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Cumulative and residual effect of kharif maize fertility treatments on growth and nutritional quality of onion

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Abstract
A field experiment is conducted to study the direct, cumulative and residual effect of fertility treatments on *Rabi* onion. The results revealed that the highest dry matter, N, P, K & S and micro nutrient content and uptake was recorded at harvest stages both in leaf and bulb under fertilized cumulative field condition. Onion grown on preceding maize fertility treatments shown significant variation in growth and nutrient content among the preceding maize fertility treatments in cumulative and residual strips. Onion responded well under integrated use of organic and inorganic source of nutrients and biofertilizer treatments of preceding maize both under cumulative and residual treatments over other inorganic sources of nutrients to preceding maize crop.

Keywords: Onion, residual nutrients, cumulative nutrient effect

Introduction
Among the essential plant nutrient, nitrogen is an essential constituent of various metabolically active compounds of cell like chlorophyll, amino acids, protein, nucleic acids, pyrimidine, flavins, purine, nucleoproteins, enzymes and alkaloids. Therefore, it plays an important role in plant metabolism. It promotes the cell multiplication and elongation and ultimately accelerates vegetative growth. It also increases sink size in terms of bulb size and helps in efficient use of other plant nutrients. An adequate supply of nitrogen is associated with vigorous vegetative growth and more efficient use of available inputs finally leading to higher productivity. Phosphorus plays a vital role in onion production by stimulating root development, energy transformation, impart various metabolic process, hasten maturity and thereby increase the yield of onion. The application of phosphorus effectively increase the growth probably due to the cell division and more development of meristematic tissues. Potassium plays an important role in crop productivity. Not only protein and carbohydrate synthesis require potassium but the enzymes for their proper functioning also need the presence of potassium ion in plants (Yadav *et al.*, 2003) [7].

Plant growth is predominantly influenced by climate, water and nutrients. The success of crop depends on the vegetative growth, harvesting of solar radiation, and its storage as photosynthates and finally its proper translocation to the sink. Dry matter and bulb yield of onion is a function of yield attributes which are significantly and favorably influenced by the application of nutrients. In general, the dry matter production and bulb yield of onion increase significantly with increasing levels of nutrient application.

Nutrient uptake is the total amount of nutrients taken up by a crop during the crop growth period. The uptake values provide a reliable estimate of the nutrient requirements under varying soil and climatic situations. In general, the uptake of N, P, K and S by onion significantly increased with increasing levels of application of nutrients through fertilizers. Keeping in view the present study is carried out to study the direct, cumulative and residual effects of nutrients on succeeding onion crop under preceding maize situation.

Material and Methods
A field experiment was conducted to know the, Direct, Residual and cumulative nutrient effects on *Rabi* onion crop at College Farm, College of Agriculture, Rajendranagar, Hyderabad, after harvest of *Kharif* maize crop. The *Kharif* maize nutrient 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}). The organic sources of nutrients and biofertilizers were applied at the time of field preparation to maize. After harvest of maize in *rabi* season onion grown in strip plot design by dividing the plot in to two equal halves to know the cumulative and residual effect of *Kharif* crop treatments on *Rabi* onion, all the plots were divided into two equal halves. Fertilizers were not applied to one half 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 Direct and cumulative effect. The soil and plant samples were collected after harvest of each crop and analyzed for nutrient contents by following standard methods (Piper 1966, Jackson, 1973) [4, 2].

Direct, Cumulative and Residual nutrients on dry matter, concentration of N, P, K, S, Fe, Mn, Zn and Cu and their uptake by onion leaves at harvest

The data on dry matter, concentration of N, P, K and S and their uptake by the leaves of onion at harvest in response to different fertility treatments in maize - onion cropping system is presented in table 1. Onion produced more dry matter in the leaves due to the cumulative influence of different fertility levels to maize than their residual effect. Dry matter content of 15.20 q ha^{-1} was recorded due to the direct influence of fertilizer application to onion. It increased significantly to 16.06 q ha^{-1} due to the cumulative influence of fertilizer application to both the crops. The integrated nutrient management treatments to maize were superior to fertilizer application. They increased the dry matter of onion leaves significantly.

