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Effect of organic and inorganic sources of nutrients and biofertilizers on soil available nutrients, growth and production of maize–onion cropping system

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Abstract
A pot culture experiment was conducted to study the effect of integrated use of organic and inorganic sources of nutrients and biofertilizers on Maize and their residual and cumulative effects on sequence *Rabi* crop Onion. The results revealed that application of 75% RDF along with 25% N or P substituted through vermicompost or poultry manure with addition of azotobacter or phosphorus solubilising bacteria improved the drymatter production, nutrient content and soil availability of N, P_2O5, K_2O & S over the control and other inorganic treatments. Where as in rabi onion grown in two different situations like fertilized and unfertilized to know the cumulative and residual effect of *kharif* maize treatments on subsequent *rabi* onion crop. The results revealed that, growth and nutrient content of fertilized onion is more on integrated nutrient treated pots. The soil available N, P_2O5, K_2O & S after harvest of onion is more in fertilized pots than unfertilized pots.

Keywords: Maize, onion, soil properties, nutrient content

Introduction
In India after wheat and rice crops maize is one of the important food crop. It is grown in an area of 8.17 m ha with a production of 19.7 M t and an average productivity of 1793 kg ha^{-1} in India. In Andhra Pradesh, it covers an area of 0.85 M ha with a production of 3.09 M t with an average productivity of 4066 kg ha^{-1}. (CMIE, 2011) [3]

Onion (*Allium cepa* L.) is one of the most important commercial vegetable crops grown in India. It occupies an area of 0.83 million hectares with a total production of 13.56 million tones with an average yield of 126.5 q ha^{-1}. In Andhra Pradesh it is grown in an area of 0.039 million hectares with a production of 0.66 million tones with an average yield 160.0 q ha^{-1}. (CMIE, 2011) [3]

Use of chemical fertilizers have played significant role in providing nutrients for intensive crop production. Continuous and indiscriminate use of high analysis fertilizers has resulted in several physical and physico- chemical problems such as acidity, alkalinity etc, (Chhonkar, 1995). To maintain better soil quality it is compulsory to go integrating all the resources of nutrients in a proper manner to get good yields without affecting the quality of soil.

Though much work has been reported on the use of organic manures along with inorganic fertilizers on production of maize and onion individually, but no systemic investigation has been carried out on the use of organic manures along with inorganic fertilizers and biofertilizers on soil available nutrients, growth and production of maize-onion cropping system.

Material and Methods
A Pot culture experiment was conducted during *kharif*, (maize) on Alfisols at College of Agriculture, Rajendranagar, Hyderabad. The experimental soil was sandy loam with bulk density 1.56 Mg m^{-3}, hydraulic conductivity 2.17 cm h^{-1}, water holding capacity 22.8%, neutral in reaction (pH 7.28), non saline (EC 0.22 dSm^{-1}), low in organic carbon (0.49%), low in alkaline $KMNO_4$ extractable N(186 kg ha^{-1}), Olsen's P(28 kg ha^{-1}), K_2O (395 kg ha^{-1}) & S (12.5 mg kg^{-1}).The experiment was laid out in Completely Randomized Block Design consisting of twelve treatment combinations each replicated 4 times. The treatments consisted control (T_1); three inorganic N and P levels 50% N and P through RDF (T_2), 75% N and P through RDF (T_3) and 100% N and P through RDF (T_4) and integrated nutrient management treatments viz., 75% N through RDF + 25% N through poultry manure (T_5), 75% N through RDF + 25% N through poultry manure + azotobacter (T_6), 75% N through RDF + 25% N

through vermicompost (T_7), 75% N through RDF + 25% N through vermicompost + azotobacter (T_8), 75% P through RDF + 25% P through poultry manure(T_9), 75% P through RDF + 25% P through poultry manure + phosphorus solubulising bacteria(T_{10}), 75% P through RDF + 25% P through vermicompost (T_{11}), 75% P through RDF + 25% P through vermicompost + phosphorus solubulising bacteria (T_{12}). Maize seeds were sown on treated plots and grown upto flowering stage and harvested. Onion crop is grown after harvest of maize. Fertilizers were not applied to half of the replications to know the residual effect on onion grown during rabi after harvest of maize crop. In another half a common dose of 75 percent of recommended dose of N, P and K fertilizers were applied to onion crop for all the treatments to know the cumulative effect. The organic sources of nutrients and biofertilizers were applied 10 days before sowing of maize. The plant and soil samples were collected after harvest of each crop and analyzed for available nutrient status by following standard methods (Piper 1966, Richards 1965 and Jackson, 1973) [8, 9, 5].

