Effect of Organic Manure, Inorganic Fertilizers and Biofertilizers on nutrient content of maize (*Zea mays* L.) and their residual effect on succeeding wheat (*Triticum aestivum* L.) crop

Abstract

An experiment was conducted at Students' Instructional Farm, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur. The aim of the study to evaluate the different sources of nutrient on nutrient content of maize (*Zea mays* L.) and their residual effect on succeeding wheat (*Triticum aestivum* L.) crop. On the basis of results emanated from present investigation it could be concluded that application of 100%RDN+25% N-VC+S+Zn+Az.+PSB significantly recorded maximum nutrient content in maize viz. N (1.58%), P (0.46%), K (0.56%) and S (0.25%) and Zn (24.20 mg kg^{-1}) content in grain during first year and during second year nutrient content in maize grain is N (1.61%), P (0.50%), K (0.60%) and S (0.29%) and Zn (24.26mg kg^{-1})similarly maximum nutrient content in maize stover viz. N (0.71%), P (0.29%), K (1.28%) and S (0.26%) and Zn (41.50 mg kg^{-1})during first year and during second year nutrient content in maize stover is N (0.74%), P (0.32%), K (1.31%) and S (0.30%) and Zn (41.55mg kg^{-1}). Similar, trend was also repeated during both of the years for succeeding wheat crop in terms of nutrient content in grain and straw of wheat. Application of 100%RDN+25% N-VC+S+Zn+Az.+PSB significantly recorded maximum nutrient content in wheat grain viz. N (1.94%), P (0.40%), K (0.64%) , S (0.30%) and Zn (42.21mg kg^{-1}) during first year and during second year nutrient content in wheat grain is N (1.98%), P (0.44%), K (0.68%), S (0.34%) and Zn (42.26mg kg^{-1}) similarly maximum nutrient content in wheat straw viz. N (0.63%), P (0.22%), K (1.38%), S (0.29%) and Zn (14.82mg kg^{-1}) during first year and during second year nutrient content in wheat straw is N (0.67%), P (0.25%), K (1.42%) and S (0.33%) and Zn (14.87mg kg^{-1}).

Key Words: Maize, Nutrient Content, PSB, Vermicompost and Wheat

Introduction

Maize (*Zea mays*) – wheat (*Triticum aestivum*) cropping system is becoming one of the most profitable agricultural production systems in the Indo-Gangetic Plains of India. Among different maize based cropping systems, maize-wheat ranks first and it is the 3rd most important cropping sequence after rice-wheat and rice-rice having 1.8 mha area **(Hashim *et al.*, 2017)**

In India maize is grown in an area of 9.47 m ha with the production of 28.72 million tonnes while the average productivity is only 3032 kg ha^{-1}.However, in Uttar Pradesh it contributes 7.87 and 5.14 per cent in terms of area and production with an average productivity of 1981 kg/ha **(Anonymous 2017-18)** .

Wheat is one of the most important food crop in the world in terms of area, production and nutrition which contributes around 20 per cent of total food requirement of world population. India ranks 2nd in terms of wheat production with an area of 29.58 million hectare having production of 99.70 million tonnes along with average productivity of 3371 kg ha^{-1}. Whereas in UP it also occupies a notable position among food grain having an area about 9.75 m ha with total production of 31.88 million tonnes along with an average yield of 3269 kg ha^{-1}**(Anonymous 2018)**.

Integrated use of organic and mineral fertilizers has become more effective in maintaining higher productivity and stability through correction of deficiencies of primary, secondary and micronutrients. Application of fertilizer N along with organic amendment helps in synchronizing N supply with crop demand **(Biswas *et al.* 2017)**. In addition to NPK, sulphur is increasingly being recognized as the fourth major limiting nutrient element in crop production due to its deficiency owing to use of high yielding varieties and sulphur free fertilizers along with low or no use of organic source of nutrients in intensive cropping systems thereby needs prioritization in plant nutrition **(Habashy and Hemeid, 2011).**

Among the micronutrients, zinc deficiency appears to be the most widespread owing to intensive agricultural practices, use of high analysis NPK fertilizers and limited or no application of Zinc by farmers **(Rakshit *et al*. 2017).** At present about 48.1% of Indian soils are rated as very low in available zinc **(Gupta 2005)**.

