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INTERACTIVE EFFECTS OF ORGANIC AND INORGANIC SOURCES OF NUTRITION ON GROWTH OF BABY CORN AND POST-HARVEST SOIL PROPERTIES

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Maize (*Zea mays* L.), as the third most important cereal crop in the world following wheat and rice, has been cultivated for centuries as a grain crop and morerecently as a vegetable crop, such as babycorn and sweet maize (*Zea mays* var. saccharata). Maize is classified into different groups or types based on the endosperm of kernels among which babycorn is grown for vegetable purpose. Babycorn is the young, finger-length fresh maize ear harvested within 2 or 3 days of silk emergence but prior to fertilization (Muthukumar *et al.,* 2005; Mahajan *et al.,* 2007). It is a delicious and nutritive vegetable consumed as natural food. Thavaprakaash *et al.* (2005) and Das *et al.* (2008) reported that 100 g of baby corn contain 89.1% moisture, 0.2 g fat, 1.9 g protein, 8.2 g carbohydrate, 0.06 g ash, 28.0 mg calcium, 86.0 mg phosphorus and 11.0 mg of ascorbic acid. In addition to high nutritional value as human food, another benefit of babycorn consists of utilizing husk, silk and stover as green herbage for feeding ruminants and swine.

Babycorn cultivation, being a relatively new practice in India, requires a suitable production technology in realizing higher baby corn yield and monetary returns before it could be popularized among maize growers. It is well established that the improvement of quality and productivity of crops could be made possible with combined application of organic manures and balanced chemical fertilizers. The concept of integrated nutrient management seeks to sustain soil fertility through an integration of different sources of nutrition that will produce maximum crop yield per unit input use (De Datta and Broadbent, 1990). The present investigation was, therefore, undertaken to find out suitable integrated nutrient requirements for baby corn.

A field experiment was conducted during *kharif* 2013 at the research farm of Punjab Agricultural University, Ludhiana, which is situated at 30° 56' N latitude; with 75° 52' E longitude with a mean height of 247 m above the mean sea level. The field soil was sandy loam in texture with a pH of 7.4, EC of 0.36 $dSm^1$and bulk density of 1.58 g/cm^3. The soil was low in available nitrogen (134.1 kg/ha), medium in available phosphorus (19.46 kg/ha) and potassium (132.3 kg/ha.The experiment was laid out in a randomized complete block design replicated four times. The experiment had ten treatments comprising ofcontrol (unfertilized)(T_1), recommended N (60 kg/ha) (T_2), N-K_2O; 60-6; kg/ha (T_3), N-P_2O_5; 60-12; kg/ha (T_4), N-P_2O_5-K_2O;45-9-4.5; kg/ha (T_5), N-P_2O_5-K_2O; 60-12-6; kg/ha (T_6), N-P_2O_5-K_2O; 75-15-11.3; kg/ha (T_7), 30 kg N/ha (FYM) + 30 kg N/ha (through inorganic sources) (T_8), 15 kg N/ha (FYM) + 45 kg N/ha (through inorganic sources) (T_9) and 15 kg N/ha (FYM) + 60 kg N/ha (through inorganic sources) (T_{10}). The recommended dose of N (60 kg/ha) was applied in two splits irrespective of treatments. Half of nitrogen (as per treatment level) and full doses of phosphorus and potassium were applied at the time of sowing in integrated nutrient management treatments and half the dose of nitrogen along with full dose of organic manures was applied at the time of sowing and remaining nitrogen was top dressed 25 days after sowing. Nitrogen was given in the form of urea, phosphorus in the form of single super phosphate and potassium as muriate of potash. The variety 'Composite Kesri' was sown on 25th June 2013 at 30 x 20 cm spacing and immature cobs were harvested in end of August 2013. Four plants were periodically (at 15 days interval) cut from each plot separately and sun dried for 48 hours and then kept in an oven at 65ºC up to constant weight. The dry weight of plants were recorded and converted into dry weight kg/ha. The crop growth rate (CGR) was calculated by the given formula:

$$\text{CGR} = \frac{W_2 - W_1}{t_2 - t_1}$$

W_2 - Weight of crop at 60 DAS t_2 – 60 DAS

W_1 - Weight of crop at 15 DAS t_1 – 15 DAS

The crop was detasseled before pollen shed to prevent fertilization and also to divert nutrient flow to developing cob. Glass electrode pH meter in 1:2 soil-water suspension (Jackson, 1967) was used to measure soil pH and 1:2 soil: water supernatant with Solubridge conductivity meter (Jackson, 1967) was used to measure soil electrical conductivity. Soil samples for calculating bulk density of undisturbed soil were taken before sowing the experiment and after harvesting baby corn crop by using a 5 cm long scoop having 2.5cm internal diameter. Soil samples were taken from 5-10 cm depth before and after harvesting of crop. The samples were oven dried and bulk density was expressed as g/cm^3. The infiltration

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rate was measured from one replication before sowing and after harvesting baby corn with the help of double ring infiltrometers of 35 and 45 cm diameter and 28 cm height as described by Black (1965) and was expressed in cm. Soil strength was measured before sowing and after harvesting of baby corn crop by using penetrometer (base diameter 13 cm and base area 1.33 cm^2). These measurements were made from 0-5, 5-10, 10-15, 15-20, 20-25 and 25-30 cm soil depth. Soil strength was expressed as deci Mpa.

Growth attributes

The data pertaining to the dry matter accumulation revealed that it increased with advancement of crop age in all the treatments. The highest dry matter accumulation was recorded in N-P-K (75-15-11.3kg/ha) which was statistically at par with 15 kg N/ha (FYM) + 60 kg N/ha and N-P-K (60-12-6 kg/ha) and the minimum dry matter accumulation was observed in control plot. The increased dry matter production might be due to better utilization of nutrient and phased release of nutrients as per requirement of maize. This corroborates the findings of Thakur *et al.* (1997) and Luikham *et al.* (2003). The crop growth rate (CGR) is an important index of measuring efficiency of various treatments. CGR was calculated for 15 DAS and 60 DAS. In Table 1 data revealed that the crop growth rate was maximum in N-P-K (75-15-11.3 kg/ha) and minimum in control plot. The per cent increase in crop growth rate of T_7 over recommended fertilizer (N 60 kg/ha) was 32.22. The reason for higher growth rate could be higher leaf area index in respective treatments.

Soil pH

The data (Table 1) revealed that the pH of soil decreased in comparison to its initial status (pH 7.40). The soil pH was lowest in T_8 treatment. All the INM treatments registered slightly lower pH than treatments. However, all the treatments were at par being non-significant statistically. Hence, it may be concluded that farmyard manure decreased soil pH as compared to application of chemical fertilizers alone as a sources of nutrients. These results are in conformity with the findings of Yadav and Kumar (2000).

Electrical conductivity

The perusal of data (Table 1) indicated that electrical conductivity (EC) of soil decreased as compared to initial value 0.36 dS/m. It varied from 0.30 to 0.35 d/m and lowest value was observed in the INM treatments (ranging from 0.30-032 d/m) as compared to application of chemical fertilizers alone. However, all the treatments were at par statistically. Similar results have been reported by Yadav and Kumar (2000).

Bulk density

Soil bulk density values were recorded after baby corn crop harvest for different chemical and INM treatments (Table 1). The results indicated that the bulk density was decreased in INM treatments as compared to where chemical fertilizers applied alone in 0-15 cm soil depth. The bulk density of the soil was reduced to greater extent in all INM treatments *i.e.* 30 kg N/ha (FYM) + 30 kg N/ha, 15 kg N/ha (FYM) + 45 kg N/ha and 15 kg N/ha (FYM) + 60 kg N/ha. The maximum reduction was observed in 30 kg N/ha (FYM) + 30 kg N/ha and minimum was observed in control treatment. The decreased in bulk density of soil may be ascribed to addition of organic through farmyard manure. Similar results have been reported by More (1994) and Sheeba and Chellamuthu (2002).