The residual effect of fertilizer application to onion significantly increased the dry matter of leaves in the unfertilized onion. The residual fertility due to different integrated nutrient management treatments to maize was on par with that of the fertilizer application.

The cumulative effect of different fertility levels of fertilizer application to maize and the application of 75% NPK to onion was similar with the effect of direct influence of fertilization only to onion on the concentration of NPK and S. The concentration of these nutrients increased due to different integrated nutrient management treatments to maize. The residual fertility due to different levels of N and P fertilizers to maize did not alter the concentration of N, P, K and S in the leaves of onion at harvest. The concentration of P and K recorded a significant increase due to the residual fertility of integrated nutrient management treatments. The response trends due to the cumulative influence of integrated nutrient management and fertilizer application to maize were similar on the concentration of N, P K and S in the fertilized and unfertilized onion.

The uptake of N and K increased significantly application at recommended level of N and P to maize and 75% recommended level of NPK to onion compared to the influence of direct effect of fertilizer application only to onion. The cumulative effect due to the integrated nutrient management treatments was better than the fertilizer application to maize. They increased the uptake of these nutrients significantly in the treated onion. The uptake of N, K and S was significantly more due to the residual fertility by the application of recommended level of N and P fertilizers to maize. The residual fertility due to different integrated nutrient management treatments was similar to the effect of fertilizer application. The response trends due to the integrated nutrient management and fertilizer treatments were similar for the cumulative and residual influence on the uptake of N, P, K and S.

The data on the micro nutrient concentration and their uptake by the leaves of onion in maize - onion cropping system as influenced by different fertility treatments is presented table 2. The results showed that the Fe, Mn, Zn and Cu concentration in the leaves of onion was less in the unfertilized crop. There were no significant differences due to the cumulative influence of integrated nutrient management treatments or fertilizer application to maize on fertilized onion. Similarly, the residual effects due to the fertilizer or integrated nutrient management treatments were on par in the unfertilized onion. The uptake of Zn and Cu was significantly more in the leaves of onion at harvest due to the application of recommended level of N and P fertilizers to maize and 75% N P K to onion compared to the direct effect of fertilizer application only to onion. The integrated nutrient management treatments to maize exercised a significant improvement through their cumulative influence with fertilizer application to onion and significantly increased the uptake of Fe, Mn, Zn and Cu compared to the cumulative effect of fertilizer application to both the crops. But, the residual fertility effects of integrated nutrient management treatments were on par with the recommended level of N and P fertilizers on the uptake of these micronutrients. The response trends did not differ due to the cumulative effect or the residual influence on fertilized and unfertilized onion in the uptake of any one of these micronutrients.

The dry matter content in the onion bulbs was twice the leaves at harvest. The nutrient content of the bulbs was also superior in terms of N, P, S but inferior in K, Fe, Mn, Zn and Cu than in the leaves. The response to fertilizers showed that the dry matter accumulated both in the bulbs and leaves was significantly less due to the application of fertilizers only to onion than application to both the crops. This trend imply that the cumulative influence of fertilizer application increased the drymatter production of onion compared to the direct effect of fertilizer application only to onion. The percent N, S and Fe in the bulbs was also significantly enhanced by the cumulative influence of fertilizer application. Thus both production and nutrient content in terms of N and S increased on application of fertilizers to both the crops. The cumulative effect of integrated nutrient management treatments to maize and fertilizer application to onion was more beneficial increasing the dry matter of both the bulbs and leaves at harvest. These treatments also enriched the concentration of P, K, S and Mn in bulbs. This is a important consideration to increase the productivity and nutrient content. The cumulative influence of organic manuring to the *kharif* crop along with fertilizers and fertilizer application to the succeeding crop in increasing the production and nutrient value has also been ascertained in tomato- onion (Reddy, 1998) [5] maize-wheat (Parmar and Sharma, 2001) [3], maize-gobhi sarson (Anil Kumar *et al*.,

2005) [1] soybean-onion (Tumbare and Pawar, 2003) and okra-onion (Sharma *et al*., 2009) [6].