The application of well decomposed farm yard manure(FYM) to soil has been practiced for many centuries for increasing crop yield, soil organic matter, microbial activities and improving soil fertility and soil aggregation for sustainable agriculture for long time **(Yang *et al*., 2015; Kundu *et al*., 2007)**. Balance application of N, P, K fertilizers with FYM was best alternative for higher crop yield in maize wheat cropping system **(Brar *et al*., 2015)**.

Several microorganisms are commonly used as biofertilizers including nitrogen- fixing soil bacteria (Azotobacter, Rhizobium), nitrogen fixing cyanobacteria (Anabaena), phosphate – solubilizing bacteria (Bacillus, Pseudomonas sp.), and AM fungi. Azotobacter is a free living nitrogen fixing aerobic diazotroph which is widely employed as a bio-fertilizer for all non-leguminous plants especially paddy, cotton, vegetables etc. Whereas phosphate solubilising bacteria are a group of non-specific microbes which is most suitable for all crops, produces

enzymes by metabolic activities that mineralize the insoluble organic P into a soluble form, thereby increasing phosphorus uptake by the plants. They act as biofertilizers by making otherwise unavailable P into available forms to growing plants by stimulating the efficiency of biological nitrogen fixation, synthesizing phytohormones, and enhancing the availability of insoluble micronutrients. **Kuniyal *et al*. (2012)**

Method and Material

Experimental Soil

The soil of the experimental field had originated from alluvial deposits. Soil is sandy loam in texture alkaline in reaction (pH 8.07), low inorganic carbon (0.33%), available N (156.22 kg ha^{-1}), in available P (10.34 kg ha^{-1}), medium in available K (198.16 kg ha^{-1}), low in available S (14.20 kg ha^{-1}) and low in available Zn (0.36 g kg^{-1}).

Layout and Design of the Experiment

The experiment was laid out in randomized block design with three replications. The total numbers of unit plots were 42. The size of a unit plot was 6.0 m X 3.0 m. The width of the main irrigation channel is 1.5 m.

Treatments of the Investigation

Table 1 : Treatment Combination

The equal doses of P, K, S and Zn was applied as basal in all the plots of maize @ 60:40:25:5.0 kg ha^{-1}.Whereas, wheat crop was given recommended dose of fertilizers @ (120:60:40) during *rabi* season in the all plots of different treatments applied to preceding maize crop.

S. No.	Treatment Symbol	Treatment combination
1.	T_1	Control
2.	T_2	75% RDN
3.	T_3	75% RDN+25% N through FYM
4.	T_4	75%RDN+25% N through VC
5.	T_5	75% RDN+25% N through FYM+S+Zn+Azotobacter+PSB
6.	T_6	75%RDN+25% N through VC+S+Zn+Azotobacter+PSB
7.	T_7	100%RDN

8.	T_8	100%RDN+S
9.	T_9	100%RDN+S+Zn
10.	T_{10}	100%RDN+S+Zn+Azotobacter+PSB
11.	T_{11}	100%RDN+25%N through FYM
12.	T_{12}	100%RDN+25%N through VC
13.	T_{13}	100%RDN+25% N through FYM+S+Zn+Azotobacter+PSB
14.	T_{14}	100%RDN+25% N through VC+S+Zn+Azotobacter+PSB

Chemical composition of FYM and Vermicompost:

Well decomposed FYM was supplied by Department of Animal Husbandry and Dairying of this University. The NPK content in FYM was determined as per standard procedures and obtained 0.45% N, 0.25% P and 0.48% K (on oven dry basis). The Vermicompost was procured from the Bhaunti Goshala, Panki, Kanpur and its content was: N = 1.60%, P = 0.75%, K = 1.20%, and ca, Mg, S, Zn, Cu, I, Bo, Cl, and Si in traces. In second year, the value of nutrient content was nearly same in both FYM and Vermicompost.

Biofertilizer application

Azotobacter and PSB were thoroughly mixed with soil as per respective treatments @ 8-10 packets ha^{-1}.