Results and Discussion

Effect of different fertility management treatments on dry matter yield, concentration of N, P, K and S and their uptake at flowering stage of maize

The data on dry matter, N, P, K and S concentration and their uptake by maize at 60 days after sowing in response to different levels of N and P fertilizers and their substitution by 25% with poultry manure and vermicompost with or without the addition of biofertilizers is presented in table 1. The crop responded to produce significantly more dry matter on application of recommended level of 120 kg N and 60 kg P_2O_5 ha^{-1} compared to the relatively low levels of fertilizers or control. Integrating nutrient supply by substituting 25% N or P with poultry manure or vermicompost increased the dry matter significantly compared to the inorganic fertilizer application. The plant tissues were significantly enriched with N and P concentration by the application of recommended level of N and P fertilizers compared to the control. The concentration of K and S did not change by the application of different levels of fertilizers. The integrated nutrient management treatments significantly increased the concentration of only P compared to inorganic fertilizer application. These treatments significantly increased the uptake of N, P, K and S. This might be due to higher availability of nutrients due to mineralization of organic matter (Arya and Singh, 2000, Anita *et al*. 2007) [2, 1]

Effect of different fertility management treatments on status of soil available N, P, K and S after the harvest of maize

The data on soil available N, P, K and S after the harvest of maize in response to the levels of inorganic fertilizer application and integrated nutrient management treatments is presented in table 2. The soil available N increased to 191 kg ha^{-1} by the application of recommended level of N and P fertilizers. This was on par with the available nitrogen due to the supply of nutrients both through inorganic and organic sources. The soil available P_2O_5 increased from 25 kg ha^{-1} in the control to 32 kgha^{-1} by the application of recommended level of N and P fertilizers. The integrated nutrient management treatments significantly increased the availability of these nutrients compared to the inorganic fertilizer application.

The soil available potassium increased from 395 kg K_2O ha^{-1} from its initial test value to 418 kg ha^{-1} after the harvest of maize fertilized with 120 kg N and 60 kg P_2O_5 ha^{-1}. No further significant improvement in the availability of this nutrient was detected due to the integrated supply of nutrients to maize. The soil available S was similar in the unfertilized plots and those supplied with different levels of fertilizers as at the commencement of experiment. Increase availability of soil nutrients due to application of organic and inorganic sources of nutrients was reported by Das *et al*. (2010) [4], Kumar and Dhar (2010) [6]

Cumulative, residual and direct influence of fertility management treatments in maize – onion cropping system on dry matter of onion at bulb formation stage.

The results (Table 3) showed that as a result residual effect of nutrient supplied to maize the dry matter of untreated onion drastically reduced. The application of 75% or the recommended level of N and P fertilizers to maize and 75% recommended level of N P K fertilizers to onion significantly increased the dry matter content of the latter than due to the cumulative effect of fertilizing maize with 50% N and P. But, the cumulative effect of integrated nutrient management and fertilizer application to onion was useful in increasing the dry matter content significantly. The residual influence of integrated nutrient management treatments in maize was also significant to increasing the dry matter of onion. The increase in drymatter production with increasing levels of nutrient application also reported by Sarita (2005) [10].

Cumulative, residual and direct influence of fertility management treatments in maize-onion cropping system on the concentration of N, P, K and S in onion at bulb formation stage.

The data on the concentration of N, P, K and S in onion plant in response to cumulative influence of nutrient supply to maize and onion, direct influence of fertilizer application to onion and the residual influence due to the nutrient management treatments imposed only to maize are presented in table 4. The results showed that the N, P, K and S concentration were not influenced due to the cumulative or residual influence.