The residual fertility due to the application of 120 kg N and 60 kg P_2O_5 ha^{-1} to maize also recorded a significant increase in the dry matter of both the bulbs and leaves of untreated onion. This treatment also improved the concentration of N and S in the bulbs. The residual fertility due to the integrated nutrient supply had a more pronounced influence in increasing the dry matter content of bulbs as well as their nutritive value in terms of N, P, K, S, Fe, Mn and Zn. The increase in micronutrients of bulbs could be ascribed to the residual carry over effect of these micronutrients present in the organic manures which were released on mineralization for absorption by the roots of the crop.

Table 1: Influence of fertility management treatments in maize - onion cropping system on dry matter yield, N, P, K and S concentration and uptake of onion leaf at harvest (Field experiment *rabi*,2009-10)

Fertilized(cumulative)	Drymatter	N		P		K		S	
	(q ha^{-1})	(%)	(kg ha^{-1})	(%)	(kg ha^{-1})	(%)	(kg ha^{-1})	(%)	(kg ha^{-1})
T_1: Control	15.20	1.54	23.41	0.11	1.67	2.86	43.48	0.58	8.82
T_2:50% N, P (RDF)	15.40	1.59	24.48	0.12	1.85	2.88	44.37	0.59	9.08
T_3:75% N, P (RDF)	15.60	1.59	24.80	0.13	1.97	2.89	45.13	0.59	9.20
T_4:100% N, P through RDF(120-60 Kg N, P_2O_5 ha^{-1})	16.06	1.59	25.52	0.13	2.06	2.91	46.93	0.59	9.45
T_5:75% N (RDF) + 25% N Poultry manure	17.36	1.74	30.15	0.18	3.27	2.97	51.92	0.66	11.49
T_6: 75% N (RDF) + 25% N Poultry manure + azotobacter	18.43	1.75	32.14	0.18	3.34	2.98	54.83	0.66	12.19
T_7: 75% N (RDF) + 25% N Vermicompost	19.13	1.77	33.83	0.22	4.07	3.03	57.93	0.68	12.99
T_8: 75% N (RDF) + 25% N V.C. + AZB	20.13	1.79	35.83	0.22	4.22	3.04	61.28	0.68	13.71
T_9: 75% P (RDF)+ 25% P P.M.	17.83	1.74	30.97	0.18	3.06	2.99	53.20	0.66	11.78
T_{10}: 75% P (RDF) + 25% P P.M. + Phosphorus solubilising bacteria	18.63	1.74	32.33	0.19	3.58	2.99	55.85	0.66	12.27
T_{11}: 75% P (RDF) + 25% P V.C	19.00	1.75	32.98	0.19	3.63	3.03	57.49	0.66	12.56
T_{12}: 75% P RDF + 25% P V.C + P.S.B.	19.40	1.76	34.10	0.24	4.58	3.04	59.00	0.66	12.67
Unfertlized(Residual)									
T_1: Control	8.84	1.41	12.46	0.11	0.97	2.45	21.65	0.48	4.24
T_2:50% N, P (RDF)	9.51	1.41	13.40	0.11	1.04	2.47	23.48	0.50	4.75
T_3:75% N, P (RDF)	9.58	1.41	13.57	0.11	1.05	2.50	23.94	0.51	4.88
T_4:100% N, P through RDF(120-60 Kg N, P_2O_5 ha^{-1})	10.00	1.42	14.20	0.11	1.10	2.50	24.99	0.52	5.20
T_5:75% N (RDF) + 25% N Poultry manure	10.32	1.47	15.17	0.14	1.44	2.56	26.41	0.56	5.78
T_6: 75% N (RDF) + 25% N Poultry manure + azotobacter	10.35	1.49	15.42	0.14	1.45	2.56	26.49	0.56	5.79
T_7: 75% N (RDF) + 25% N Vermicompost	10.52	1.49	15.67	0.14	1.47	2.62	27.56	0.56	5.89
T_8: 75% N (RDF) + 25% N V.C. + AZB	10.56	1.49	15.73	0.14	1.48	2.63	27.77	0.57	6.02
T_9: 75% P (RDF)+ 25% P P.M.	10.38	1.49	15.46	0.14	1.45	2.60	26.98	0.56	5.81
T_{10}: 75% P (RDF) + 25% P P.M. + Phosphorus solubilising bacteria	10.42	1.49	15.52	0.15	1.56	2.62	27.30	0.57	5.93
T_{11}: 75% P (RDF) + 25% P V.C	10.35	1.49	15.42	0.14	1.56	2.60	26.90	0.56	5.79
T_{12}: 75% P RDF + 25% P V.C + P.S.B.	10.50	1.49	15.80	0.15	1.57	2.62	27.51	0.57	5.96
Effect of kharif treatments at same levels of rabi treatments SEm±	0.28	0.05	0.52	0.01	0.18	0.03	1.13	0.01	0.32
CD(P=0.05)	0.84	0.14	1.52	0.03	0.52	0.09	3.31	0.03	0.93
Effect of rabi treatments at same or different levels of kharif treatments SEm±	2.34	0.30	3.69	0.06	1.06	0.12	7.58	0.09	2.26
CD(P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2: Influence of fertility management treatments in maize - onion cropping system on concentration and uptake of Fe, Mn,Zn and Cu in dry matter of onion leaf at harvest (Field experiment *rabi*, 2009-10)

