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NUTRIENT UPTAKE AND CHEMICAL PROPERTIES OF SOIL AFTER HARVEST OF BABY CORN (*Zea mays* L.) AS INFLUENCED BY ORGANIC MANURES AND FERTILIZERS

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ABSTRACT
An experiment was conducted during Kharif season, to study the effect of combination of different source and dosage of organic manures with fertilizers on nutrients uptake, available nutrients and chemical properties of soil after harvest of baby corn and its effect on yield of baby corn. Results revealed that, application of recommended dose of fertilizer along with FYM (150:75:40 kg N: P_2O_5:K_2O ha^{-1}) + 10 t FYM recorded significantly higher uptake of nitrogen, phosphorus and potassium (204.24, 35.23 and 213.6 kg/ha, respectively than applying only recommended dose of fertilizer. In same way, application of 100% N through different sources of organic manures, application of FYM + balance P and K through fertilizer significantly recorded next higher available nitrogen, phosphorus and potassium (233.5, 33.0 and 226.8 kg/ha, respectively) compared to other combinations of organic manure treatments. The same trend was noted with respect to yield. Highest baby corn yield (17.67q ha^{-1}) and green fodder yield (36.53 t ha^{-1}) was recorded in treatment where application of organic manure through FYM in combination of recommended dose of fertilizer (150:75:40 kg N: P_2O_5:K_2O ha^{-1}) + 10 t FYM was applied. Organic carbon content of soil was improved where organic manures along with fertilizers were applied.

INTRODUCTION

Maize, of all the cereal grains is the most highly valued for its multifarious uses, being utilized as human food, animal feed and raw materials in industry. Maize is the third most important cereal crop next to rice and wheat and has the highest production potential among the cereals. For diversification and value addition, as well as growth of food processing industries, an interesting recent development is growing maize for vegetable purpose, which is known as 'baby corn'. It is so called because young, fresh and fingerlike green ears are harvested when the silk length is of 2-3 cm but prior to fertilization (Pandey *et al*., 2000). It is used as vegetable after dehusking and desilking. Its delicate texture, sweet flavour and crisp nature contribute to its increasing popularity making it an indispensable ingredient in many multi-cuisine dishes of present day.

Baby corn is a vegetable crop that can potentially improve the economic status of farmers (Das *et al*., 2008). In addition to its sweet, succulent, and delicious taste, baby corn's nutritional value is comparable to other vegetables such as cauliflower, cabbage and tomato. When baby corn is harvested good quality green fodder is also obtained. The succulent green fodder of high quality adds enormously to the total returns to the farmers, resulting in higher profit per unit area per unit time compared to grain maize. Although, baby corn has been developed as an export vegetable that can generate foreign exchange, it is serving the local people with nutritious vegetable. Despite its great nutritional importance and economic security to the farmers only limited scientific research has been reported on baby corn, resulting in insufficient knowledge and lack of standard technologies that hamper the popularization of baby corn production (Muthukumar *et al*., 2007; Thavaprakaash and Velayudham., 2008). Cultivation practices have not been standardized. With this background, to standardize the agro techniques not only for its potential yield but also for its quality babies and fodder this study was taken at farmers field.

MATERIALS AND METHODS

An experiment was conducted during Kharif 2008 and 2009, at farmer's field of Shettahalli Village, Mandya District, Karnataka, India situated in 12018' to 13004' N latitude and 76079' to 77020'E longitude with an altitude of 695 meters above the MSL located in the Agro

