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Effect of Integrated Nutrient Management on Growth Parameters and Productivity of Maize Cultivar PMH-5

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ABSTRACT

The present study was undertaken to study the effect of INM on growth parameters and productivity of maize cultivar PMH-5. An investigation was taken up during *kharif* season of 2020-21 at the Instructional Farm, Rajasthan College of Agriculture, Udaipur. The experiment was laid down in factorial randomized block design (FRBD) with three replications. The treatments comprised of three levels of vermicompost, i.e. Control (VC_0), Vermicompost @ 2.5 t ha^{-1} (VC_1), Vermicompost @ 5 t ha^{-1} (VC_2), four levels of chemical fertilizers i.e. Control (F_0), 50 % RDF(F1), 75 % RDF (F_2), 100 % RDF (F_3) and two levels of biofertilizer, i.e. Control (B_0), *Azotobacter* + PSB (B_1). The results revealed that all plant growth parameters, grain, straw and biological yield of maize were found highest with the combined application of Vermicompost @ 5 t ha^{-1} (VC_2)+ 100% RDF (F_2)+ *Azotobacter* + PSB (B_1) Respectively, which is statistically at par with combined application of Vermicompost @ 5 t ha^{-1} (VC_2)+ 100 % RDF (F_3) + *Azotobacter* + PSB (B_1).

Key words: *Vermicompost, RDF, Maize, Azotobacter and PSB*

Introduction

Maize (*Zea mays* L.) is a multi-faceted crop grown for food, fodder, feed and industrial purpose globally. Maize belongs to family *Gramineae* and popularly known as corn, ranking third among the food crops, next to rice and wheat in the world and ranking fourth after rice, wheat and sorghum in India. It is the most widely cultivated crop with global production volume just near 1.07 billion tones. In India, this coarse grain is currently being cultivated on 9.22 m ha with 27.82 million tones production. The productivity of maize is very high because of it is C_4 plants and it is very efficient in converting solar energy into production of dry matter but in tropical countries like India, its productivity is quite low (3100 kg ha^{-1}) which is near half of global average yield. The crop has high genetic yield potential and hence, it is called as miracle crop and as the "Queen of cereals".

Integrated nutrient management (INM) is a judicious use of organic and inorganic sources of nutrient to crop fields for sustaining and maintaining soil productivity. However, the use of appropriate and conjunctive use of application of suitable nutrients through organic and inorganic solely or in combination can provide the solutions to the problems such as increase in the price of inorganic fertilizers and deterioration effect of soil fertility and productivity. Hence, judicious application of these combinations can sustain the soil fertility and productivity.

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Material and Methods

Experimental site and soil

The experiment was carried out at the Instructional Farm, Rajasthan College of Agriculture, Udaipur. The site is situated in south-eastern part of Rajasthan at an altitude of 579.5 m above mean sea level, at 24°35′ N latitude and 74°42′ E longitude. The climate of the study area is sub-humid with an average maximum temperature 33.60 °C. The mean annual rainfall of the region varies in between 650 to 750 mm. The soil of the experimental field was clay loam in texture and slightly alkaline in reaction.

Experimental design and treatments

The experiment was laid out in factorial randomized block design and replicated thrice in the plot area of 18 m^2. Treatments consisted of three levels of organic manure, four levels of chemical fertilizer and two levels of biofertilizer. The maize variety PMH-5 was sown at the seed rate of 25 kg ha^{-1} at inter row of 60 and plant to plant spacing of 20 cm. Before sowing seeds were treated with Azotobcter +PSB seed to protect it from fungal diseases. The vermicompost applied in the field as per treatments and thoroughly mixed at the time of sowing and the recommended dose of nitrogen applied in two equal splits, the half as basal and the remaining half as top dressing at the time of first irrigation. The whole quantity of phosphorus through diammonium phosphate and potassium through muriate of potash drilled as basal dose at 8-10 cm depth along with half dose of nitrogen prior to sowing.

Statistical Analysis

In order to test the significance of variation in experimental data obtained for various treatment effects, data were statistically analyzed. The value of test at 5 and 1 per cent level of significant was determined and the values of SEm, CV per cent were calculated.

Results and Discussion

Effect of INM on growth parameters of maize

The application of Chemical, organic manure and biofertilizer enhanced the growth parameters of maize crop. Perusal of the data presented in Table number 1.1 and 1.2 revealed that the significantly higher No. of cobs per plant (1.39), Weight of Cob (250.56), No. of seeds Cob^{-1} (351.42) and Test weight (283.55g) was recorded with the treatment VC_2 which was applied of 5 t Vermi compost ha^{-1} as compared to rest of the treatments and minimum recorded under control similar findings were find out by Singh *et al.* (2017) and Yadav *et al*. (2022). It is well known fact that vermicompost enrich the soil by improving the physical and biological properties including supply of all the essential plant nutrients for the growth and development of plants. It encourages the production of beneficial microflora which helps in the breakdown of higher molecular weight compound into the lower one and by this way it provides all necessary nutrients to the plant.

