Plant Archives Vol. 24, No. 2, 2024 pp. 1695-1700 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2024.v24.no.2.241

INFLUENCE OF INTEGRATED NUTRIENT MANAGEMENT ON MACRONUTRIENT CONTENT AND UPTAKE IN SWEET CORN

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(Date of Receiving-03-07-2024; Date of Acceptance-18-09-2024)

ABSTRACT

A field experiment was conducted at Northern block, Agricultural College Farm, Bapatla to study the effect of integrated nutrient management of sweet corn on macro nutrient content and uptake. The experiment was replicated thrice, with 10 treatments comprising integration of using inorganic fertilizers, FYM, liquid biofertilizers, beejamrutham and jeevamrutham. The results revealed that highest macronutrient content and uptake of N, P and K were observed with application of 100 per cent recommended dose of NPK through in organic fertilizers (T_2) whereas sulphur content and uptake was observed highest with the application of 50 per cent RDF with FYM @ 5 t ha^{-1} and it was on par with treatment T_2 (100% Recommended dose of fertilizers).

Key words : Sweet corn, Macro nutrients, Content and uptake, Beejamrutham and Jeevamrutham,

Introduction

Recently, sweet corn becoming popular among health-conscious urban populations in India, demonstrating significant potential in both domestic and international markets. This crop is a rich source of sugars, dietary fibre, vitamin C, beta-carotene, niacin, calcium and potassium. Due to its rising demand, the cultivation of sweet corn is receiving greater attention. Farmers, particularly those on the outskirts of large cities and metropolitan areas, are increasingly producing sweet corn commercially to boost their income. Given the limited scope for expanding cultivation areas, enhancing productivity through various management practices is essential. Organic manures, such as animal manures and composted materials, are fundamental to sustainable agriculture. They supply substantial amounts of macro and micronutrients essential for crop growth, are environmentally friendly, and serve as renewable alternatives to mineral fertilizers. In contrast, inorganic fertilizers contain high nutrient concentrations and are readily available to crops, but their excessive use can be harmful to both the crop and the environment. While increased production levels can be achieved solely with inorganic fertilizers, this approach can lead to soil quality deterioration and environmental pollution. To sustain the soil fertility and crop productivity, the role of solid organic manures viz. FYM and fermented liquid organic manures mainly Jeevamrutam and Beejamrutha are very important (Safiullah *et al.*, 2018). It is well-established that higher grain yields depend on effective nutrient management practices. In this context, INM has emerged as a critical approach in sustainable agriculture, aiming to optimize the use of organic and inorganic fertilizers to improve soil fertility and crop productivity. This study aims to evaluate the influence of INM on the nutrient dynamics of sweet corn, providing insights into effective nutrient management strategies for optimizing crop performance and maintaining soil health.

Materials and Methods

A field experiment entitled "Sustaining soil health and productivity of sweet corn through nutrient management" was conducted at Agricultural College Farm, Bapatla which was located in Krishna agro-climatic zone of coastal Andhra Pradesh situated between 15° 55' N latitude and 80°30' E longitude and at an altitude of 4.29 meters above the mean sea level and eight kilometers away from Bay of Bengal using sweet corn hybrid maize Mahy-301 as a test crop. The experiment comprising of 10 treatments *viz*., T_1: Absolute Control, T_2: 100% RDF, T_3: FYM @ 5 t ha^{-1} + LBF @ 1.5 L ha^{-1}, T_4: Beejamrutham + Jeevamrutham, T_5: 50% RDF + FYM @ 5 t ha^{-1}, T_6: 50% RDF + LBF @ 1.5 L ha^{-1}, T_7: 50 % RDF + T_4, T_8: 25% RDF + T_4, T_9: 25% RDF + FYM @ 5 t ha^{-1} + T_4, T_{10}: 25% RDF +LBF @ 1.5 L ha^{-1} + T_4 laid out in randomized complete block design with three replications. The nitrogen content was estimated by micro Kjeldahl distillation method (Piper, 1966). P, K were estimated by Jackson (1973), Sulphur by Vogel (1979) and micro nutrients by Lindsay and Norvell (1978).