Climatic Zone - 6 (Southern Dry Zone) of Karnataka. The soil of experimental site was sandy clay loam in texture. The soil pH was 6.8 with an electrical conductivity of 0.14 dSm-1. The soil was low in available nitrogen (210.8 kg ha^{-1}), medium in available phosphorus (24.6 kg ha^{-1}) and potassium (168.0 kg ha^{-1}). The organic carbon content was low (0.46 %). Nutrients composition of organic manures used in the experiment were N: 0.56 %, P:0.21 % and K:0.45 % (Farm yard manure), N: 1.80 %, P:1.10 % and K:1.58 % (vermicompost) and N: 3.21 %, P:2.16 % and K:1.72 % (poultry manure). The experiment was laid out in a randomized block design with eight treatments, *viz*. T_1: Recommended dose of fertilizer (RDF) (150:75:40 kg N:P_2O_5:K_2O ha^{-1}), T_2: 50 % N through FYM + balance N, P and K through fertilizer, T_3: 50 % N through vermicompost + balance N, P and K through fertilizer, T_4: 50 % N through poultry manure + balance N, P and K through fertilizer, T_5: 100% N through FYM + balance P and K through fertilizer, T_6: 100% N through vermicompost + balance P and K through fertilizer, T_7: 100% N through poultry manure + balance P and K through fertilizer, T_8: RDF (150:75:40 kg N: P_2O_5: K_2O ha^{-1}) + 10 t FYM ha^{-1} and replicated thrice. The nitrogen contents in organic manures *viz*., FYM, vermicompost and poultry manure were determined and the amount of these materials required for substituting recommended dose of nitrogen as per the treatment was calculated and applied 15 days prior to sowing and were thoroughly mixed in the soil. Fertilizer N was applied as per the treatments in two equal splits *viz*., first half at the time of sowing as basal dose and remaining half as top dressed at 20 days after emergence. Entire quantity of phosphorus and potassium were applied as basal dose. Baby corn seeds were sown with recommended spacing (45 x 20 cm) with a variety PAC 792. Five plants were randomly selected in each plot of each replication and were tagged for the purpose of recording observations. Tassels were removed as and when they emerged. This was done to avoid pollination. If the silk gets pollinated, the kernels would start developing within hours and the cob would become hard and unfit for consumption. Harvesting was done at three days after silk emergence. Similarly, baby corn and fodder yield from each net plot in each replication was harvested, weighed and recorded as baby corn and fodder yield per net plot. Further, this net plot yields were converted to yields per hectare. The analysis and interpretation of the data was done using the Fisher's method of analysis and variance techniques as given by Panse and Sukatme (1967). The level of significance used in 'F' and 't' test was P=0.05 probability level and wherever 'F' test was found significant, the 't' test was performed to estimate critical differences among various treatments.

RESULTS AND DISCUSSION

Effect of organic manures and fertilizers on nutrient uptake by baby corn

The pooled data of two years (Table 1) on uptake of nitrogen, phosphorus and revealed that, application of recommended dose of fertilizer (150:75:40 kg NPK ha^{-1}) + FYM (10 t ha^{-1}) recorded significantly maximum uptake of nitrogen, phosphorus and potassium (204.24, 35.23 and 213.6 kg/ha, respectively) compared to other treatments. However, 50 per cent N through organic manure and balance NPK through fertilizer recorded highest nitrogen, phosphorus and potassium uptake as compared to 100 per cent N through organic manure and balance P and K through fertilizer. Total uptake of nutrients showed a pronounced positive effect with the application of combination of organic manures and fertilizers. Combined application of organic manures and fertilizers ensure the release of readily available nutrients in adequate quantity to promote early growth as compared to sole organic manure treatments. This might be due to result of steady and continuous availability of instant N in the rhizosphere. The lowest uptake of nitrogen, phosphorus and potassium (118.47, 17.09 and 140.15 kg/ha, respectively) recorded in the treatment with the application of 100 per cent N through FYM and balance P and K through fertilizer compared to other treatments. This is attributed to lesser availability of instant nutrients in rhizosphere, due to relatively slow mineralization of organic sources. This corroborates the findings of Arun Kumar *et al*. (2009).