Cumulative, residual and direct influence of fertility management treatments in maize-onion cropping system on N, P, K and S uptake by onion at bulb formation stage.

The data on uptake of N, P, K and S by onion at bulb formation stage is presented table 5. The uptake recorded considerable impact of nutrient management in the maize - onion cropping system. The uptake was invariably low on growing onion without the fertilizer application after the harvest of maize treated with different levels of fertilizers. The uptake of N, P, K and S increased significantly to 62.60, 5.54, 67.91 and 14.5 mg pot^{-1} due to the cumulative influence of inorganic fertilizers to both the crops compared to the uptake of 50.83, 4.07, 56.45 and 11.83 mg pot^{-1} of the respective nutrients in case of control. The integrated nutrient management treatments to maize and fertilizer application to onion enabled the latter to draw more nutrients than the inorganic fertilizer application to both the crops. The uptake of N, K and S was significantly higher due to the residual influence of inorganic fertilizer application to maize. The integrated nutrient management treatments showed significant increase in the uptake of N, P, K and S owing to the residual effect of fertilizer application to maize. Highest nutrient

uptake by fertilizer application also reported by Kumar *et al.* (2001) [7]

Cumulative, residual and direct influence of fertility management treatments in maize-onion cropping system on soil available N, P, K and S after harvest of onion.

The data on soil available N, P, K and S due to the cumulative influence of nutrient supply to both the crops and the residual effect of nutrient management treatments to maize is presented in table 6. The results showed that these nutrients were available in relatively larger quantities due to the cumulative influence of nutrient supply to both the crops than due to the residual influence of nutrient addition only to maize. The soil available N and K recorded substantial depletion due to the residual effect of fertilizer application after the harvest of unfertilized maize or onion compared to the initial soil content. The cumulative influence of fertilizer application both to maize and onion increased the soil availability of the two nutrients. The usefulness of organic source of nutrients in benefitting the succeeding crop was suggested by Kumar and Dhar (2010) [6].

Table 1: Effect of different fertility management treatments on dry matter yield, concentrations (%) and uptake (mg pot^{-1}) of N, P, K and S at flowering stage (60 DAS) of maize. (pot culture experiment)

Treatment	Dry matter yield (g pot^{-1})	N		P		K		S	
		(%)	(mg pot^{-1})	(%)	(mg pot^{-1})	(%)	(mg pot^{-1})	(%)	(mg pot^{-1})
T_1: Control (No fertilizers)	19.06	1.16	221.77	0.16	31.10	0.98	186.65	0.29	55.62
T_2: 50% N, P through RDF	22.16	1.22	270.16	0.18	40.16	1.09	241.75	0.30	66.36
T_3: 75% N, P through RDF	30.16	1.28	386.66	0.20	60.60	1.13	340.08	0.30	90.76
T_4:100% N, P through RDF(120-60 Kg N, P_2O_5 ha^{-1})	35.10	1.44	505.57	0.21	73.64	1.15	403.58	0.31	108.74
T_5: 75% N through RDF + 25% N through Poultry manure	43.10	1.50	650.50	0.26	112.66	1.22	528.48	0.31	133.41
T_6: 75% N through RDF + 25% N through Poultry manure + Azotobacter	45.13	1.51	681.44	0.26	117.28	1.25	564.03	0.31	139.84
T_7: 75% N through RDF + 25% N through Vermi compost	45.20	1.52	687.30	0.26	117.65	1.23	556.22	0.31	139.98
T_8: 75% N through RDF + 25% N through V.C. + AZB	47.00	1.53	719.21	0.27	126.72	1.21	569.37	0.31	145.93
T_9: 75% P through RDF + 25% P through P.M.	44.06	1.50	660.86	0.26	114.84	1.22	537.88	0.31	136.87
T_{10}: 75% P through RDF + 25% P through P.M. + Phosphorus solubilising bacteria	45.10	1.49	671.92	0.27	121.90	1.23	554.59	0.31	139.87
T_{11}: 75% P through RDF + 25% P through V.C	44.10	1.52	669.92	0.27	119.47	1.21	533.81	0.31	137.10
T_{12}: 75% P through RDF + 25% P through V.C + P.S.B.	46.06	1.52	699.94	0.27	124.11	1.23	566.48	0.31	142.54
SEm±	1.32	0.03	27.65	0.01	6.40	0.16	22.70	0.01	5.47
CD(P=0.05)	3.90	0.10	81.19	0.03	18.79	N.S.	47.13	N.S.	16.14

Table 2: Effect of different fertility management treatments on available N, P, K and S after harvest of maize (Pot culture experiment).