The uptake of nutrients at harvest was worked out by using the following formulae. Macronutrient's uptake was expressed as kg ha^{-1}.

$$\text{Macronutrient Uptake (kg ha}^{-1}) = \frac{\text{Nutrient concentration (\%)} \times \text{Drymatter yield (kg ha}^{-1})}{100}$$

Results and Discussion

Nutrient content

The nitrogen content in sweet corn (Table 1) was significantly varied with the application of various sources of nutrients. The treatment which received 100 per cent RDF (T_2) recorded significantly highest nitrogen content (2.06% at tasselling, 0.85 and 1.65% in Stover and kernel at harvest, respectively) and the lowest (1.10% at tasselling, 0.5 and 1.16% in Stover and kernel at harvest, respectively) was observed in absolute control plot (T_1). The treatment T_5 supplied with 50 per cent RDF with FYM exhibited superiority among the integrated treatments. The treatment recorded higher values (1.73 % at tasselling, 0.71 and 1.51% in Stover and kernel at harvest, respectively) and it was on par with T_6 (50% RDF + LBF @ 1.5L ha^{-1}), T_7 (50% RDF + beejamrutham + jeevamrutham). This might be due to the integrated application of organic manure (FYM) and inorganic sources, the inorganic fertilizer component provided nutrients during early vegetative growth stage, while the organic component provided nutrients at the later stage of the development as it takes some time for the mineralization resulted in higher nutrient contents for crop growth. Similar results were reported by Mahajan *et al*. (2020) and Sharma *et al*. (2021).

The maximum content of phosphorus (0.30% at tasselling, 0.22 and 0.63% in Stover and kernel at harvest, respectively) was recorded in the treatment which received 100 per cent RDF (T_2) and the minimum values (0.18% at tasselling, 0.12 and 0.26% in Stover and in kernel at harvest, respectively) were recorded in absolute control plot (T_1) (Table 1). Among the treatments receiving integrated sources of nutrients, the treatment T_5 supplied with 50 per cent RDF with FYM recorded higher values (0.26 at tasselling, 0.19 and 0.53% in Stover and in kernel, respectively) and it was on par with T_6 (50% RDF + LBF @ 1.5L ha^{-1}) and T_7 (50% RDF + beejamrutham + jeevamrutham). Addition of organics and liquid bio fertilizer might have prevented the fixation of phosphorus in soil and ensure steady supply throughout the growth period that helped in better root growth, higher availability of P to plants. This was in close conformity with the findings of Chatterjee and Bandyopadhyay (2014).

The significantly highest potassium content Table 2. (1.62% at tasselling) and at harvest (1.15 and 0.53% in Stover and kernel, respectively) was observed in 100 per cent RDF (T_2). The lowest potassium content (1.00% at tasselling) and at harvest (0.65 and 0.11% in Stover and kernel, respectively) was observed in absolute control (T_1). Among the treatments receiving integrated application of organic and inorganic sources of nutrients integration of 50 per cent RDF recorded higher values than integration of 25 per cent with organic sources of nutrients. The increase in the shoot potassium content with the increasing rates of potassium could be attributed to the increased absorption by the crop from the soil (Malik *et al*., 2013).

The significantly highest sulphur content Table 2. (35.67mg kg^{-1} at tasselling) and at harvest (54.00 and 257.07 mg kg^{-1} in Stover and kernel, respectively) was recorded in the treatment which received 50 per cent RDF with FYM @ 5 t ha^{-1} and it was on a par with the treatments T_2, T_7 and T_9 at both the stages of crop growth. This might be due to application FYM and inorganic sources of nutrients might have helped in steady supply of all essential nutrients throughout the crop growth period and responsible for the increased sulphur content in sweet corn. Whereas the lowest (22.33 mg kg^{-1} at tasselling) and at harvest (38.42 and 117.30 mg kg^{-1} in Stover and kernel, respectively) was recorded in absolute control (T_1).

Table 1 : Nitrogen and phosphorus contents in sweet corn as influenced by integrated nutrient management.