The data presented in Table 1 and 2 indicate that the application of recommended dose of fertilizer significantly influenced No. of cobs per plant, Weight of Cob, No. of seeds Cob^{-1} and Test weight of maize crop. The highest no. of cobs per plant (1.40), Weight of Cob (250.68), No. of seeds Cob^{-1} (351.42) and Test weight (283.50g) was recorded with the treatment ($F_{3)}$ which was applied of 100% RDF as compared to rest of the treatments and minimum recorded under control. These findings are in conformity with Mahato *et al.* (2020), Prusty *et al.* (2022) and Nagosoi *et al.* (2018). Chemical fertilizer did bring about significant improvement in overall growth of the crop by providing needed nutrients

Table 1. Effect of integrated nutrient management on number of cobs $plant^{-1}$ of maize

Particulars	Cobs $plant^{-1}$		
	2020	2021	Pooled
Vermicompost			
Control	1.21	1.30	1.26
2.5t/ha	1.30	1.39	1.35
5.0 t/ha	1.34	1.44	1.39
SEm±	0.03	0.03	0.02
CD (P=0.05)	0.07	0.08	0.05
NPK levels (% RDF)			
Control	1.21	1.30	1.26
50	1.28	1.36	1.32
75	1.29	1.41	1.35
100	1.35	1.45	1.40
SEm±	0.03	0.03	0.02
CD (P=0.05)	0.08	0.10	0.06
Bio fertilizer			
Control	1.23	1.31	1.27
Azotobacter + PSB	1.34	1.45	1.39
SEm±	0.02	0.03	0.02
CD (P=0.05)	0.06	0.08	0.04
CV (%)	9.70	10.38	10.08

from initial stage and increase in supply of N, P and K in more synchronized way at the treatment receiving integrated supply of nutrient from organic manure along with inorganic fertilizer and which expressed in terms of plant height, cobs per plant, cob girth, cob length, cob weight with and without husk by virtue of increased photosynthetic efficiency. Thus, greater availability of photosynthates, metabolites and nutrients to develop reproductive structures seems to have resulted in increased productive plants, cob girth, cob length and cob weight with these integrated nutrient management treatments.

The data presented in Table 2 indicate that the application of biofertilizer significantly influenced No. of cobs per plant, Weight of Cob, No. of seeds Cob^{-1} and Test weight of maize crop. The highest no. of cobs per plant (1.39), Weight of Cob (249.14), No. of seeds Cob^{-1} (350.58) and Test weight (283.13g) was recorded with the treatment (B_1) Azotobcter +PSB. These findings are in conformity with Nagavani and Subbian (2014) and Mani *et al* (2011). Biofertilizers add nutrients through the natural processes of nitrogen fixation, solubilizing phosphorus and stimulating plant growth through the synthesis of growth promoting substances. Biofertilizers can be expected to reduce the use of chemical fertilizer and pesticides. The microorganisms in biofertilizers restore the soil's natural nutrient cycle and build soil organic matter. Biofertilizers can symbiotically associate with plant root.

Effect of INM on yield of maize

Application of vermicompost, enhanced the grain and stover yield of maize significantly over control in both the years of experiment as well as in pooled analysis. The maximum grain, stover and biological yield (4317, 7807 and 12124 kg ha^{-1} respectively) was recorded with the application of 5 t vermicompost ha^{-1}(VC_2) during 2020, 2021 and in pooled analysis, respectively. These results are in conformity with the findings of Prajapati *et al*. (2018), Jinjala *et al.* (2016) and Panchal *et al*. (2018). Balanced nutrition under congenial environment might have helped in production of new tissues and development of new shoots. Increase in yield might be the reflection of source of nutrient available in the root zone which stimulate the physiological processes in plant, ultimately results into increase in Yield and the integrated effect of inorganic fertilizer, organic manures and biofertilizers.

