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Effect of Integrated Nutrient Management on Yield and Quality Parameters of Baby Corn (*Zea mays* L.)

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Abstract

A field study was carried out at the students' research farm, Department of Agriculture, Khalsa Collge Amritsar, for two consecutive kharif seasons of 2014 and 2015. To study the effect of Integrated nutrient management (INM) on soil fertility, yield contributing characters, yield, fodder yield and quality parameters of baby corn (Zea mays). Seven treatments i.e. T_1= Control, T_2= 100 per cent recommended dose of N, T_3 = 5 tonnes of FYM(Farm yard manure) + 100 kg inorganic N ha^{-1} ,T_4= 10 tonnes of FYM + 75kg inorganic N ha^{-1} , T_5= 15tonnes of FYM + 50 kg inorganic N ha^{-1}, T_6= 20tonnes of FYM + 25 kg inorganic N ha^{-1} , T_7= 25 tonnes of FYM ha^{-1} replicated four times each were carried out in the plot in RBD design. Significant increase in yield and quality contributing characters(Number of days taken to baby corn formation, Number of cobs per plant, Baby corn length, Baby corn girth, Green cob weight, Baby corn weight, Baby corn yield, Green fodder yeild, TSS and protein content in baby corn) with INM over control. Moreover 5 tonnes of FYM + 100 kg inorganic N ha^{-1} came out to best over all other treatments.

Key words: Baby corn, Kharif, INM, FYM, Cob, Yield and Quality.

I. Introduction

Maize is called as a miracle crop also known as queen of cereals due to high genetic yield potential than other cereal crops. As a heavy feeder of nutrients, maize productivity is largely depends on the nutrient management. Therefore, it needs fertile soil to express its yield potential. Organic manures not only supply the plant nutrients but also improve soil health. Moreover, the amount of micronutrients present in organic manures may be sufficient to meet the requirement of crop production Duhan *et al*., 2002. Nowadays low soil fertility is one of the bottlenecks to sustain agricultural production and productivity. Anthropogenic factors such as inappropriate land use systems, monocropping, nutrient mining and inadequate supply of nutrients aggravated the situation. To alleviate this problem, integrated nutrient management (INM) is considered as a best option as it utilizes available organic and inorganic nutrients to build ecologically sound and economically viable farming system.

Intensive cultivation, growing of exhaustive crops, use of unbalanced and inadequate fertilizers accompanied by restricted use of organic manures have made the soils not only deficient in the nutrients, but also deteriorated the soil health resulting in decline in crop response to recommended dose of N fertilizer in the region under such situation, INM has assumed a great importance and has vital significance for the maintenance of soil productivity. Organic manures, particularly FYM and vermicompost, not only supply macronutrients but also meet the requirements of micronutrients, besides improving soil health. The use of organics plays a major role in maintaining soil health due to buildup of soil organic matter, beneficial microbes. To sustain the soil fertility and crop productivity the role of organic manures and fermented organic nutrients are very important. The organic fertilizers in addition to nutrients contain microbial load and growth promoting substances which help in improving the plant growth, metabolic activity and resistance to pest and diseases. Boosting yield, reducing production cost and improving soil health are three inter - linked components of the sustainable triangle. Therefore suitable combination of chemical fertilizer and organic manures cultures need to be developed for particular cropping system and soil. In crop production, nutrient availability from manure has been recognized for many centuries.

Before the introduction of inorganic fertilizer manure was the primary source of nutrients for crop production. Recently there has been a renewed interest in use of farmyard manure. This interest is attributed to concerns for

maintaining sustainable agricultural production while preserving the environment. For better utilization of resources and to produce crops with less expenditure, INM is the best approach. In this approach all the possible source of plant nutrients are applied based on economic consideration and the balance required for the crop is supplemented with chemical fertilizers. The combined use of organic and inorganic sources of plant nutrient not only pushes the production and profitability of field crops, but also it helps in maintaining the permanent fertility status of the soil. It is highly desirable to make massive efforts to adopt organic sources as a source of plant nutrients as well as soil productivity in the developing countries.

Keeping the above in view and the known possible reasons, the present study was taken up with the following objective aiming to develop a sustainable maize production with eco-friendly techniques at profitable levels,

- To know the effect of INM on yield and quality parameters of maize crop.