Plant analysis (Maize – Wheat)

Treatment wise plant sample collected from each plot at harvest of the crop for analysis of N, P, K, S and Zn content and their uptake in grain and Stover/straw of Maize-wheat cropping system. For this purpose five plants having intact leaves were selected randomly from sampled row of each plot. The stalk/straw samples were first air-dried and kept in oven at 60-70 ^{0}C for drying till the 12 hours to become free from moisture. Afterwards the samples were ground in a willey mill and stored in clean polythene bags. Similarly, dried grain samples were also ground oven dried, passed through 2 mesh sieve and stored in the sample bottles.

Table 2 : Method of determination for the study

S.No.	Properties	Method of Determination	Reference
1.	Nitrogen Content (%)	Kjeldhal's Method	Jackson (1973)
2.	Phosphorous Content (%)	Vanadomolybdate phosphoric acid yellow color method	Jackson (1973)
3.	Potassium Content (%)	Flame Photometric Method	Jackson (1973)
4.	Sulphur Content (%)	Turbidometric Method	Chesnin and Yein,

			(1951)
5.	Zinc Content (mg kg^{-1})	DTPA extraction (AAS)	Lindsey and Norvell, (1978)

Result and Discussion

Nutrient Content in Maize Grain

The data emanated from the table (a) is that the maximum nutrient concentration in Maize grain (%N, %P, % K, %S and Zn mg kg^{-1}) has been associated with the with the application of T_{14} (100% RDN+25 N-VC+S+Zn+Az.+PSB) which was closely followed by T_{13} (100% RDN+25 N-FYM+S+Zn+Az+PSB), T_6 (75% RDN+25 N-VC+S+Zn+Az.+PSB), T_5 (75% RDN+25 N-FYM+S+Zn+Az+PSB) and T_{10} (100% RDN+S+Zn+Az+PSB) during both the years of experimentation and on pooled mean basis. N content (%) in maize grain which varied from 1.31 to 1.58 and 1.30 to 1.61 during first and second years, respectively. P content (%) varied from 0.28 to 0.46 and 0.27 to 0.50 during first and second years, respectively. K content (%) varied from 0.36 to 0.56 and 0.34 to 0.60 during first and second years, respectively. S content (%) varied from 0.06 to 0.25 and 0.05 to 0.29 during first and second years, respectively similarly Zn content (mg ka^{-1}) varied from 18.93 to 24.20 and 18.89 to 24.26 during first and second years, respectively. It clearly indicated that the addition of FYM or Vermicompost with or without S+ Zn + Azotobacter +PSB further increased the concentration of nutrient content in maize grain. The lowest value regarding nutrient content in maize grain was recorded with T_1 (control) during both the years and on pooled mean basis. Comparative findings were detailed by **Meena *et al.* (2006), Shah *et al*. (2017) and Meena *et al*. (2017)**

Nutrient Content in Maize Stover

It is visualized from the data given in table (b) is that the maximum improvement in nutrient content in maize stover were recorded with the application of T_{14} (100% RDN+25% N-VC+S+Zn+Az.+PSB) followed by T_{13} (100% RDN+25% N-FYM+S+Zn+Az+PSB), T_{10} (100% RDN+S+Zn+Az+PSB), T_6 (75% RDN+25% N-VC+S+Zn+Az.+PSB) and T_5 (75% RDN+25% N-FYM+S+Zn+Az+PSB) however, significantly higher than control during both the years of experimentation and on pooled mean basis. The lowest value regarding nutrient content in maize stover was recorded with T_1 (control) during both the years and on pooled mean basis. N content (%) in maize stover which varied from 0.50 to 0.71 and 0.48 to 0.74 during first and second years, respectively. P content (%) varied from 0.10 to 0.29 and 0.09 to 0.32 during first and second years, respectively. K content (%) varied from 1.08 to 1.28 and

1.07 to 1.31 during first and second years, respectively. S content (%) varied from 0.08 to 0.26 and 0.06 to 0.30 during first and second years, respectively similarly Zn content (mg ka^{-1}) varied from 35.73 to 41.50 and 35.68 to 41.55 during first and second years, respectively.The consequences of the current investigation are additionally in concurrence with the investigation of **Joshi *et al*. (2013), Gundlur *et al.* (2015) and Kumar *et al*. (2018)**