Fertilized (cumulative)	Fe		Mn		Zn		Cu	
	(mg kg^{-1})	(g ha^{-1})	(mg kg^{-1})	(g ha^{-1})	(mg kg^{-1})	(g ha^{-1})	(mg kg^{-1})	(g ha^{-1})
T_1: Control	32.20	48.94	15.21	23.11	17.18	26.11	3.80	5.72
T_2:50% N, P (RDF)	32.23	49.63	15.23	23.45	17.21	26.50	3.82	5.98
T_3:75% N, P (RDF)	32.23	50.29	15.23	23.75	17.21	26.84	3.82	5.88
T_4:100% N, P through RDF(120-60 Kg N, P_2O_5 ha^{-1})	32.24	51.80	15.23	24.46	17.21	27.65	3.82	6.90
T_5:75% N (RDF) + 25% N Poultry manure	32.27	56.02	15.25	26.48	17.25	29.96	3.86	6.12
T_6: 75% N (RDF) + 25% N Poultry manure + azotobacter	32.26	59.46	15.25	28.10	17.25	31.80	3.86	7.65
T_7: 75% N (RDF) + 25% N Vermicompost	32.26	61.72	15.26	29.19	17.25	33.00	3.86	7.90
T_8: 75% N (RDF) + 25% N V.C. + AZB	32.28	64.98	15.26	30.72	17.25	34.73	3.86	8.54
T_9: 75% P (RDF)+ 25% P P.M.	32.26	57.52	15.26	27.21	17.25	30.76	3.86	7.44
T_{10}: 75% P (RDF) + 25% P P.M. + Phosphorus solubilising bacteria	32.26	60.10	15.26	28.43	17.25	32.14	3.86	7.99
T_{11}: 75% P (RDF) + 25% P V.C	32.26	61.29	15.26	28.99	17.25	32.77	3.86	8.36
T_{12}: 75% P RDF + 25% P V.C + P.S.B.	32.26	62.58	15.26	29.53	17.25	33.46	3.86	7.74
Unfertlized(Residual)								
T_1: Control	25.21	22.28	14.63	12.93	15.60	13.79	3.32	2.93
T_2:50% N, P (RDF)	25.21	23.97	14.65	13.93	15.63	14.86	3.32	3.15
T_3:75% N, P (RDF)	25.21	24.15	14.65	14.03	15.63	14.97	3.34	3.19
T_4:100% N, P through RDF(120-60 Kg N, P_2O_5 ha^{-1})	25.21	25.20	14.65	14.65	15.64	15.64	3.34	3.34
T_5:75% N (RDF) + 25% N Poultry manure	25.32	26.13	14.68	15.14	15.71	16.21	3.34	3.44
T_6: 75% N (RDF) + 25% N Poultry manure + azotobacter	25.32	26.20	14.68	15.19	15.72	16.27	3.34	3.45
T_7: 75% N (RDF) + 25% N Vermicompost	25.32	26.63	14.68	15.44	15.72	16.53	3.34	3.51
T_8: 75% N (RDF) + 25% N V.C. + AZB	25.33	26.74	14.70	15.52	15.73	16.61	3.33	3.52