II. Materials and Methods

The field experiment consisted of seven treatments carried out in complete randomized block design (RBD). These seven treatments combined with four replications were conducted at Student's research farm, Khalsa College, Amritsar for two Kharif years in a row(2014-2015).The combination consisting of Control, 100 per cent of recommended N, 5 tonnes of FYM ha^{-1} +100 kg inorganic N ha^{-1}, 10 tonnes of FYM ha^{-1} +75 kg inorganic N ha^{-1} , 15 tonnes of FYM ha^{-1} + 50 kg inorganic N ha^{-1} , 20 tonnes of FYM ha^{-1} + 25kg inorganic N ha^{-1} and 25 tonnes of FYM ha^{-1} . The observations were recorded at intervals of 15DAS, 30DAS, 45DAS and 60DAS. The soil samples from four random places were taken , tested low in organic carbon and available nitrogen. However, available phosphorus and potassium status were high and pH and value was within normal range. After the pre-paratory tillage, field was divided into 28 different plots of 42 cmx42m size. The plots having INM were applied with well decomposed FYM before 15 days of sowing of crop. The pre treated seeds of variety PMH-1 were sown by Kera method in between the rows by using corn seeds at the rate of 16 kg ha^{-1} with a spacing of 20x30cm. Half dose of nitrogen was applied at the time of sowing to all the plots as per treatment; remaining half dose of nitrogen was applied at 30DAS. The field was kept free from weeds by manual hoeing. The field was irrigated six times per season of the crop. The crop was sprayed with Fenvalrate(100ml ha^{-1}) after three weeks of sowing. Baby corns were harvested at 2-3days after silk emergence.

Table1.Cropping History of the experimental Field

Year	Crop Season	
	Kharif	Rabi
2012-13	Rice	Wheat
2013-14	Rice	Mustard
2014	Baby Corn (Experimental Crop)	

Experimental Observation Recorded

To assess the effect of various treatments, different plant characters were studied *viz*; Number of days taken to baby corn formation, Number of cobs per plant, Baby corn length, Baby corn girth, Green cob weight, Baby corn weight, Baby corn yield, Green fodder yeild, TSS and protein content in baby corn.

Statistical Analysis

Recorded data was analyzed statistically as per randomized block design (Cochran and Cox., 1963) using CPCS-1 software developed by the development by the department of Mathematics and Statistics, PAU, Ludhiana. The comparison was made at five per cent level of significance.

III. Results

The results obtained from the field experiments conducted to study the changes in soil nutrient availability by maize as influenced by various organic manures and fertilizer as well as integrated nutrient management are briefly summarized hereunder. The seven types of different treatments were applied to the soil and their effects were investigated on the important quality and yield parameters of maize plant.

The treatments were categorized as strong, moderate and least. Treatment T3 was considered best over all other treatment and it had shown parity with treatment T2 and treatment T1 was found in the least effective category throughout the experiment. Treatments T4,T5,T6 and T7 were seen in the moderate category and shown more or less similar results. It was analysed that better results found because of improved physical and chemical conditions of the soil With the application FYM and chemical fertilizer in a particular combination to the soil help in releasing balanced plant nutrient which directly intiates early cob formation, more number of cobs per plant, increase the baby corn yield and fodder yield.

56 days were taken for cob formation where T3 treatments were applied and treatment T2 plots also gave similar results but T1 treatments plot plants took long (61 days) for cob formation as compared to all other treatments. Moreover treatments T6 and T7 plots took 60 days for cob formation which is slightly less than treatment T1. Similar trend was observed in the plots when the number cobs per plant were studied. It was observed that 3.00 cobs per plant found in the plots of T2,T3 and T4 treated plots followed by 2.00 cobs per plant which was found where T5 and T6 treatments applied. T1 and T7 (1.43 and 1.89) showed statistical parity with each other. In case of baby corn yield again T3 was the best treatment maximum yield (19.31 q ha^{-1}) was obtained from the plots where T3 treatment incorporated with soil. 18.49 and 18.38 q ha^{-1} yield were from the plants with T2 and T4 treatments. Minimum yield was observed in the plots where T1 treatment applied it was just 9.15 q ha. T7 also gave minimum yield 12.39 q ha-1 but slightly better than T1. Treatments T5 and T6 were somewhat similar in results. The yield of green fodder were recorded 312.3 qha^{-1} in the plots with treatment T3. Treatment T2 showed similar results with minor differences 299.4 and least amount of green fodder was from the plot with T1 treatment 177.8 T4,T5,T6 and T7 showed statistical parity with each other (289.1,269.2, 242.3 and 210.4) (Table 3).

Table 3:Effect of Integrated Nutrient Management on Number of days taken for cob formation, Number of Cobs per plant, Number of Cobs per plant, Baby corn yield q ha^{-1} , Green fodder yield q ha^{-1} and Baby corn girth (cm) (pooled data).