Table 1. Effect of inorganic fertilizers and organic manure on growth attributes of babycorn and soil properties after crop harvest

Treatment	Dry matter accumulation (q/ha)		Crop growth rate q/day / ha	pH	EC (dS/m)	Cumulative infiltration rate (cm)	Soil strength (deci MPa) Depth of Soil (cm)	Bulk density (g/cm^3) Mean (0-15 cm)
	(15 DAS)	(60 DAS)				cm/hr.	Mean	
T_1 – Control	0.85	35.93	0.78	7.39	0.33	5.36	12.5	1.58
T_2 - Recommended N (60 kg/ha)	1.15	41.75	0.90	7.41	0.33	5.40	13.0	1.57
T_3 - N-K (60-6) kg/ha	1.20	44.28	0.96	7.43	0.34	5.58	13.1	1.57
T_4 - N-P (60-12) kg/ha	1.18	46.65	1.01	7.43	0.33	5.62	13.1	1.56
T_5 - N-P-K (45-9-4.5) kg/ha	1.21	47.80	1.04	7.46	0.34	7.18	13.6	1.57
T_6 - N-P-K (60-12-6) kg/ha	1.23	52.13	1.13	7.49	0.35	7.62	13.9	1.56
T_7 - N-P-K (75-15-11.3) kg/ha	1.26	54.63	1.19	7.51	0.35	8.18	14.3	1.55
T_8 - 30 kg N/ha (FYM) + 30 kg N/ha	1.22	49.40	1.07	7.30	0.30	12.04	9.8	1.51
T_9 - 15 kg N/ha (FYM) + 45 kg N/ha	1.22	50.25	1.09	7.33	0.31	10.64	10.3	1.52
T_{10} - 15 kg N/ha (FYM) + 60 kg N/ha	1.24	52.93	1.14	7.35	0.32	9.16	10.8	1.53
CD (p=0.05)	0.03	2.58		NS	NS	-	-	0.01

Soil strength

Soil strength (penetration resistance) represents the compactness of the soil and it is important term in expression of the development of plant roots because higher the soil strength, higher will be penetration resistance. As evidenced from data presented in Table 1, chemical fertilizer treatments offered more penetration resistance (21.1-22.0 deci MPa) as compared to INM treatments (18.7-19.6 deci MPa). Critical analysis of data also revealed that the INM decreased the penetration resistance particularly in the upper 0-5, 5-10 and 10-15 cm soil layers. The decrease in penetration resistance of the soil may be attributed to improvement in physical condition of soil due to addition of farmyard manure and decreased bulk density (Table 1). These results are in agreement with the findings of Mishra and Sharma (1997) and Tiwari *et al.* (2000).

Cumulative infiltration

Infiltration rate shows vertical downward movement of water in the soil. The infiltration rate (cumulative intake) of water under different treatments recorded after harvesting baby corn crop from unploughed field given in Table 1 showed that cumulative infiltration varied from 26.8 cm to 60.2 cm for 5 hours. The highest cumulative infiltration was observed in 30 kg N/ha (FYM) + 30 kg N/ha treatment (12.04 cm). The application of 30 kg N/ha (FYM) + 30 kg N/ ha treatment increased cumulative intake of water by 47.2 per cent over N-P-K (75-15-11.3) kg/ha treatment.

The application of 30 kg N/ha (FYM) + 30 kg N/ha, 15 kg N/ha (FYM) + 45 kg N/ha and 15 kg N/ha (FYM) + 60 kg N/ha not only increased dry matter accumulation but crop growth rate was also recorded higher in later treatments. The maximum reduction in bulk density was at 30 kg N/ha (FYM) + 30 kg N/ha (1.51g/cm^3) and minimum was observed in control treatment (1.58 g/cm^3).The alone chemical fertilized treatments offer more penetration resistance (21.1-22.0 deci MPa) as compared to INM treatments (18.7-19.6 deci MPa). The cumulative infiltration varies from 26.8 cm to 60.2 cm for 5 hours. The highest cumulative infiltration was at 30 kg N/ha (FYM) + 30 kg N/ha treatment (12.04 cm).

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