T_9: 75% P (RDF)+ 25% P P.M.	25.32	26.28	14.68	15.23	15.72	16.31	3.34	3.46
T_{10}: 75% P (RDF) + 25% P P.M. + Phosphorus solubilising bacteria	25.32	26.38	14.68	15.29	15.72	16.38	3.34	3.48
T_{11}: 75% P (RDF) + 25% P V.C	25.32	26.20	14.68	15.19	15.72	16.27	3.33	3.44
T_{12}: 75% P RDF + 25% P V.C + P.S.B.	25.33	26.60	14.68	15.44	15.72	16.53	3.34	3.51
Effect of kharif treatments at same levels of rabi treatments SEm±	0.19	0.98	0.21	0.48	0.15	0.52	0.04	0.12
CD(P=0.05)	NS	2.87	NS	1.40	NS	1.52	NS	0.33
Effect of rabi treatments at same or different levels of kharif treatments SEm±	0.84	7.53	1.76	3.52	0.65	4.08	0.19	0.65
CD(P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

Direct, Cumulative and Residual nutrients on dry matter, concentration of N, P, K, S, Fe, Mn, Zn and Cu and their uptake by onion bulb at harvest.

The data on dry matter accumulation, concentration of N, P, K and S and their uptake by the onion bulbs at harvest in response to the direct, cumulative and residual influence of fertility treatments is presented in table 3. The treated onion accumulated more dry matter at all level of fertilizer applied to the preceding maize. Dry matter content of 36.28 q ha^{-1} accumulated due to the direct influence of fertilizer application only to onion. There was a significant increase in this parameter due to the cumulative influence of residual fertility by the application of different levels of fertilizers to maize and the application of 75% recommended level of N, P and K to onion. Dry matter content of 34.30 q ha^{-1} was recorded by the application of recommended levels of N and P fertilizers to maize and 75% N P and K to onion. The integrated nutrient management treatments to maize were more effective than the fertilizer application to enhance the dry matter of onion bulbs to the extent of 36.15 to 37.16 q ha^{-1}. The untreated onion accumulated 20.40 q ha^{-1} dry matter content it increased significantly due to the residual influence of different levels of fertilizers. Dry matter of 24.10 q ha^{-1} was produced due to the residual nutrient influence of treating maize with recommended level of N and P fertilizers. The residual fertility due to integrated nutrient management treatments was more effective. The dry matter increased significantly ranging from 25.10 to 25.80 q ha^{-1}. The magnitude of positive response to increase in dry matter production due to the influence of integrated nutrient management treatments over inorganic fertilizers was similar both cumulative as well as residual effects.

The fertilized onion had a higher concentration of N, P, K and S in the bulbs at harvest. The bulbs had 2.60% N, due to the direct effect of fertilizer application to onion. The cumulative response due to the residual effect through different levels of fertilizer application to maize and the direct effect of 75% NPK applied to onion significantly increased the concentration of N in the bulbs. They were enriched to 2.92% N by the application of recommended level of N and P fertilizers to maize and 75% recommended level of NPK to onion. The integrated nutrient management treatments to maize did not show further improvement. The P and K concentration did not change significantly due to the cumulative influence of fertilizer application to both the crops than to the direct influence of fertilization only to onion. The S concentrated in significantly larger quantity due to the cumulative influence of fertilizer application to both the crops than to the direct effect on onion. But the integrated nutrient management treatments to maize were more effective. They increased the concentration of P, K and S significantly over fertilizer application to maize.