Treatments	Nitrogen (%)			Phosphorus (%)		
	Tasseling	Harvest		Tasseling	Harvest	
		Stover	Grain		Stover	Grain
T_1 : Absolute Control	1.10	0.50	1.16	0.18	0.12	0.26
T_2 : 100 % RDF	2.06	0.85	1.65	0.30	0.22	0.63
T_3: FYM @ 5t ha^{-1} + LBF @ 1.5L ha^{-1}	1.23	0.57	1.28	0.22	0.15	0.40
T_4 : Beejamrutham + Jeevamrutham	1.20	0.55	1.31	0.20	0.14	0.38
T_5 : 50% RDF + FYM @ 5t ha^{-1}	1.73	0.71	1.51	0.26	0.19	0.53
T_6 : 50% RDF + LBF @ 1.5L ha^{-1}	1.73	0.70	1.51	0.26	0.19	0.53
T_7 : 50% RDF+T_4	1.70	0.70	1.50	0.26	0.19	0.53
T_8 : 25% RDF +T_4	1.36	0.60	1.43	0.22	0.16	0.43
T_9 : 25% RDF + FYM @ 5t ha^{-1}+T_4	1.53	0.66	1.46	0.24	0.17	0.48
T_{10} : 25% RDF +LBF @ 1.5L ha^{-1}+T_4	1.48	0.63	1.45	0.24	0.17	0.45
SEm±	0.09	0.03	0.06	0.01	0.01	0.02
CD @ 0.05	**0.26**	**0.10**	**0.18**	**0.03**	**0.02**	**0.06**
CV (%)	**9.89**	**8.97**	**7.19**	**6.61**	**8.37**	**7.07**

Table 2 : Potassium and sulphur contents in sweet corn as influenced by integrated nutrient management.

Treatments	Potassium (kg ha^{-1})			Sulphur (mg kg^{-1})		
	Tasseling	Harvest		Tasseling	Harvest	
		Stover	Grain		Stover	Grain
T_1 : Absolute Control	1.00	0.65	0.33	22.33	38.42	117.30
T_2 : 100% RDF	1.62	1.15	0.53	33.32	51.67	245.00
T_3: FYM @ 5t ha^{-1} + LBF @ 1.5L ha^{-1}	1.11	0.73	0.38	25.57	45.27	215.03
T_4 : Beejamrutham + Jeevamrutham	1.07	0.72	0.35	23.67	41.00	210.51
T_5 : 50% RDF + FYM @ 5t ha^{-1}	1.38	0.95	0.48	35.67	54.00	257.07
T_6 : 50% RDF + LBF @ 1.5L ha^{-1}	1.28	0.94	0.48	31.97	50.90	212.23
T_7 : 50% RDF+T_4	1.24	0.94	0.47	31.31	48.62	222.00
T_8 : 25% RDF +T_4	1.12	0.83	0.40	25.00	47.10	206.55
T_9 : 25% RDF + FYM @ 5t ha^{-1}+T_4	1.18	0.89	0.42	26.40	48.67	226.67
T_{10} : 25% RDF +LBF @ 1.5L ha^{-1}+T_4	1.14	0.87	0.41	25.79	48.33	222.00
SEm±	0.07	0.04	0.02	1.40	1.74	12.29
CD @ 0.05	**0.20**	**0.13**	**0.06**	**4.14**	**5.16**	**36.50**
CV (%)	**9.61**	**8.51**	**8.09**	**8.60**	**6.35**	**9.97**

In general, higher concentration of nitrogen, phosphorus and sulphur was observed in kernel while, relatively high potassium was recorded in stover.