The visualization of data in Table 3 revealed that the grain yield was significantly affected by recommended dose of fertilizer during 2020, 2021 and in pooled basis. The highest grain yield (4321 kg ha^{-1}), stover yield (7815 kg ha^{-1}) and biological yield

Table 2. Effect of integrated nutrient management on yield attributing parameters and yield of maize

Particulars	Weight of cob (g cob^{-1}) with husk			No of seeds cob^{-1}			Test weight (g)		
	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
Vermicompost									
Control	232.49	236.41	234.45	277.22	283.37	280.30	252.05	254.49	253.27
2.5t/ha	237.47	243.45	240.46	314.37	322.96	318.66	268.44	270.01	269.22
5.0 t/ha	248.55	252.57	250.56	342.78	360.05	351.42	283.12	283.98	283.55
SEm±	2.76	3.01	2.04	2.84	2.49	1.89	2.49	2.60	1.80
CD (P=0.05)	7.85	8.56	5.73	8.09	7.08	5.30	7.07	7.40	5.05
NPK levels (% RDF)									
Control	231.30	235.55	233.42	276.90	282.18	279.54	252.00	253.09	252.55
50	235.33	239.03	237.18	288.32	292.70	290.51	260.25	261.77	261.01
75	243.12	248.89	246.00	338.28	353.11	345.70	276.24	279.11	277.67
100	248.27	253.10	250.68	342.33	360.51	351.42	283.00	284.00	283.50
SEm±	3.19	3.47	2.36	3.28	2.87	2.18	2.87	3.00	2.08
CD (P=0.05)	9.07	9.88	6.62	9.34	8.18	6.12	8.17	8.55	5.83
Bio fertilizer									
Control	232.25	236.75	234.50	280.93	285.07	283.00	253.07	255.40	254.23
Azotobacter + PSB	246.76	251.53	249.14	341.98	359.19	350.58	282.68	283.58	283.13
SEm±	2.25	2.84	1.67	2.32	2.35	1.54	2.03	2.45	1.47
CD (P=0.05)	6.41	8.07	4.68	6.60	6.68	4.33	5.78	6.98	4.13
CV (%)	5.64	6.03	5.85	4.47	3.78	4.13	4.54	4.73	4.64

Table 3. Effect of integrated nutrient management on yield attributing parameters and yield of maize

Particulars	Yield (Kg ha^{-1})								
	Seed			Stover			Biological		
	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
Vermicompost									
c	3158	3352	3255	6396	6966	6681	9555	10317	9936
2.5t/ha	3718	3903	3811	7165	7446	7306	10883	11349	11116
5.0 t/ha	4243	4391	4317	7694	7920	7807	11937	12311	12124
SEm±	53	58	39	88	84	61	113	98	75
CD (P=0.05)	152	165	111	252	240	172	323	279	210
NPK levels (% RDF)									
C	3123	3348	3235	6373	6942	6658	9495	10290	9893
50	3313	3541	3427	6702	7235	6968	10015	10776	10395
75	4143	4245	4194	7569	7667	7618	11712	11912	11812
100	4246	4395	4321	7698	7931	7815	11944	12326	12135
SEm±	62	67	46	102	97	71	131	113	86
CD (P=0.05)	175	191	128	290	277	198	373	322	243
Bio fertilizer									
Control	3198	3389	3293	6482	6992	6737	9681	10381	10031
Azotobacter + PSB	4215	4376	4295	7688	7895	7792	11903	12271	12087
SEm±	44	55	32	72	79	50	93	92	61
CD (P=0.05)	124	156	90	205	226	140	264	263	172
CV (%)	7.06	7.33	7.20	6.11	5.55	5.82	5.15	4.23	4.69

(12135 kg ha^{-1}) was found with the application of F_3 (100% RDF) The lowest seed and straw yield were found under control.

The data presented in Table 3 indicate that the application of biofertilizer significantly influenced the Seed yield, stover yield and biological yield at harvest of maize over the control during *kharif* season 2020, 2021 and in pooled basis. The highest Seed yield (4295 kg ha^{-1}) stover yield (7792 kg ha^{-1}) and biological yield (12087 kg ha^{-1}) was found with treatment B_1 (*Azotobacter* + PSB) which was significantly superior over B_0 (control) during 2020, 2021 and in pooled basis, respectively. The lowest Seed yield (3198 kg ha^{-1}) was recorded under control (B_0) during both the years as well as in pooled analysis, respectively. The results are in agreement with the Baradhan and Suresh Kumar (2018) and Bezboruah and Dutta (2021). The enhancement of yield might be due to Application of all the sources makes availability of essential nutrients more quickly to crop plants. Slow and steady release of nutrients from inorganic sources would increase the availability of nutrients which will result in translocation of more photosynthates from source to sink and finally improve the yield attributing characters.

Conclusion

On the basis of two year experimental results, it is concluded that application of vermicompost 5 t ha^{-1} or 100 % RDF in maize crop is most efficient preposition, when judged in terms of productivity, quality, all parameters of soil fertility and economic viability of maize.

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