Nutrient Content in Wheat Grain

At a glance over the data given in the table (c) is that the maximum nutrient concentration in wheat grain (%N, %P, % K, %S and Zn mg kg^{-1}) has been associated with the with the application of T_{14} (100% RDN+25 N-VC+S+Zn+Az.+PSB) which was closely followed by T_{13} (100% RDN+25 N-FYM+S+Zn+Az+PSB), T_6 (75% RDN+25 N-VC+S+Zn+Az.+PSB), T_5 (75% RDN+25 N-FYM+S+Zn+Az+PSB) and T_{10} (100% RDN+S+Zn+Az+PSB) during both the years of experimentation and on pooled mean basis. N content (%) in wheat grain which varied from 1.72 to 1.94 and 1.74 to 1.98 during first and second years, respectively. P content (%) varied from 0.24 to 0.41 and 0.26 to 0.45 during first and second years, respectively. K content (%) varied from 0.46 to 0.64 and 0.49 to 0.68 during first and second years, respectively. S content (%) varied from 0.11 to 0.30 and 0.13 to 0.34 during first and second years, respectively similarly Zn content (mg ka^{-1}) varied from 37.70 to 42.21 and 37.73 to 42.26 during first and second years, respectively.It clearly indicated that the addition of FYM or VC with or without S+ Zn + Azotobacter +PSB further increased the concentration of nutrient content in wheat grain. The lowest value regarding nutrient content in wheat grain was recorded with T_1 (control) during both the years and on pooled mean basis. The results of the present investigation are also in agreement with the findings of **Keram *et al.* (2012), Rakesh *et al.* (2009) and Kakraliya et al. (2017)**

Nutrient Content in Wheat Straw

It is apparent from the data given in table (d) is that the maximum improvement in nutrient content in wheat stover were recorded with the application of T_{14} (100% RDN+25% N-VC+S+Zn+Az.+PSB) followed by T_{13} (100% RDN+25% N-FYM+S+Zn+Az+PSB), T_{10} (100% RDN+S+Zn+Az+PSB), T_6 (75% RDN+25% N-VC+S+Zn+Az.+PSB) and T_5 (75% RDN+25% N-FYM+S+Zn+Az+PSB) however, significantly higher than control during both the years of experimentation and on pooled mean basis. The lowest value regarding nutrient content in wheat straw was recorded with T_1 (control) during both the years and on pooled mean basis. N content (%) in wheat straw which varied from 0.41 to 0.63 and 0.43 to 0.67

during first and second years, respectively. P content (%) varied from 0.05 to 0.23 and 0.07 to 0.26 during first and second years, respectively. K content (%) varied from 1.18 to 1.38 and 1.21 to 1.42 during first and second years, respectively. S content (%) varied from 0.11 to 0.29 and 0.13 to 0.33 during first and second years, respectively similarly Zn content (mg ka^{-1}) varied from 8.93 to 14.82 and 8.95 to 14.87 during first and second years, respectively. The consequences of the current investigation are additionally in concurrence with the investigation of **Sharma *et al.* (2015), DV Prasanth *et al*. (2020), Bejbaruha *et al.* (2009), Yadav *et al*. (2015) and DV Prasanth *et al*. (2020)**