Treatments	Number of days taken for cob formation	Number of Cobs per plant	Baby corn yield q ha^{-1}	Green fodder yield q ha^{-1}	Baby corn girth (cm)
T1:Control	61.5	1.43	9.15	177.8	3.79
T2: 100% of recommended Nitrogen	57.0	3.00	18.49	299.4	5.11
T3: 5tonnes of FYM+100Kg inorganic N ha^{-1}	56.0	3.00	19.31	312.3	5.27
T4: 10tonnes of FYM+75Kg inorganic N ha^{-1}	58.0	3.00	18.38	289.1	5.01
T5: 15tonnes of FYM+50Kg inorganic N ha^{-1}	59.0	2.80	16.35	269.2	4.73
T6: 20tonnes of FYM+25Kg inorganic N ha^{-1}	60.7	2.37	14.63	242.3	4.53
T7: 25tonnes of FYM	60.7	1.89	12.39	210.4	4.06
CD(p=0.05)	1.2	0.19	0.21	13.09	0.19

Table4:Effect of Integrated Nutrient Management on Baby corn length(cm) , Baby corn girth(cm),Green cob weight(gm),Baby Cob weight (gm),Total soluble sugars% and Protein Content % (pooled data) .

Treatments	Baby corn length (cm)	Baby corn girth (cm)	Green cob weight (gm)	Baby Cob weight (gm)	Total soluble sugars(%)	Protein content(%)
T1:Control	7.15	3.79	32.7	6.70	7.52	13.79
T2: 100% of recommended Nitrogen	8.94	5.11	51.2	10.4	10.1	17.96
T3: 5tonnes of FYM+100Kg inorganic N ha^{-1}	9.13	5.27	54.3	10.6	10.2	18.04
T4: 10tonnes of FYM+75Kg inorganic N ha^{-1}	8.75	5.01	48.1	10.1	9.73	17.78
T5: 15tonnes of FYM+50Kg inorganic N ha^{-1}	7.96	4.73	44.4	8.75	9.55	17.59
T6: 20tonnes of FYM+25Kg inorganic N ha^{-1}	7.73	4.53	40.9	8.24	9.36	17.42
T7: 25tonnes of FYM	7.47	4.06	37.1	7.80	8.83	17.23
CD(p=0.05)	0.21	0.19	3.197	0.35	0.19	0.13

The data given in the table reveals that plots with treatment gave significantly best results for thw test characters of maize plants. Cobs of the plot with treatment T3 showed increased in length of cobs 9.13 cm followed by T2 8.94 cm . significant differenced were observed in the plots with T1 treatment 7.15 cm with similarity with T7 (7.47) T5,T6, treatment T4 showed moderate length of cobs 8.75cm.

In case of girth, maximum girth of the cobs were observed with T3 treatment 5.27 and decrease in girth was seen with the other treatment viz. 5.11(T2), 5.01(T4), 4.73(T5) and 4.53(T6) and drastic decrease was observed in the plots with T1(3.79) and T7 (4.06)treatments. Whereas the green cob weight was found highest with T3 treatment 54.3 gma followed by T2 (51.2 gm) and decrease in weight was observed 48.1, 44.4, 409 and striking decline in weight was seen in T1 and T 7 plots. Similar trend was recorded in baby cob weight T3 and T2 gave best results 10.4 and 10.6 gm as compare to all other treatments and minimum weighted cobs seen in the plants with T1 treatment. The protein and total soluble sugar(TSS) contents are also an important parameters of quality. Data revealed that treatment T3 enhanced the production of both protein and TSS to greater extent as compared to other treatments followed by treatment T2 which showed statistical parity with the treatment T3. Further treatment T4 was found significantly superior over all other treatments T4,T5,T6,T7 and T1. On contrary treatment T1 was found to be significantly lower than all other treatments for protein and TSS contents in baby corn (Table4).

IV. Discussion

Yield of a crop is the final result of successful completion of growth and development of its individual plant which in turn, depends upon rate of carbon assimilation and conversion into harvestable poducts.In 2014 Bekeko stated from an experiment that grain yield and harvest index of the hybrid maize increased significantly with the application of 4 t enriched FYM and 75 kg ha-1 N + 60 kg ha-1 P over all other treatments applied to the crop. In other study Manjihi *et al.,* 2014 observed that highest grain yield of maize and wheat was obtained by the application of 50% N through FYM + 50% RDF which was recorded to be at par with the recommended dose of fertilizer. Shinde *et al*., 2014 concluded that significantly increase in number of cobs per plant, 1000-grain weight, grain yield and stover yield were attained by maize plants with the application of 100% RDF + 10t FYM over all other treatments. Similar findings were given by Gupta *et at*., 2014 from a long, term experiment conducted that 50% RDF+50% FYM resulted in significant increase in cob girth, cob length and grain yield of maize and also resulted in significant increase in yield of gobhi sarson. Patil in 2014 explained that highest grain yield and straw yield of sorghum was obtained with the application of treatment containing 100% recommended rate of N + 50% recommended rate of N through orgainc materials(50:50 of *Leucaena* lopping and FYM)+ *Azosprillium*. In 2013 Kannan *et al*., stated that significantly higher cob weight of maize achieved by the application of treatment involving RDF+FYM and number of grain per cob was found to be maximum with the application of RDF +FYM.