Nutrient uptake

The significantly highest uptake of nitrogen by sweet corn (Table 3). at tasselling (61.42 kg ha^{-1}) and in Stover (30.28 kg ha^{-1}) and kernel (58.88 kg ha^{-1}) at harvest was observed with the application of 100 per cent RDF (T_2). The significantly highest values of nitrogen uptake by sweet corn were associated with the higher level of NPK through chemical sources and higher biomass production might be the most pertinent reason for the highest uptake of nitrogen. This was evident from highly significant correlation (0.978**) between soil available nitrogen with dry matter production. The lowest uptake of nitrogen was observed in absolute control (T_1). Among the integrated treatments, the treatment (T_5) which received combination of 50 per cent RDF and FYM @ 5 t ha^{-1} recorded higher nitrogen uptake and it was on par with the treatments T_6 and T_7 which received integration of 50 per cent RDF with LBF @ 1.5 L ha^{-1} and

Table 3 : Nitrogen and phosphorus uptake in sweet corn as influenced by integrated nutrient management.

Treatments	Nitrogen			Phosphorus		
	(kg ha^{-1})					
	Tasseling	Harvest		Tasseling	Harvest	
		Stover	Grain		Stover	Grain
T_1 : Absolute control	14.69	8.12	18.79	2.46	1.92	4.19
T_2 : 100% RDF	61.42	30.28	58.88	12.44	7.83	22.43
T_3: FYM @ 5t ha^{-1} + LBF @ 1.5L ha^{-1}	20.93	10.87	24.46	3.76	2.81	7.71
T_4 : Beejamrutham + Jeevamrutham	19.23	10.41	24.85	3.27	2.69	7.16
T_5 : 50% RDF + FYM @ 5t ha^{-1}	47.28	24.10	51.41	7.25	6.36	18.17
T_6 : 50% RDF + LBF @ 1.5L ha^{-1}	47.80	23.16	50.04	7.82	6.18	17.43
T_7 : 50% RDF+T_4	46.38	22.56	48.28	7.07	6.19	16.93
T_8 : 25% RDF +T_4	26.59	12.06	28.69	4.23	3.15	8.62
T_9 : 25% RDF + FYM @ 5t ha^{-1}+T_4	34.78	16.06	35.49	5.51	4.21	11.80
T_{10} : 25% RDF +LBF @ 1.5L ha^{-1}+T_4	29.95	14.05	32.24	4.78	3.69	10.04
SEm±	2.00	0.86	1.93	0.29	0.25	0.39
CD @ 0.05	5.93	2.55	5.73	0.87	0.74	1.15
CV (%)	9.90	8.66	8.95	8.68	9.63	5.38

beejamrutham and jeevamrutham application, respectively. This might be due to applied organic manures (FYM) might have added nutrients and liquid bio fertilizers might have enhanced the activity of beneficial soil microflora in increasing the availability and uptake of nutrients by the crop.

The treatment supplied with 100 per cent RDF (T_2) was recorded significantly highest values of phosphorus uptake (Table 3) at tasseling (12.44 kg ha^{-1}) and in stover (7.83 kg ha^{-1}) and kernel (22.43 kg ha^{-1}) at harvest while, the significantly lowest P uptake at tasselling (2.46 kg ha^{-1}) and in stover (1.92 kg ha^{-1}) and kernel (4.19 kg ha^{-1}) at harvest was obtained in T_1 (absolute control). The next best treatment was T_5 (50% RDF + FYM @ 5 t ha^{-1}) and it was on par with treatments receiving the combination of 50 per cent RDF, liquid bio fertilizers and beejamrutham and jeevamrutham (T_6 and T_7). Among the different sources of nutrients, combination of organic and inorganic sources recorded higher uptake over sole application of organic sources of nutrients. Applied organic manures may enhance the carbon availability. Under such situation, uptake of macronutrients *viz*., N and P by the microbial biomass is high. On the other hand, microbial P uptake can prevent P fixation by soil colloids (Ayaga *et al*., 2006; Gichangi *et al*., 2009 and Khan and Joergensen, 2006).