Table (a) Nutrient Content Maize Grain

Treatments	N content (%)			P content (%)			K content (%)			S content (%)			Zn content (mg kg^{-1})		
	2018 - 2019	2019 - 2020	Pooled Mean	2018 - 2019	2019 - 2020	Pooled Mean	2018 - 2019	2019 - 2020	Pooled Mean	2018 - 2019	2019 - 2020	Pooled Mean	2018 - 2019	2019 - 2020	Pooled Mean
T_1	1.31	1.30	1.30	0.28	0.27	0.27	0.36	0.34	0.35	0.06	0.05	0.05	18.93	18.89	18.91
T_2	1.36	1.38	1.37	0.31	0.33	0.32	0.39	0.42	0.40	0.07	0.09	0.08	19.36	19.40	19.38
T_3	1.39	1.42	1.4	0.33	0.36	0.34	0.41	0.44	0.42	0.09	0.12	0.10	20.45	20.49	20.47
T_4	1.41	1.44	1.42	0.34	0.37	0.35	0.43	0.46	0.44	0.10	0.13	0.11	20.66	20.70	20.68
T_5	1.51	1.54	1.52	0.41	0.45	0.43	0.51	0.54	0.52	0.20	0.24	0.22	23.53	23.58	23.56
T_6	1.53	1.56	1.54	0.42	0.46	0.44	0.53	0.56	0.54	0.22	0.26	0.24	23.78	23.83	23.81
T_7	1.42	1.45	1.43	0.35	0.38	0.36	0.44	0.47	0.45	0.11	0.13	0.12	20.83	20.87	20.85
T_8	1.44	1.47	1.45	0.37	0.40	0.38	0.46	0.49	0.47	0.15	0.18	0.16	20.95	20.99	20.97
T_9	1.49	1.52	1.50	0.39	0.42	0.40	0.49	0.52	0.50	0.18	0.21	0.19	22.06	22.10	22.08
T_{10}	1.55	1.58	1.56	0.43	0.46	0.44	0.54	0.57	0.55	0.23	0.27	0.25	23.93	23.97	23.95
T_{11}	1.46	1.49	1.47	0.38	0.41	0.39	0.47	0.5	0.48	0.15	0.18	0.16	21.52	21.56	21.54
T_{12}	1.48	1.51	1.49	0.39	0.42	0.40	0.48	0.51	0.49	0.16	0.19	0.17	21.68	21.72	21.70
T_{13}	1.56	1.59	1.57	0.44	0.48	0.46	0.55	0.58	0.56	0.24	0.28	0.26	24.03	24.08	24.06
T_{14}	1.58	1.61	1.59	0.46	0.50	0.48	0.56	0.60	0.58	0.25	0.29	0.27	24.20	24.26	24.23
SE(m)	0.026	0.032	0.019	0.015	0.019	0.012	0.023	0.028	0.018	0.012	0.015	0.010	0.19	0.22	0.15
CD (5%)	0.067	0.090	0.054	0.045	0.054	0.034	0.067	0.081	0.050	0.036	0.045	0.028	0.54	0.63	0.425

Table (b) Nutrient Content Maize Stover

Treatments	N content (%)			P content (%)			K content (%)			S content (%)			Zn content (mg kg^{-1})		
	2018 - 2019	2019 - 2020	Pooled Mean	2018 - 2019	2019-2020	Pooled Mean	2018 - 2019	2019 - 2020	Pooled Mean	2018-2019	2019 - 2020	Pooled Mean	2018 - 2019	2019 - 2020	Pooled Mean
T_1	0.50	0.48	0.49	0.10	0.09	0.09	1.08	1.07	1.07	0.08	0.06	0.07	35.73	35.68	35.70
T_2	0.53	0.56	0.54	0.12	0.13	0.12	1.1	1.13	1.12	0.10	0.12	0.11	36.21	36.25	36.23
T_3	0.55	0.58	0.56	0.14	0.16	0.15	1.12	1.15	1.14	0.12	0.15	0.13	37.33	37.36	37.34
T_4	0.56	0.59	0.57	0.15	0.17	0.16	1.13	1.16	1.15	0.13	0.16	0.14	37.56	37.60	37.58
T_5	0.65	0.68	0.66	0.23	0.26	0.24	1.22	1.25	1.24	0.20	0.24	0.22	40.68	40.73	40.70
T_6	0.67	0.7	0.68	0.25	0.28	0.26	1.24	1.27	1.26	0.21	0.25	0.23	40.96	41.02	40.99
T_7	0.57	0.6	0.58	0.16	0.18	0.17	1.14	1.17	1.16	0.14	0.16	0.15	37.78	37.82	37.80
T_8	0.59	0.62	0.60	0.17	0.19	0.18	1.16	1.19	1.18	0.16	0.19	0.17	37.93	37.97	37.95
T_9	0.63	0.66	0.64	0.2	0.22	0.21	1.20	1.23	1.22	0.18	0.21	0.19	39.15	39.19	39.17
T_{10}	0.68	0.71	0.69	0.26	0.29	0.27	1.25	1.28	1.27	0.22	0.26	0.24	41.15	41.20	41.17
T_{11}	0.60	0.63	0.61	0.19	0.21	0.20	1.18	1.21	1.20	0.17	0.2	0.18	38.55	38.60	38.57
T_{12}	0.62	0.65	0.63	0.2	0.22	0.21	1.19	1.22	1.21	0.18	0.21	0.19	38.73	38.77	38.65
T_{13}	0.69	0.72	0.70	0.28	0.31	0.29	1.26	1.29	1.28	0.25	0.29	0.27	41.26	41.11	41.18
T_{14}	0.71	0.74	0.72	0.29	0.32	0.30	1.28	1.31	1.30	0.26	0.30	0.28	41.50	41.55	41.52
SE(m)	0.015	0.023	0.014	0.015	0.019	0.012	0.031	0.037	0.025	0.015	0.019	0.012	0.27	0.31	0.22
CD (5%)	0.044	0.067	0.039	0.045	0.054	0.034	0.099	0.122	0.072	0.045	0.054	0.034	0.78	0.90	0.62