Treatments	Available nutrient status (kg ha^{-1})			
	N	P_2O_5	K_2O	S
T_1: Control (No fertilizers)	121	25.3	379	13.1
T_2: 50% N, P through RDF	164	29.1	412	13.3
T_3: 75% N, P through RDF	184	31.2	413	13.4
T_4:100% N, P through RDF(120-60 Kg N, P_2O_5 ha^{-1})	191	32.3	418	13.6
T_5: 75% N through RDF + 25% N through Poultry manure	198	38.1	423	14.3
T_6: 75% N through RDF + 25% N through Poultry manure + Azotobacter	201	38.3	427	14.5
T_7: 75% N through RDF + 25% N through Vermicompost	203	38.3	430	14.6
T_8: 75% N through RDF + 25% N through V.C. + AZB	208	39.1	432	14.7
T_9: 75% P through RDF + 25% P through P.M.	202	40.1	426	14.6
T_{10}: 75% P through RDF + 25% P through P.M. + Phosphorus solubilising bacteria	203	41.5	428	14.7
T_{11}: 75% P through RDF + 25% P through V.C	203	41.8	427	14.6
T_{12}: 75% P through RDF + 25% P through V.C + P.S.B.	206	42.9	429	14.7
SEm±	15.6	1.1	7.4	0.36
CD(P=0.05)	46.0	3.1	22.0	N.S.

Table 3: Cumulative, residual effect of integrated use of organic and inorganic sources of nutrients and biofertilizers on drymatter of onion at bulb formation stage (Pot culture experiment)

Treatments	Drymatter (g pot^{-1})	
	Cumulative	Residual
T_1: Control (No fertilizers)	1.94	1.62
T_2:50% N, P through RDF	1.96	1.71
T_3:75% N, P through RDF	2.12	1.78
T_4:100% N, P through RDF(120-60 Kg N, P_2O_5 ha^{-1})	2.31	1.83
T_5:75% N through RDF + 25% N through Poultry manure	2.55	2.21
T_6: 75% N through RDF + 25% N through Poultry manure + Azotobacter	2.56	2.25
T_7: 75% N through RDF + 25% N through vermicompost	2.62	2.28
T_8: 75% N through RDF + 25% N through V.C. + AZB	2.64	2.30
T_9: 75% P through RDF + 25% P through P.M.	2.58	2.26
T_{10}: 75% P through RDF + 25% P through P.M. + phosphorus solubilising bacteria.	2.61	2.27
T_{11}: 75% P through RDF + 25% P through V.C	2.60	2.27
T_{12}: 75% P through RDF + 25% P through V.C + P.S.B.	2.64	2.29
SEm±	0.04	0.03
CD(P=0.05)	0.13	0.08

Table 4: Cumulative and residual effects of integrated use of organic and inorganic sources of nutrients and biofertilizers on concentrations of N, P, K and S in onion at bulb formation stage (Pot culture experiment)

