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Research Article

RESIDUAL EFFECT OF INTEGRATED NUTRIENT MANAGEMENT IN *RABI* MAIZE ON GROWTH AND YIELD PARAMETERS OF SUMMER GREEN GRAM UNDER MAIZE-GREEN GRAM CROPPING SEQUENCE

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Abstract- A field experiment was conducted during *rabi* and summer seasons of 2014-15 and 2015-16 at N.A.U to study the production potential of maize-green gram cropping sequence under integrated nutrient management system. The treatment consisted of integrated nutrient management *viz*., T_1-General RDF (RDF + FYM @ 10 t/ha), T_2-75% RDN through chemical fertilizer + 25% RDN through biocompost, T_3 -75% RDN through chemical fertilizer + 25% RDN through vermicompost, T_4 -75% RDN through chemical fertilizer + 25% RDN through FYM and T_5 -control to maize in *rabi* season as main plot treatments replicated four times in randomized block design. During summer season each main plot treatment was split into four sub plot treatments with four levels of recommended dose of fertilizers *viz*., S_1 -control, S_2 - 50% RDF, S_2 -75% RDF and S_4 -100% RDF to green gram resulting in twenty treatment combinations replicated four times in split plot design. The results showed that application of either 75% RDN through chemical fertilizer + 25% RDN through biocompost or 75% RDN through chemical fertilizer + 25% RDN through vermicompost along with recommended dose of 60 kg P_2O_5 (Considering the phosphorus content in bio-compost and vermicompost) to maize had significant residual effect on the succeeding green gram crop and significantly influenced growth parameters and yield of succeeding green gram, while summer green gram crop should be fertilized with 75% RDF (15-30-00 kg N-P-K/ha) through inorganic fertilizer in maize- green gram sequence. During summer season the residual effect of general RDF (RDF + FYM @ 10 t/ha) applied to *rabi* maize showed higher growth, yield attributes, seed and stover yields followed by 75% RDN through chemical fertilizer + 25% RDN through vermicompost. Among the levels of RDF directly applied to green gram in summer season, significantly higher values of growth, yield attributes, seed and stover yields were obtained under the application of 100% RDF (S_4), which was at par with 75% RDF (S_3). Thus, application of 120 kg nitrogen (75% RDN through chemical fertilizer + 25% RDN through bio-compost) or 75% RDN through chemical fertilizer + 25% RDN through vermicompost along with recommended dose of 60 kg P_2O_5 to maize, while summer green gram crop should be fertilized with 75% RDF (15-30-00 kg N-P-K/ha) through inorganic fertilizer.

Keywords- Biocompost, FYM, Green gram, Grain yield, Maize, Vermicompost

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Introduction

Maize- pulses is one of the important cropping systems practiced in India. The productivity of the system mainly depends on proper nutrient management practices. Low organic matter content in soil coupled with low and imbalanced application of macronutrients to the crop limits the full potential of yield Tandon [11].

Integrating chemical fertilizers with organic manures was quite promising, in maintaining higher productivity. In the maize-green gram cropping system, application of vermicompost, biocompost and FYM increased growth attributes, yield parameters and yield of individual crops. Green gram is an important pulse crop of India as it is grown an area of 2.98 million hectares with total production of 1.61 million tonnes and productivity of 407 kg/ha. (Singh [9]) India, major green gram producing states are Odisha, Madhya Pradesh, Rajasthan, Maharashtra, Gujarat and Bihar. In Gujarat, it is cultivated in about 2.3 lakh hectares with an annual production of 1.21 lakh tonnes and average productivity of 526 kg /ha [1]. At present, studies on nutrient utilization in cropping system of different crops are available but, effect of organic sources with different levels of inorganic fertilizer applied to maize on the performance of succeeding green gram especially on the aspects of residual effect, growth and yield is very meager. Hence, the present study was undertaken.