The maximum uptake of potassium uptake (Table. 4) at tasselling (48.13 kg ha^{-1}) and in stover (40.98 kg ha^{-1}) and kernel (18.99 kg ha^{-1}) at harvest was recorded in the treatment, which received 100 per cent RDF (T_2) and exhibited superiority over the other treatments. Among the integrated treatments, application of 50 per cent RDF along with FYM @ 5 t ha^{-1} (T_5) was identified as the next best treatment and it was on par with 50 per cent RDF along with LBF @ 1.5 L ha^{-1} and 50% RDF + beejamrutham and jeevamrutham (T_6 and T_7). The higher uptake of potassium under integrated treatments might be due to release of potassium from organic manures during decomposition and increase of native potassium availability. The lowest values uptake at tasselling (13.32 kg ha^{-1}) and in stover (10.55 kg ha^{-1}) and kernel (5.41 kg ha^{-1}) at harvest were recorded in absolute control (T_1). The increase in uptake of potassium in organics treated plots due to release of potassium from organic manures during decomposition and solubilisation and release of native and fixed forms of potassium by the application of LBF, charging the soil solution with K^+ ions. The results are coinciding with those of Mahavishnan *et al.* (2004).

Higher values for the uptake of NPK by sweet corn with enhanced levels of nutrient supply was also evidenced by earlier researchers; Meena *et al*. (2013), Sunitha and Maheswara Reddey (2012).

The significantly highest sulphur uptake (Table 4) was recorded in the treatment T_2, which received 100 per cent RDF at tasselling and it was on par with the treatment T_5 in Stover (1842 g ha^{-1}) and kernel (8763 g ha^{-1}) at harvest which received integration of 50 per cent RDF with FYM @ 5 t ha^{-1}. The next best treatments were integration of 50 per cent RDF with LBF and beejamrutham and jeevamrutham. The lowest uptake was

Table 4 : Potassium and sulphur uptake in sweet corn as influenced by integrated nutrient management.

Treatments	Potassium (kg ha^{-1})			Sulphur (mg kg^{-1})		
	Tasseling	Harvest		Tasseling	Harvest	
		Stover	Grain		Stover	Grain
T_1 : Absolute Control	13.32	10.55	5.41	298	623	1904
T_2 : 100% RDF	48.13	40.98	18.99	995	1838	8734
T_3: FYM @ 5t ha^{-1} + LBF @ 1.5L ha^{-1}	18.94	13.64	7.18	437	866	4113
T_4 : Beejamrutham + Jeevamrutham	17.15	13.97	6.70	379	777	3998
T_5 : 50% RDF + FYM @ 5t ha^{-1}	37.99	32.40	16.50	980	1842	8763
T_6 : 50% RDF + LBF @ 1.5L ha^{-1}	35.31	31.01	16.01	877	1684	7029
T_7 : 50% RDF+T_4	34.10	30.41	15.23	863	1579	7250
T_8 : 25% RDF +T_4	21.82	16.76	8.03	484	945	4157
T_9 : 25% RDF + FYM @ 5t ha^{-1}+T_4	27.00	21.65	10.22	603	1184	5515
T_{10} : 25% RDF +LBF @ 1.5L ha^{-1}+T_4	23.13	19.17	9.15	520	1069	4911
SEm±	1.41	1.23	0.62	36.85	56.08	299.13
CD @ 0.05	**4.19**	**3.66**	**1.85**	**109.47**	**166.59**	**888.62**
CV (%)	**8.82**	**9.25**	**9.50**	**9.91**	**7.83**	**9.19**

recorded in the treatment T_1 (absolute control).

Significant increase in nutrients uptake could be due to irrespective increase in nutrient concentration of kernel and Stover as well as increase in total dry matter production. The results of the present study were in agreement with the findings of Surya *et al.* (2000).

Conclusion

Integrated application of organic and inorganic sources of nutrients resulted in higher nutrient contents at both the stages of crop growth compared to sole application of inorganic nutrients. Among organic treatments, FYM treated plots performed better than beejamrutham and jeevamrutham treated plots. Moreover, the adoption of INM practices contributes to environmental sustainability by reducing the reliance on chemical fertilizers, thereby minimizing nutrient leaching and greenhouse gas emissions. The use of bio-fertilizers, such as nitrogen-fixing bacteria and mycorrhizal fungi, further supports nutrient acquisition and enhances plant resilience against abiotic stresses.

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