Treatments	Content (%)							
	N		P		K		S	
	Cumu-lative	Residual	Cumu-lative	Residual	Cumu-lative	Residual	Cumu-lative	Residual
T_1: Control (No fertilizers)	2.62	2.34	0.21	0.21	2.91	2.53	0.61	0.52
T_2:50% N, P through RDF	2.64	2.36	0.22	0.21	2.92	2.53	0.62	0.53
T_3:75% N, P through RDF	2.65	2.36	0.24	0.21	2.92	2.54	0.63	0.53
T_4:100% N, P through RDF(120-60 Kg N, P_2O_5 ha^{-1})	2.71	2.37	0.24	0.22	2.94	2.56	0.63	0.54
T_5:75% N through RDF + 25% N through Poultry manure	2.86	2.41	0.26	0.24	3.26	3.15	0.68	0.56
T_6: 75% N through RDF + 25% N through Poultry manure + Azotobacter	2.88	2.41	0.27	0.24	3.28	3.15	0.69	0.57
T_7: 75% N through RDF + 25% N through vermicompost	2.89	2.41	0.28	0.24	3.30	3.17	0.69	0.58
T_8: 75% N through RDF + 25% N through V.C. + AZB	2.90	2.42	0.28	0.24	3.32	3.17	0.67	0.58
T_9: 75% P through RDF + 25% P through P.M.	2.88	2.41	0.27	0.24	3.30	3.15	0.69	0.57
T_{10}: 75% P through RDF + 25% P through P.M. + phosphorus solubilising bacteria.	2.88	2.41	0.27	0.24	3.30	3.15	0.69	0.57
T_{11}: 75% P through RDF + 25% P through V.C	2.88	2.41	0.26	0.24	3.30	3.15	0.68	0.57
T_{12}: 75% P through RDF + 25% P through V.C + P.S.B.	2.89	2.41	0.26	0.25	3.31	3.17	0.69	0.57
SEm ±	0.16	0.08	0.02	0.01	0.17	0.19	0.02	0.01
CD(P=0.05)	N.S.	N.S.	N.S.	N.S	N.S.	0.56	N.S.	N.S.

Table 5: Cumulative and residual effects of integrated use of organic and inorganic sources of nutrients and biofertilizers on uptake of N, P and K in onion at bulb formation stage (Pot culture experiment)

Treatments	Uptake (mg pot^{-1})							
	N		P		K		S	
	Cumu-lative	Residual	Cumu-lative	Residual	Cumu-lative	Residual	Cumu-lative	Residual
T_1: Control (No fertilizers)	50.83	37.91	4.07	3.40	56.45	40.98	11.83	8.42
T_2:50% N, P through RDF	51.75	40.35	4.31	3.59	57.22	43.26	12.14	9.06
T_3:75% N, P through RDF	56.18	42.00	5.08	3.79	61.90	45.21	13.35	9.43
T_4:100% N, P through RDF(120-60 Kg N, P_2O_5 ha^{-1})	62.60	43.37	5.54	4.02	67.91	46.84	14.55	9.87
T_5:75% N through RDF + 25% N through Poultry manure	72.92	53.26	6.65	5.30	83.14	68.95	17.33	12.37
T_6: 75% N through RDF + 25% N through Poultry manure + Azotobacter	73.72	54.22	6.91	5.39	83.97	70.64	17.66	12.82
T_7: 75% N through RDF + 25% N through vermicompost	75.72	54.95	7.33	5.47	86.47	72.28	18.07	13.21
T_8: 75% N through RDF + 25% N through V.C. + AZB	76.56	55.63	7.38	5.50	87.65	73.12	17.84	13.31
T_9: 75% P through RDF + 25% P through P.M.	74.30	54.63	6.96	5.42	85.08	70.97	17.79	12.89
T_{10}: 75% P through RDF + 25% P through P.M. + phosphorus solubilising bacteria.	75.16	54.66	7.04	5.45	86.13	71.51	18.01	12.92
T_{11}: 75% P through RDF + 25% P through V.C	74.90	54.69	6.80	5.45	86.00	71.50	17.72	12.93
T_{12}: 75% P through RDF + 25% P through V.C + P.S.B.	76.29	55.14	6.85	5.71	87.38	72.55	18.21	13.04
SEm±	1.35	2.11	0.41	0.23	2.14	1.48	0.56	0.32
CD(P=0.05)	3.98	6.19	1.21	0.70	6.32	4.36	1.67	0.95

Table 6: Effect of integrated use of organic and inorganic sources of nutrients and biofertilizers on available N,P and K after harvest of onion (Pot culture experiment)