The residual influence of fertilizer application to maize had a significant influence in increasing the concentration of N and S. The residual effect of integrated nutrient management treatments significantly increased the N, P, K and S concentration in the bulbs of onion over the residual influence due to fertilizer application to maize. The cumulative and residual responses due to the integrated nutrient management treatments over fertilizer application to maize were similar on the concentration of N, P, K and S.

The uptake of nutrients was 85.01 kg N ha^{-1}, 5.56 kg P ha^{-1}, 69.95 kg K ha^{-1} and 23.21 kg S ha^{-1} in the bulbs of fertilized onion. The corresponding nutrient uptake increased significantly to 100.15, 6.39, 73.40 and 26.06 kg ha^{-1} due to the cumulative influence through the application of recommended level of N and P to maize and 75% recommended level of NPK to onion. Their uptake further increased through the cumulative influence of integrated nutrient management treatments to maize than its fertilization in the fertilized onion crop. The uptake of N, P, K and S was less in the unfertilized onion due to the residual effect of treatments to maize. The uptake was 41.86 kg N, 2.87 kg P, 37.14 kg K and 10.82 kg S per hectare by the unfertilized crop preceded by unfertilized maize. The uptake increased significantly to 52.05 kg N, 3.85 kg P, 43.86 kg K and 15.66 kg S per hectare due to the residual fertility of fertilizer application to maize, the integrated nutrient management treatments were superior to fertilizer application. The uptake of N, P, K and S increased significantly.

The response pattern on the uptake of N, P, K and S to enhance their uptake was of the same magnitude both due to cumulative and residual influence of integrated nutrient management treatments over inorganic fertilization to maize.

The data on the concentration and uptake of Fe, Mn, Zn and Cu by the onion bulbs at harvest in response to the direct, cumulative and residual responses due to different fertility management treatments is presented in table 4. The concentration and uptake of these micronutrients increased by the application of fertilizers to onion for any set of treatments to maize. Different levels of fertilizer application to maize did not influence the concentration of these nutrients through their cumulative or residual influence. The cumulative influence of integrated nutrient management to maize and fertilizer application to onion significantly increased the concentration of Fe, Mn, Zn and Cu compared to cumulative influence of inorganic fertilization both to maize and onion. The Fe, Mn and Zn concentration increased significantly in the bulbs of onion in response to the residual effect of integrated nutrient management treatments than the fertilizer application to maize. The magnitude of positive response to integrated nutrient management treatments over fertilizers was similar both for the cumulative and residual effects.

Table 3: Influence of fertility management treatments in maize - onion cropping system on dry matter yield, N, P, K and S concentration and uptake of onion bulb at harvest.