Table (c) Nutrient Content Wheat Grain

Treatments	N content (%)			P content (%)			K content (%)			S content (%)			Zn content (mg kg^{-1})		
	2018 - 2019	2019 - 2020	Pooled Mean	2018 - 2019	2019- 2020	Pooled Mean	2018 - 2019	2019 - 2020	Pooled Mean	2018- 2019	2019 - 2020	Pooled Mean	2018 - 2019	2019 - 2020	Pooled Mean
T_1	1.72	1.74	1.73	0.24	0.26	0.25	0.46	0.49	0.48	0.11	0.13	0.12	37.70	37.73	37.72
T_2	1.75	1.78	1.77	0.26	0.29	0.28	0.48	0.51	0.50	0.13	0.15	0.14	38.22	38.26	38.24
T_3	1.79	1.81	1.80	0.29	0.32	0.31	0.51	0.54	0.53	0.16	0.19	0.18	39.15	39.19	39.17
T_4	1.80	1.83	1.82	0.30	0.33	0.32	0.52	0.55	0.54	0.17	0.20	0.19	39.18	39.22	39.20
T_5	1.90	1.94	1.92	0.38	0.42	0.40	0.60	0.64	0.62	0.27	0.31	0.30	41.35	41.40	41.38
T_6	1.91	1.95	1.93	0.39	0.43	0.41	0.61	0.65	0.63	0.28	0.32	0.31	41.50	41.55	41.53
T_7	1.77	1.8	1.79	0.28	0.31	0.30	0.50	0.53	0.52	0.14	0.16	0.15	38.66	38.70	38.68
T_8	1.81	1.84	1.83	0.31	0.34	0.33	0.53	0.56	0.55	0.20	0.23	0.22	39.45	39.49	39.47
T_9	1.83	1.86	1.85	0.32	0.35	0.34	0.54	0.57	0.56	0.21	0.24	0.23	40.78	40.82	40.09
T_{10}	1.87	1.91	1.90	0.37	0.41	0.39	0.59	0.62	0.61	0.26	0.30	0.28	41.13	41.18	41.16
T_{11}	1.84	1.87	1.86	0.34	0.37	0.36	0.56	0.59	0.58	0.23	0.26	0.25	40.25	40.29	40.27
T_{12}	1.85	1.88	1.87	0.35	0.38	0.37	0.57	0.60	0.59	0.24	0.27	0.26	40.29	40.33	40.39
T_{13}	1.93	1.97	1.95	0.40	0.44	0.42	0.63	0.67	0.65	0.29	0.33	0.31	42.03	42.08	42.06
T_{14}	1.94	1.98	1.96	0.41	0.45	0.43	0.64	0.68	0.66	0.30	0.34	0.32	42.21	42.26	42.24
SE(m)	0.018	0.026	0.015	0.015	0.020	0.012	0.015	0.018	0.012	0.017	0.20	0.013	0.46	0.62	0.38
CD (5%)	0.054	0.067	0.041	0.044	0.058	0.035	0.045	0.054	0.034	0.049	0.058	0.037	1.34	1.80	1.08