Treatments	Available nutrient status (kg ha^{-1})							
	N		P_2O_5		K_2O		S	
	Cumulative	Residual	Cumulative	Residual	Cumulative	Residual	Cumulative	Residual
T_1: Control (No fertilizers)	201	161	24.0	20.1	379	302	13.08	12.50
T_2:50% N, P through RDF	206	168	32.1	24.3	424	310	13.30	12.52
T_3:75% N, P through RDF	214	171	34.0	28.1	432	317	13.70	12.55
T_4:100% N, P through RDF(120-60 Kg N, P_2O_5 ha^{-1})	235	176	37.0	29.2	432	323	13.80	12.55
T_5:75% N through RDF + 25% N through Poultry manure	240	184	39.2	31.0	461	329	15.20	12.91
T_6: 75% N through RDF + 25% N through Poultry manure + Azotobacter	243	188	40.2	31.1	467	330	15.23	12.92
T_7: 75% N through RDF + 25% N through vermicompost	247	188	40.3	31.1	466	330	15.23	12.92
T_8: 75% N through RDF + 25% N through V.C. + AZB	250	193	43.2	33.1	468	331	15.26	12.95
T_9: 75% P through RDF + 25% P through P.M.	237	183	41.2	32.3	466	328	15.23	12.92
T_{10}: 75% P through RDF + 25% P through P.M. + phosphorus solubilising bacteria.	240	187	42.1	33.1	466	339	15.24	12.93
T_{11}: 75% P through RDF + 25% P through V.C	244	190	41.0	32.1	466	339	15.23	12.93

T_{12}: 75% P through RDF + 25% P through V.C + P.S.B.	247	192	45.1	35.1	467	331	15.24	12.94
SEm±	5.2	3.0	2.4	1.4	3.5	5.4	0.25	0.09
CD(P=0.05)	10.7	8.9	7.7	4.2	10.4	15.7	0.74	0.25

Conclusion

The present investigation revealed that, the performance of maize in terms of nutrient content, drymatter production superior in integrated use of organic and inorganic sources of nutrients over the only application of inorganic fertilizers. The *Rabi* onion grown on *Kharif* maize pots shown good response to application fertilizers. The soil available nutrients are more in integrated pots over the other treatments.

Reference

1. Anita B, Barik KC, Garnayak LM, Mahapatra. Nitrogen management in baby corn (*Zea mays*). Indian Journal of Agronomy. 2007; 52(2):135-138.
2. Arya KC, Singh SN. Effect of different levels of P and Zn on yield and nutrients uptake of maize (*Zea mays* L.) with and without irrigation. Indian Journal of Agronomy. 2000; 45(4):717-721.
3. CMIE. Centre for Monitoring Indian Economy. Apple Heritage, Mumbai, 2011.
4. Das A, Patel DP, Munda GC, Gosh PK. Soil nutrient balance sheet and economics of maize (*Zea mays*)-Mustard (*Brassica campestris*) cropping system as influenced by organic and inorganic fertilizer. Indian Agric. 2010; 54(1&2):53-57.
5. Jackson ML, Soil chemical analysis. Prentice Hall of India Private Limited, New Delhi, 1973.
6. Kumar A, Dhar S. Evaluation of organic and inorganic sources of nutrients in maize (*Zea mays*) and their residual effect on wheat (*Triticum aestivum*) under different fertility levels. The Indian Journal of Agricultural Sciences. 2010; 80(5):364-371.
7. Kumar A, Ranbir Singh, Chillar RK. Influence of nitrogen and potassium application on growth, yield and nutrient uptake by onion (*Allium cepa*). Indian Journal of Agronomy. 2001; 46(4):742-746.
8. Piper CS. Soil and Plant Analysis. Hans Publishers, Bombay, 1966, 137-153.
9. Richards LA. Physical condition of water in soil. In Methods of Soil analysis-Part I (ed. C. A. Slack). American Society of Agronomy, Inc., USA, 1965, 128-152.
10. Sarita D. Integrated nutrient management with nitrogenous fertilizers and castor cake in onion cv. Nasik Red (N-53). M. Sc (Horti.) Thesis. Acharya N G Ranga Agricultural University, Rajendranagar, Hyderabad, India, 2005.