Fertilized (cumulative)	Drymatter	N		P		K		S	
	(q ha^{-1})	(%)	(kg ha^{-1})	(%)	(kg ha^{-1})	(%)	(kg ha^{-1})	(%)	(kg ha^{-1})
T_1: Control	32.68	2.60	85.01	0.17	5.56	2.140	69.95	0.71	23.21
T_2:50% N, P (RDF)	34.25	2.74	93.84	0.17	5.82	2.140	73.29	0.73	25.00
T_3:75% N, P (RDF)	34.28	2.75	94.27	0.18	6.17	2.140	73.35	0.75	25.71
T_4:100% N, P through RDF(120-60 Kg N, P_2O_5 ha^{-1})	34.30	2.92	100.15	0.18	6.39	2.140	73.40	0.76	26.06
T_5:75% N (RDF) + 25% N Poultry manure	36.15	2.92	105.56	0.24	8.67	2.250	81.34	0.83	30.00
T_6: 75% N (RDF) + 25% N Poultry manure + Azotobacter	36.15	2.92	105.56	0.26	9.39	2.250	81.33	0.84	30.36
T_7: 75% N (RDF) + 25% N Vermicompost	36.76	2.92	107.29	0.28	10.22	2.250	82.75	0.85	31.16
T_8: 75% N (RDF) + 25% N V.C. + AZB	37.16	2.94	109.33	0.28	10.36	2.260	84.04	0.86	31.82
T_9: 75% P (RDF)+ 25% P P.M.	36.20	2.91	105.56	0.27	9.76	2.250	81.45	0.82	29.68
T_{10}: 75% P (RDF) + 25% P P.M. + Phosphorus solubilising bacteria	36.54	2.93	107.07	0.28	10.22	2.250	82.23	0.85	30.80
T_{11}: 75% P (RDF) + 25% P V.C	36.20	2.90	105.22	0.28	10.13	2.250	81.44	0.85	30.77
T_{12}: 75% P RDF + 25% P V.C + P.S.B.	37.06	2.93	108.58	0.30	11.10	2.260	83.81	0.86	31.82
Unfertlized (Residual)									
T_1: Control	20.40	2.05	41.86	0.14	2.87	1.820	37.14	0.53	10.82
T_2:50% N, P (RDF)	23.45	2.13	49.94	0.14	3.28	1.820	42.67	0.63	14.77
T_3:75% N, P (RDF)	23.62	2.14	50.54	0.15	3.54	1.820	42.98	0.64	15.11
T_4:100% N, P through RDF(120-60 Kg N, P_2O_5 ha^{-1})	24.10	2.16	52.05	0.16	3.85	1.820	43.86	0.65	15.66
T_5:75% N (RDF) + 25% N Poultry manure	25.23	2.19	55.25	0.20	5.04	1.850	46.67	0.69	17.40
T_6: 75% N (RDF) + 25% N Poultry manure + azotobacter	25.50	2.21	56.36	0.22	5.78	1.860	47.43	0.70	17.83
T_7: 75% N (RDF) + 25% N Vermicompost	25.20	2.21	55.69	0.22	5.54	1.850	46.62	0.71	17.89
T_8: 75% N (RDF) + 25% N V.C. + AZB	25.80	2.23	57.52	0.24	6.19	1.860	47.99	0.73	18.83
T_9: 75% P (RDF)+ 25% P P.M.	25.30	2.19	55.41	0.23	5.82	1.850	46.80	0.71	17.96
T_{10}: 75% P (RDF) + 25% P P.M. + Phosphorus solubilising bacteria	25.60	2.19	56.06	0.22	5.62	1.860	47.61	0.71	18.17
T_{11}: 75% P (RDF) + 25% P V.C	25.10	2.18	54.71	0.22	5.52	1.850	46.43	0.71	17.82
T_{12}: 75% P RDF + 25% P V.C + P.S.B.	25.60	2.19	56.05	0.24	6.17	1.860	47.62	0.72	18.43
Effect of kharif treatments at same levels of rabi treatments SEm±	0.20	0.01	0.64	0.01	0.20	0.004	0.56	0.01	0.24
CD(P=0.05)	0.57	0.03	1.87	0.03	0.57	0.012	1.64	0.03	0.70
Effect of rabi treatments at same or different levels of kharif treatments SEm±	1.04	0.04	3.30	0.06	1.03	0.028	2.92	0.05	1.47
CD(P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 4: Influence of fertility management treatments in maize - onion cropping system on concentration and uptake of Fe, Mn, Zn and Cu in dry matter of onion bulb at harvest.