MaterialsandMethods

The investigation entitled "Effect of integrated nutrient management in maize - green gram cropping sequence under south Gujarat condition" was conducted during rabi and summer seasons of 2014-15 and 2015-16 at College Farm, Navsari Agricultural University, Navsari to study the production potential of maize-green gram cropping sequence under integrated nutrient management system. The soil of the experimental field was clayey in texture and slightly alkaline in reaction (pH 7.8), low in organic carbon (0.44%) and available nitrogen (206.50 kg/ha), medium in available phosphorus (38.20 kg/ha) and high in available potassium (323.18 kg/ha).The treatment consisted of integrated nutrient management *viz*., T1-General RDF (RDF + FYM @ 10 t/ha), T2 - 75% RDN through chemical fertilizer + 25% RDN through biocompost, T3 -75% RDN through chemical fertilizer + 25% RDN through vermicompost, T4 -75% RDN through chemical fertilizer + 25% RDN through FYM and T5 -control to maize in *rabi* season as main plot treatments replicated four times in randomized block design. During summer season each main plot treatment was split into four sub-plot treatments with four levels of recommended dose of fertilizer *viz*., S1 -control, S2 - 50% RDF (10-15-00 kg N-P-K/ha), S2 -75% RDF(15-30-00 kg N-P-K/ha) and S4 - 100% RDF(20-40-00 kg N-P-K/ha) to green gram resulting in twenty treatment combinations replicated four times in split plot design. Organic manures (FYM,

bio-compost and vermicompost) were applied to maize crop as per treatments and evenly spread and mixed in that particular bed. Before application of organic manures, it was analyzed for NPK content. The nitrogen was applied through urea, whereas phosphorus was applied through single superphosphate. The 50% dose of nitrogen and full dose of phosphorus were applied at the time of sowing, remaining half dose of nitrogen was top dressed as urea as per treatment. In case of phosphorus fertilizer, the quantity of phosphorus from bio-compost, vermicompost and FYM was counted and deducted from the quantity of recommended dose of phosphorus and remaining phosphorus was applied in the form of SSP.

Results and Discussion

Growth

In order to quantify the response observed due to integrated nutrient management to the preceding *rabi* maize, the plant growth and development was assessed on pooled basis in terms of plant height. [Table-1]. At 60 DAS and harvest, treatment receiving application of general RDF (RDF + FYM @ 10 t/ha) (T1) produced significantly taller plants being remained at par with T3 (75% RDN through chemical fertilizer + 25% RDN through vermicompost). Application of RDF + FYM @ 10 t/ha (T1) recorded significantly higher number of branches per plant which was at par with remaining treatments except control at 30 DAS, but in case of 60 DAS and at harvest, it was being at par with T3 (75% RDN through chemical fertilizer + 25% RDN through vermicompost) and T2 (75% RDN through chemical fertilizer + 25% RDN through biocompost). At 60 DAS, significantly maximum dry matter accumulation per plant was recorded with application of general RDF (RDF + FYM @ 10 t/ha) (T1) which was at par with T3 (75% RDN through chemical fertilizer + 25% RDN through vermicompost) and T2 (application of 75% RDN through chemical fertilizer + 25% RDN through biocompost). At 30 DAS and harvest, significantly maximum dry matter accumulation per plant was recorded with application of general RDF (RDF + FYM @ 10 t/ha) (T1) which was at par with T3 (75% RDN through chemical fertilizer + 25% RDN through vermicompost). It may be due to the fact that more nutrient availability under INM treatments resulted into increased conversion of carbohydrates into protein which in turn elaborated into protoplasm and cell wall material increased the size of the cell, which expressed morphologically in terms of plant height, number of branches and ultimately dry matter accumulation. Cellulose is a highly persistent composition material, which requires longer time for decomposition. Thus, FYM, biocompost and vermicompost have not been fully utilized by the maize crop in first crop season and notably benefitted the succeeding green gram crop. Similarly, the beneficial residual effect of INM under cropping system on growth attributes recorded by Singh [10] in rice-lentil, Gawai and Pawar [2] in sorghum-chickpea, Gudadhe [3] in cotton-chickpea as well as Nawle [5] in sorghum-chickpea cropping sequence.