Table (d) Nutrient Content Wheat Straw

Treatments	N content (%)			P content (%)			K content (%)			S content (%)			Zn content (mg kg^{-1})		
	2018 - 2019	2019 - 2020	Pooled Mean	2018 - 2019	2019 - 2020	Pooled Mean	2018 - 2019	2019 - 2020	Pooled Mean	2018 - 2019	2019 - 2020	Pooled Mean	2018 - 2019	2019 - 2020	Pooled Mean
T_1	0.41	0.43	0.42	0.05	0.07	0.06	1.18	1.21	1.20	0.11	0.13	0.12	8.93	8.95	8.94
T_2	0.46	0.49	0.48	0.08	0.11	0.10	1.21	1.24	1.23	0.12	0.16	0.14	9.45	9.49	9.47
T_3	0.5	0.53	0.52	0.11	0.14	0.13	1.24	1.27	1.26	0.16	0.19	0.18	10.88	10.37	10.35
T_4	0.51	0.54	0.53	0.12	0.15	0.14	1.25	1.28	1.27	0.17	0.20	0.19	11.05	11.54	11.52
T_5	0.60	0.64	0.62	0.20	0.23	0.22	1.34	1.38	1.36	0.26	0.30	0.28	13.85	13.90	13.88
T_6	0.61	0.65	0.63	0.21	0.24	0.23	1.35	1.39	1.37	0.27	0.31	0.29	14.03	14.08	14.06
T_7	0.48	0.51	0.50	0.10	0.13	0.12	1.23	1.26	1.25	0.14	0.17	0.16	9.88	9.92	9.90
T_8	0.52	0.55	0.54	0.13	0.16	0.15	1.26	1.29	1.28	0.20	0.23	0.22	11.82	11.86	11.84
T_9	0.54	0.57	0.56	0.14	0.17	0.16	1.28	1.31	1.30	0.21	0.24	0.23	12.77	12.81	12.79
T_{10}	0.57	0.60	0.59	0.19	0.22	0.21	1.33	1.37	1.35	0.25	0.28	0.28	13.60	13.65	13.63
T_{11}	0.55	0.58	0.57	0.16	0.19	0.18	1.30	1.33	1.32	0.22	0.25	0.24	12.15	12.19	12.17
T_{12}	0.56	0.59	0.58	0.17	0.20	0.19	1.31	1.34	1.33	0.23	0.26	0.25	12.18	12.22	12.20
T_{13}	0.62	0.66	0.64	0.22	0.25	0.24	1.37	1.41	1.39	0.28	0.32	0.30	14.60	14.65	14.63
T_{14}	0.63	0.67	0.65	0.23	0.26	0.25	1.38	1.42	1.40	0.29	0.33	0.31	14.82	14.87	14.85
SE(m)	0.017	0.020	0.013	0.015	0.018	0.012	0.028	0.032	0.021	0.16	0.020	0.013	0.31	0.35	0.23
CD (5%)	0.050	0.058	0.037	0.044	0.053	0.034	0.081	0.094	0.059	0.048	0.059	0.037	0.90	1.01	0.65

Conclusion

The content of nutrients in maize significantly increased with increasing doses of RDN from 0 to 100 %. The application of FYM or VC with RDN further increased the absorption of nutrient. Azotobacter, PSB enhanced the nutrients content especially N and P. The S content increased with the application of S. It has also been observed that the content of P and S markedly influenced with nitrogen application. The content of nutrients in wheat crop were observed higher where VC or FYM, 100% RDN or 75 % RDN were applied in maize in that order.

The application of VC or FYM also contributed treatment in maize contributed for higher content and uptake of nutrients in wheat. Thus, it may be concluded from the experiment that the application of treatment in maize had residual effect on wheat crop. The maximum residual impact of VC was recorded which was followed by FYM applied in maize.

Future research may focus on the cropping system approach rather than a single crop. Application of integrated nutrient management is better for sustaining soil health as well as production of wheat and maize.

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