Fertilized (cumulative)	Fe		Mn		Zn		Cu	
	(mg kg^{-1})	(g ha^{-1})	(mg kg^{-1})	(g ha^{-1})	(mg kg^{-1})	(g ha^{-1})	(mg kg^{-1})	(g ha^{-1})
T_1: Control	16.20	52.98	14.25	46.56	6.85	22.38	3.31	10.81
T_2:50% N, P (RDF)	16.21	55.51	14.25	48.80	6.85	23.46	3.31	11.33
T_3:75% N, P (RDF)	16.21	55.56	14.26	48.88	6.85	23.48	3.32	11.38
T_4:100% N, P through RDF(120-60 Kg N, P_2O_5 ha^{-1})	16.21	55.60	14.26	48.92	6.89	23.63	3.32	11.38
T_5:75% N (RDF) + 25% N Poultry manure	17.13	61.92	15.21	54.98	6.91	24.97	3.46	12.50
T_6: 75% N (RDF) + 25% N Poultry manure + azotobacter	17.13	61.93	15.21	54.98	6.91	24.97	3.46	12.50
T_7: 75% N (RDF) + 25% N Vermicompost	17.13	62.81	15.21	55.92	6.92	25.43	3.46	12.72
T_8: 75% N (RDF) + 25% N V.C. + AZB	17.15	63.74	15.22	56.57	6.92	25.71	3.47	12.89
T_9: 75% P (RDF)+ 25% P P.M.	17.13	62.00	15.21	55.05	6.91	25.01	3.46	12.52
T_{10}: 75% P (RDF) + 25% P P.M. + Phosphorus solubilising bacteria	17.14	62.64	15.21	55.58	6.91	25.25	3.47	12.67
T_{11}: 75% P (RDF) + 25% P V.C	17.13	62.01	15.21	55.06	6.91	25.01	3.46	12.52
T_{12}: 75% P RDF + 25% P V.C + P.S.B.	17.14	63.67	15.22	56.41	6.91	25.62	3.47	12.93
Unfertlized(Residual)								
T_1: Control	15.10	30.81	13.90	28.37	6.10	12.45	3.10	6.41
T_2:50% N, P (RDF)	15.21	35.66	13.95	32.71	6.21	14.56	3.21	7.52
T_3:75% N, P (RDF)	15.21	35.92	13.95	32.94	6.21	14.66	3.21	7.58
T_4:100% N, P through RDF(120-60 Kg N, P_2O_5 ha^{-1})	15.21	36.65	13.95	33.61	6.21	14.96	3.21	7.73
T_5:75% N (RDF) + 25% N Poultry manure	16.12	40.67	14.21	35.85	6.33	15.97	3.36	8.47
T_6: 75% N (RDF) + 25% N Poultry manure + azotobacter	16.12	41.10	14.21	36.23	6.33	16.14	3.36	8.56
T_7: 75% N (RDF) + 25% N Vermicompost	16.12	40.62	14.22	35.83	6.33	15.95	3.36	8.46
T_8: 75% N (RDF) + 25% N V.C. + AZB	16.14	41.64	14.22	36.68	6.34	16.35	3.38	8.72
T_9: 75% P (RDF)+ 25% P P.M.	16.12	40.78	14.22	35.97	6.33	16.01	3.37	8.53
T_{10}: 75% P (RDF) + 25% P P.M. + Phosphorus solubilising bacteria	16.12	41.26	14.22	36.40	6.33	16.20	3.36	8.60
T_{11}: 75% P (RDF) + 25% P V.C	16.12	40.46	14.22	35.69	6.33	15.88	3.36	8.43
T_{12}: 75% P RDF + 25% P V.C + P.S.B.	16.14	41.45	14.22	36.46	6.34	16.25	3.36	8.66
Effect of kharif treatments at same levels of rabi treatments SEm±	0.14	0.59	0.04	0.36	0.01	0.15	0.07	0.26
CD(P=0.05)	0.41	1.72	0.13	1.05	0.03	0.43	0.20	0.76
Effect of rabi treatments at same or different levels of kharif treatments SEm±	0.38	1.48	0.28	1.75	0.09	0.71	0.28	0.82
CD(P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

Conclusion

Onion leaf at harvest can be used as fodder for milch and other small ruminants. The improved dry matter and nutritional quality of leaf at harvest by the application of 75% recommended dose of NPK to onion under preceding maize condition improved the fodder quality of leaf under integrated treatments of preceding maize crop. The bulb nutritional quality also very important in human diet. The increased dry matter and nutritional quality and 25% reduction in fertilizer recommendation due to sequence crop and also by effective utilization of preceding crop residual and cumulative fertility gave farmer and consumer with good quality produce.

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