Table-1 *Residual effect of integrated nutrient management in rabi maize on growth parameters of summer green gram (Pooled data of 2 years)*

Treatment	Plant height (cm)			Mean number of branches/plant			Dry matter accumulation/plant (g)		
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
I). Main plot treatment(*Rabi* maize)									
T_1: General RDF (RDF + FYM @ 10 tonnes/ ha)	17.00	32.59	48.02	2.17	4.03	3.78	2.22	15.00	18.74
T_2: 75% RDN through chemical fertilizer + 25% RDN through biocompost	16.88	30.75	45.48	2.12	3.79	3.58	2.09	14.09	17.38
T_3:75% RDN through chemical fertilizer + 25% RDN through vermicompost	16.94	31.54	46.45	2.15	3.91	3.68	2.15	14.55	18.06
T_4: 75% RDN through chemical fertilizer + 25% RDN through FYM	16.82	29.87	44.34	2.10	3.67	3.47	2.03	13.63	16.70
T_5: Control	16.65	27.31	40.94	2.03	3.34	3.20	1.86	12.41	14.89
SE m±	0.31	0.48	0.79	0.03	0.09	0.08	0.04	0.36	0.38
C.D. at 5 %	NS	1.48	2.44	0.09	0.28	0.26	0.12	1.09	1.18
C.V. %	7.42	6.32	7.04	5.43	9.75	9.51	7.71	10.19	8.95
II). Sub plot treatment (Summer green gram)									
S_1 : Control	16.55	25.97	39.22	2.04	3.14	3.02	1.75	11.64	13.76
S_2 : 50 % RDF	16.82	29.83	44.31	2.10	3.67	3.48	2.03	13.66	16.74
S_3 : 75 % RDF	17.01	32.61	47.88	2.15	4.05	3.80	2.22	15.07	18.83
S_4 : 100 % RDF	17.05	33.24	48.78	2.16	4.13	3.87	2.27	15.37	19.28
SE m±	0.32	0.52	0.76	0.03	0.07	0.06	0.03	0.27	0.29
C.D. at 5 %	NS	1.48	2.16	0.08	0.20	0.18	0.09	0.77	0.83
C.V. %	8.57	7.62	7.53	5.58	8.28	8.09	6.55	8.62	7.58
Interaction (M x S)									
SE m±	0.72	1.16	1.70	0.06	0.16	0.14	0.07	0.60	0.65
C.D. at 5 %	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V. %	8.57	7.62	7.53	5.58	8.28	8.09	6.55	8.62	7.58
General mean	16.86	30.44	45.05	2.11	3.75	3.54	2.07	13.93	17.67

Yield and yield attributes

Yield is a function of various yield attributes. Most of the yield contributing characters *viz*., number of pods per plant, seed index and seed yield per plant [Table-2] were significantly influenced due to residual effect of integrated nutrient management applied in *rabi* maize. Significantly maximum values of number of pods per plant were recorded with the application of general RDF (RDF + FYM @ 10 t/ha) being remained at par with T3 (75% RDN through chemical fertilizer + 25% RDN through vermicompost). In case of seed index, it did not reach the level of significance. Such effect may be owing to increased availability of nutrient in soil from native pool as well as their residual effect through mineralization and improvement of physico-chemical properties of soil and thereby improving water and nutrient holding capacity of soil. These results are in accordance with Gawai and Pawar [2] in sorghum-chickpea, Patil [6] in sorghum-chickpea, Gudadhe [3] in cotton-chickpea, Nawle [5] in sorghum-chickpea, Shanwad [8] in maize-bengal gram and Saha[7] in maize- mustard cropping sequence. Significantly higher seed and stover yields of green gram [Table-2] was noted in treatment general RDF (RDF + FYM @ 10 t/ha) (T1) but it remained at par with the treatment receiving 75% RDN through chemical fertilizer + 25% RDN through vermicompost (T3) and treatment 75% RDN through chemical fertilizer + 25% RDN through biocompost (T2) to *rabi* maize. It may be ascertained to the increased availability of nutrients due to mineralization of organic materials, release of CO_2 increasing fertilizer use efficiency, accumulation of organic carbon and improvement of soil physical properties. The increased green gram seed yield might be due to addition of FYM or biocompost or vermicompost to preceding *rabi* maize resulting in improvement in soil structure which reduced the soil crusting and also serves as a source of energy for soil microflora which resulted in better root nodulation and nitrogen fixation. Significantly, higher stover yield under above treatments might be due to increase in vegetative growth in terms of plant height, number of branches and dry matter accumulation. Similar results reported earlier by Singh [10] in rice-lentil, Gawai and Pawar [2] in sorghum-chickpea, Gudadhe [3] in cotton-chickpea,

