		25 DAS	50 DAS	75 DAS	25 DAS	50 DAS	75 DAS
	Main Plot Treatment						
P1	Flat Bed	50.55	66.20	96	5.51	6.92	8.79
P2	Raised Bed	52.51	78.11	102.27	10.01	11.25	12.29
Sem±		0.53	1.13	0.35	0.08	0.18	0.15
CD(0.05)		2.15	4.7	1.29	0.34	0.77	0.64
	Sub Plot Treatment						
T1	100% IO						
T2	100% FYM						
T3	50% IO + 50% FYM	57.83	79.89	103.83	10.02	11.83	12.72
T4	75% IO + 25% FYM	48.58	67.17	97.67	7.20	8.32	9.92
T5	100% IO + 25% FYM	44.23	65.72	95.33	6.37	6.97	8.17
Sem±		1.44	0.98	0.56	0.34	0.45	0.38
CD(0.05)		2.94	1.89	1.05	0.71	0.94	0.79

Table 2: Effect of integrated nutrient management on Fresh weight, Dry weight and Days of 50% tasseling of maize

T. No.	Treatment	Fresh Weight (g)			Dry Weight (g)			Days of 50% tassel
		25 DAS	50 DAS	75 DAS	25 DAS	50 DAS	75 DAS	
	Main Plot Treatment							
P_1	Flat Bed	14.74	91.27	147.27	3.11	17	29.40	60.00
P_2	Raised Bed	19.66	105.12	161.40	5.52	22.07	35.53	60.60
Sem±		1.14	3.2	3.04	0.29	5.32	2.43	0.33
CD(0.05)		4.73	6.72	12.9	1.24	NS	NS	NS
	Sub Plot Treatment							
T1	100% IO	20.12	92.17	166.0	5.24	25.17	24.67	59.00
T2	100% FYM	16.20	93	156.33	3.52	14.17	35.67	59.33
T3	50% IO + 50% FYM	23.04	112.67	169.33	6.55	26.67	43.50	60.83
T4	75% IO + 25% FYM	12.63	96.50	146.50	3.79	19.83	26.33	61.00
T5	100% IO + 25% FYM	14.03	86.13	133.50	2.50	11.83	32.17	61.33
Sem±		2.70	4.5	6.6	0.41	5.66	8.13	0.61
CD(0.05)		5.6	9.4	13.8	0.86	NS	NS	1.29

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