Effect of organic manures and fertilizers on available nutrients in soil

The pooled data of two years (Table 2) revealed that, post harvest soil fertility status has been significantly improved with the application of 100 per cent N through organic manures. The highest available nitrogen was obtained with 100 per cent N through FYM and balance P and K through fertilizer (T_5) (233.55 kg ha^{-1}) and was on par with 100 per cent N through poultry manure and balance P and K through fertilizer (T7) (229.07 kg ha^{-1}) and 100 per cent N through vermicompost and balance P and K through fertilizer (T_6) (225.70 kg ha^{-1}). The highest available P_2O_5 (38.02 kg ha^{-1}) was recorded in 100 per cent N through poultry manure and balance P and K through fertilizer (T_7) and was on par with 100 per cent N through vermicompost and balance P and K through fertilizer (T_6) (35.92 kg ha_{-1}). The highest available K_2O content (226.80 kg ha^{-1}) was noticed in 100 per cent N through FYM and balance P and K through fertilizer (T_5). This might be owed to slow mineralization of organic fraction coupled with under utilization of applied nutrients by baby corn. The lowest post harvest soil fertility status was found with supply of only recommended dose of fertilizer. These results are in conformity with the findings of Karki *et al*. (2005).

Table 1: Nutrients uptake by baby corn as influenced by organic manures and fertilizers

Treatments	Nitrogen (kg ha^{-1})			Phosphorus (kg ha^{-1})			Potassium (kg ha^{-1})		
	2008	2009	Pooled	2008	2009	Pooled	2008	2009	Pooled
T_1	176.79	190.13	179.72	30	32.67	31.33	198.16	201.65	199.9
T_2	142.16	151.83	143.32	20.71	21.81	21.26	161.01	162.12	161.57
T_3	173.34	184.53	176.13	25.76	27.17	26.47	182.95	185.08	184.01
T_4	160.53	171.87	162.88	24.72	26.14	25.43	166.91	167.57	167.24
T_5	117.2	126.62	118.47	17.29	16.88	17.09	139.32	140.99	140.15
T_6	131.28	138.79	131.95	19.07	19.69	19.38	150.57	151.94	151.26
T_7	124.14	131.44	125.33	17.97	19.21	18.59	143.89	146.16	145.03
T_8	203.11	215.41	204.24	33.94	36.51	35.23	212.59	214.63	213.61
S.Em +	7.23	9.47	6.85	1.77	1.98	1.53	6.27	6.92	6.5
C.D at 5 %	21.94	28.73	20.78	5.36	6.02	4.65	19.03	20.98	19.72

T_1: RDF (150:75:40 kg N: P_2O_5 :K2O ha^{-1}) ;T_2: 50% N through FYM + balance N, P and K through fertilizer;T_3: 50% N through Vermicompost + balance N, P and K through fertilizer;T_4: 50% N through poultry manure + balance N, P and K through fertilizer;T_5: 100% N through FYM + balance P and K through fertilizer;T_6: 100% N through Vermicompost + balance P and K through fertilizer; T_7: 100% N through poultry manure + balance P and K through fertilizer;T_8: RDF (150:75:40 kg N: P2O5: K2O ha-1) + 10 t FYM ha^{-1}

Table 2: Available nutrients in soil after harvest of baby corn as influenced by organic manures and fertilizers

Treatments	Nitrogen (kg ha^{-1})			Phosphorus (P_2O_5: kg ha^{-1})			Potassium (K_2O : kg ha^{-1})		
	2008	2009	Pooled	2008	2009	Pooled	2008	2009	Pooled
T_1	187.81	172.14	179.97	16.47	14.62	15.55	143.43	141.36	142.4
T_2	217.48	222.78	220.13	25.56	27.02	26.29	184.29	192.73	188.51
T_3	214.55	218.95	216.75	28.25	30.87	29.56	179.85	188.44	184.15
T_4	215.3	219.71	217.5	29.48	31.96	30.72	171.1	182.01	176.55
T_5	232.4	234.7	233.55	32.74	33.33	33.03	220.91	232.69	226.8
T_6	224.07	227.33	225.7	34.22	37.62	35.92	206.92	218.96	212.94
T_7	227.84	230.29	229.07	36.33	39.7	38.02	193.88	205.44	199.66
T_8	213.52	215.85	214.69	24.44	25.14	24.79	175.59	178.47	177.03
S.Em +	3.97	4.19	3.69	0.93	2.08	1.24	3.58	5.17	1.68
C.D at 5 %	12.03	12.7	11.21	2.82	6.32	3.76	10.86	15.67	5.09