Lone *et al*., 2013 recorded in their experiment conducted at kashmir significantly higher cob yield, number of cobs per plant and green fodder yield with the application of farm yard manure 6 t ha-1 in combination with 100% RDF than the application of 100% of recommended dose of fertilizer alone. In 2012 Shilpashree from an experiment

conducted at college of Agriculture, Navile, Shimoga concluded that a markable increase in yield attributes like length of cob, girth of cob , test weight, grain yield and stover yield were obtained with the application of 100% RDF + 7.5 t FYM ha-1 over all other treatments. Singh *et al*., 2011 that significantly superior values of yield attributes and yield viz. baby cob weight, cobs per plant, baby corn girth and yield of baby cob, baby cob and fodder were recorded with application of 100% inorganic N over integrated nutrient applied as 50% inorgainc N+ 50% organic N and 75% inorganic N +25% organic N. Balal *et al*., 2011 conducted an experiment at udaipur and recorded significant increase in cob weight, cob length, weight of grains per cob, grain and stover yield when 100% of recommended dose of NPK + 10 t FYM ha-1 was applied as compared to all other treatments and was at par with 150% of recommended dose of NPK. Similarly, it was observed in an experiment conducted at Varanasi that the application of 75% nitrogen through fertilizer and 25% nitrogen through fertilizer and registered significantly higher values for baby corn weight per cob, number of cobs per plant, baby corn girth and baby corn yield over 50% nitrogen through fertilizer and 50% nitrogen through FYM as reported by Singh *et al*., 2010.

Kumar *et al*., 2008 to evaluate the effect of integrated nutrient management on growth, yield and quality of baby corn that the number of cobs per plant, weight per cob, cob length and baby corn yield was higher with the application of 100% of recommended dose of N through fertilizer, which was however statistically at par with the application of 75% of recommended dose of N through fertilizer along with 25% N through poultry manure or sheep manure or farmyard manure. Patel *et al*., 2007 revealed that application of 100% RDF + 10t FYM ha -1 significantly increased the green forage yield of forage maize and it was found to be at par with the application of 75%RDF + 10t FYM. Saha and Mondal 2006 conducted an experiment applying inorganic and organic sources of nutrients at kalyani and reported that the application of 75% of recommended dose of fertilizer along with farmyard manure was significantly effective in increasing baby corn weight, dehusked corn yield and fodder yield over the application of 100% recommended dose of fertilizer. Shinde *et al*., 2014 from an experiment conducted of Rabi maize at Parbhani that significantly increase in protein per cent, protein yield and protein production efficiency was recorded with the application of 100% RDF + 5 t FYM over all other treatments whereas it has shown statistical parity with the treatment receiving 100%RDF. Meena *et al*., 2013 that application of 5t FYM + 150 kg N+75kg P+ 40kg Zn + *Azotobacter* ha-1 resulted in significant increase in protein content in maize crop. Balal *et al*., 2011 concluded that a significant increase in protein percentage of maize was observed with the application of treatment involving 100% NPK + 10t FYM ha-1 over all other treatments applied. Singh *et al.,* 2010 recorded that application of 100% NPK resulted in significant increase in carbohydrate percentage, starch percentage, protein percentage and sugar percentage of baby corn over all other treatments, however it shows statistical parity with the application of 75% NPK + 25% FYM.

V. Conclusion

Maize being an exhaustive crop depletes soil fertility. The study on judicious integrated nutrient management strategy revealed that application of recommended dose of INM to Maize not only enhanced productivity of maize over the control, but also improved soil fertility in terms of higher available N, P, K and organic carbon. INM practice including the integration of 5 tonnes of FYM with 100 kg inorganic N ha^{-1} showed its best results with respect to plant yield and quality parameters. INM practice with recommended dose of inorganic Nitrogen showed its best results with respect to yield parameters like Number of days taken to baby corn formation, Number of cobs per plant, Baby corn length, Baby corn girth, Green cob weight, Baby corn weight, Baby corn yield, Green fodder yeild, TSS and protein content in baby corn over control.

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