Nawle [5] in sorghum-chickpea, Shanwad [8] in maize-bengal gram and Saha [7] in maize- mustard cropping sequence. The farm yard manure or biocompost or vermicompost not only the store house of large number of macro and micro nutrients but also helps considerably to improve the physical, chemical and biological properties of the soil. This might be ascribed to the mineralization of un-decomposed FYM, biocompost and vermicompost left out in the soil after the harvest of maize crop. The persistent material in organic manures (FYM, biocompost and vermicompost) requires more time for its decomposition, hence, about 25 to 33% of nitrogen and small fraction of phosphorus and potassium in FYM, biocompost and vermicompost may be available to immediate crop i.e. rabi maize and rest to subsequent crops (Inoko, 1984) which sustain the productivity.

Table-2 *Residual effect of integrated nutrient management in rabi maize on yield of summer green gram (Pooled data of 2 years)*

Treatment	Number of pods/plant	Seed index (g)	Seed yield/ plant(g)	Seed yield (q/ha)	Stover yield (q/ha)
I). Main plot treatment(*Rabi* maize)					
T_1: General RDF (RDF + FYM @ 10 tonnes/ ha)	19.13	3.95	5.05	8.75	21.96
T_2: 75% RDN through chemical fertilizer + 25% RDN through biocompost	17.88	3.87	4.75	8.28	20.79
T_3:75% RDN through chemical fertilizer + 25% RDN through vermicompost	18.51	3.91	4.90	8.52	21.37
T_4: 75% RDN through chemical fertilizer + 25% RDN through FYM	17.25	3.83	4.61	8.04	20.21
T_5: Control	15.58	3.72	4.21	7.42	18.65
SE m±	0.38	0.06	0.13	0.18	0.52
C.D. at 5 %	1.17	NS	0.39	0.56	1.61
C.V. %	8.60	6.24	10.83	8.90	10.16
II). Sub plot treatment (Summer green gram)					
S_1 : Control	14.53	3.66	3.96	7.02	17.68
S_2 : 50 % RDF	17.29	3.83	4.61	8.06	20.25
S_3 : 75 % RDF	19.22	3.96	5.07	8.78	22.03
S_4 : 100 % RDF	19.64	3.98	5.17	8.94	22.42
SE m±	0.29	0.05	0.10	0.14	0.40
C.D. at 5 %	0.82	0.13	0.28	0.39	1.13
C.V. %	7.28	5.32	9.18	7.55	8.62
Interaction (M x S)					
SE m±	0.64	0.10	0.22	0.31	0.89
C.D. at 5 %	NS	NS	NS	NS	NS
C.V. %	7.28	5.32	9.18	7.55	8.62
General mean	17.67	3.85	4.70	7.63	19.59

Conclusion

On the basis of experimental results, it can be concluded that for getting maximum green gram yield, *rabi* maize crop should be nourished with 120 kg nitrogen (75% RDN through chemical fertilizer + 25% RDN through biocompost) or 120 kg nitrogen (75% RDN through chemical fertilizer + 25% RDN through vermicompost) along with recommended dose of 60 kg P_2O_5 (Considering the phosphorus content in biocompost and vermicompost) and summer green gram crop should be fertilized with 75% RDF (15-30-00 kg N-P-K/ha) through inorganic fertilizer in maize- green gram sequence under south Gujarat condition

Conflict of Interest: None declared

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