T_1: RDF (150:75:40 kg N: P_2O_5 :K_2O ha^{-1});T_2: 50% N through FYM + balance N, P and K through fertilizer;T_3: 50% N through Vermicompost + balance N, P and K through fertilizer;T_4: 50% N through poultry manure + balance N, P and K through fertilizer;T_5: 100% N through FYM + balance P and K through fertilizer;T_6: 100% N through Vermicompost + balance P and K through fertilizer; T_7: 100% N through poultry manure + balance P and K through fertilizer;T_8: RDF (150:75:40 kg N: P_2O_5: K2O ha^{-1}) + 10 t FYM ha^{-1}

Table 3 : Chemical properties of soil after harvest of baby corn as influenced by organic manures and fertilizers

Treatments	pH			EC (dS m^{-2})			Organic Carbon (%)		
	2008	2009	Pooled	2008	2009	Pooled	2008	2009	Pooled
T_1	6.73	6.69	6.71	0.14	0.15	0.15	0.39	0.31	0.35
T_2	6.85	6.87	6.86	0.19	0.16	0.18	0.56	0.58	0.57
T_3	6.83	6.84	6.84	0.21	0.17	0.19	0.52	0.55	0.54
T_4	6.82	6.85	6.84	0.24	0.18	0.21	0.5	0.53	0.52
T_5	6.94	6.95	6.95	0.21	0.2	0.21	0.74	0.77	0.76
T_6	6.89	6.91	6.9	0.23	0.21	0.22	0.65	0.68	0.66
T_7	6.88	6.89	6.89	0.26	0.24	0.25	0.61	0.64	0.63
T_8	6.79	6.81	6.8	0.16	0.14	0.15	0.54	0.57	0.56
S.Em +	0.03	0.03	0.03	0.02	0.01	0.01	0.02	0.02	0.01
C.D at 5 %	0.11	0.1	0.08	0.05	0.04	0.03	0.05	0.07	0.04

T_1: RDF (150:75:40 kg N: P_2O_5 :K_2O ha^{-1});T_2: 50% N through FYM + balance N, P and K through fertilizer.; T_3: 50% N through Vermicompost + balance N, P and K through fertilizer;T_4: 50% N through poultry manure + balance N, P and K through fertilizer;T_5: 100% N through FYM + balance P and K through fertilizer;T_6: 100% N through Vermicompost + balance P and K through fertilizer;T_7: 100% N through poultry manure + balance P and K through fertilizer;T_8: RDF (150:75:40 kg N: P_2O_5: K_2O ha^{-1}) + 10 t FYM ha^{-1}

Table 4: Yield and yield parameters of baby corn as influenced by organic manures and fertilizers

Treatments	Weight of baby corn (g)			Baby corn yield (q h^{a-1})			Fodder yield (t ha^{-1})		
	2008	2009	Pooled	2008	2009	Pooled	2008	2009	Pooled
T_1	17.64	17.86	17.75	15.4	17.33	16.37	33.25	35.34	34.29
T_2	16.28	16.45	16.36	12.5	13.67	13.08	27.93	29.75	28.84
T_3	17.26	18.12	17.69	14.88	15.78	15.33	31.09	33.23	32.16
T_4	16.78	17.05	16.92	13.13	14	13.57	28.23	30.23	29.23
T_5	14.73	15.35	15.04	9.83	10.82	10.33	24.57	26.82	25.69
T_6	15.78	16.15	15.97	11.5	13.12	12.31	26.92	28.87	27.89
T_7	15.24	15.87	15.56	10.57	11.56	11.06	26.34	27.32	26.83
T8	17.97	18.37	18.17	16.59	18.76	17.67	34.81	38.24	36.53
S.Em +	0.67	0.5	0.46	0.62	1.33	0.72	1.63	1.74	1.1
C.D at 5 %	2.04	1.51	1.39	1.88	4.02	2.2	4.93	5.28	3.33

T_1: RDF (150:75:40 kg N: P_2O_5 :K_2O ha^{-1});T_2: 50% N through FYM + balance N, P and K through fertilizer;T_3: 50% N through Vermicompost + balance N, P and K through fertilizer;T_4: 50% N through poultry manure + balance N, P and K through fertilizer; T_5: 100% N through FYM + balance P and K through fertilizer;T_6: 100% N through Vermicompost + balance P and K through fertilizer;T_7: 100% N through poultry manure + balance P and K through fertilizer; T_8: RDF (150:75:40 kg N: P_2O_5: K_2O ha^{-1}) + 10 t FYM ha^{-1}

DAS: Days after sowing

RDF: Recommended dose of fertilizer

Effect of organic manures and fertilizers on chemical properties of soil

pH and organic carbon content in soil after the harvest of baby corn crop (Table 3) differed significantly due to various treatments. Significantly highest pH and organic carbon content in soil were observed in the treatment with the application of 100 per cent N through FYM and balance P and K through fertilizer (6.95 and 0.76 %, respectively). The lowest pH and organic carbon content in soil were recorded in the treatment with the application of only recommended dose of fertilizer. The EC (Electrical conductivity) of the soil after the harvest of baby corn crop was significantly influenced by different treatments. The highest EC (0.25 dSm-1) was recorded by 100 per cent N through poultry manure and balance P and K through fertilizer and which was on par with 100 per cent N through vermicompost and balance P and K through fertilizer. Whereas, the lowest EC was observed in the treatment with the application of only recommended dose of fertilizer (0.15 dSm-1). However, application of organic manures alone or in combination with chemical fertilizers recorded highest organic carbon content, pH and EC of the soil as compared to application of only recommended dose of fertilizer. This indicates that organic manures have predominant role in the improvement of soil fertility, physicalchemical properties and biological activity, besides its nutrient contribution (Kulvinder *et al*., 2005).

Effect of organic manures and fertilizers on yield parameters of baby corn

The pooled data on yield is presented in Tables 4 Results revealed that, significantly higher baby corn yield (17.69 q ha^{-1}) and green fodder yield (36.53 t ha^{-1}) were recorded in the treatment with application of recommended dose of fertilizer (150:75:40 kg NPK ha^{-1}) + FYM (10 t ha^{-1}) compared to other treatments. The extent of increase in baby corn yield was 7.94 per cent over the treatment which received only recommended dose of fertilizer (150:75:40 kg NPK ha^{-1}). The increase in yield might be due to increase in yield parameters of baby corn such as length of baby corn, girth of baby corn, weight of baby corn and number of babies per plant. The results are conformity with the findings of Natarajan (1990) and Shashidhara *et al*. (1998), where the increase in yield might be due to availability of nutrients coinciding with physiological needs of the crop, effective partitioning of the assimilates to sink that helps in higher dry matter accumulation and increase in yield (Ranjan and Preethi, 2017).

The increase in green fodder yield of baby corn recorded in this treatment was attributed to increase in plant height, number of leaves, leaf area, leaf area index and total dry matter production. The leaf area was correlated to increased fodder yield, since leaf area is an indicative of the assimilatory surface area providing the synthesis and accumulation of more photosynthates and dry matter production. These results are in conformity with the findings of Negalur (2000) and Eajas (2017)

Among the graded levels organic manures, significantly higher yield of baby corn were recorded due to application of 50 per cent N equivalent through various source of organic manure like, vermicompost, FYM and poultry manure in combination with balance NPK through inorganic fertilizers and all these treatments were on par. Application of 100 per cent N equivalent through organic manures like FYM, vermicompost and poultry manure in combination with balance P and K through commercial inorganic fertilizers recorded comparatively less yield compared to other combination of organic manures and fertilizers.

The above study indicated that baby corn responded well to combined application of organics and inorganics, especially to vermicompost which might be owing to favourable effect on soil condition and synchronized release of plant nutrients throughout the crop growth period and inorganic nutrients have positive influence on source-sink relationship as evident from remarkable improvement in plant height and dry matter accumulation and ultimately yields were increased. The results are in conformity with the findings of Dadarwal *et al*. (2009).

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