RESPONSE OF DRILL SOWN ONION TO NUTRIENT MANAGEMENT THROUGH SOIL TEST CROP RESPONSE (STCR) AND SOIL TEST LABORATORY (STL) APPROACH

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Abstract: A field experiment was conducted during *kharif* of 2011 in farmer's field at Kadadalli village, Navalagunda taluk , Dharwad district to study the "Response of drill sown onion to nutrient management through Soil Test Crop Response (STCR) and Soil Test Laboratory (STL) approach" in medium deep black soil. The results revealed that, application of nutrients through STCR approach (NPK dose based on STCR approach) significantly influenced dry matter production of leaf (1.15, 2.46 and 1.92 g plant^{-1}, respectively) and bulb (0.92, 4.32 and 6.89 g plant^{-1}) of onion at 60, 90 DAS and at harvest, respectively except at 30 DAS . With respect to TSS and incidence of thrips population of onion crop was not differed due to various nutrient management practices. Maximum nutrient content of leaf (2.12, 0.35 and 1.75 % NPK, respectively) and bulb (2.24, 0.60 and 1.82 % NPK, respectively) was noticed in treatment NPK dose based on STCR approach . Significantly higher nutrient uptake of leaf (22.29, 4.81 and 19.86 kg NPK ha^{-1}, respectively), bulb (96.09, 25.25 and 78.11 kg NPK ha^{-1}, respectively) and plant (118.38, 30.07 and 97.97 kg NPK ha^{-1}, respectively) and available N and P_2O_5 after the harvest of the crop were found with STCR approach but higher available K_2O was with treatment recommended dose of NPK.

Keywords*:* Nutrient management, Onion, STCR, STL.

Introduction: Onion (*Alium cepa*) is one of the major bulb crop of India. It belongs to the genus A*llium* of Alliaceae family. It is considered as rich source of carbohydrates, proteins and vitamin C besides minerals like phosphorus and calcium.

In India, onion is grown in an area of 1.02 Million ha with a production of 14.82 M tonnes and productivity of 14.61t ha^{-1} (Anon., 2011). In Karnataka, it occupies an area of 0.15 m ha with the production of 2.38 M tones and productivity of 16.05 t ha^{-1} (Anon., 2011). Among the various factors, nutrient management exerts a profound effect on various growth contributing characters of onion in a given environmental condition (Neeraja *et al*., 2000). The major cause for low productivity in onion are imbalance use of chemical fertilizers and northern parts of Karnataka in particular. The majority of the farmers have lack of knowledge of applying an adequate amount of chemical fertilizers and organic manures which are prerequisite for better growth and development of onion.

Keeping these points in view, the present investigation was carried out with soil test based fertilizer recommendation being followed in India. The research on this aspect is lacking in Karnataka specially on drill sown rainfed onion and elsewhere in India.

Material and Methods: A field experiment was conducted during *kharif* 2011 to study the "Response of drill sown onion to nutrient management through Soil Test Crop Response (STCR) and Soil Test Laboratory (STL) approach" in medium deep black soil on farmer's field at Kadadalli village, Navalagunda taluk of Dharwad district. Composite soil samples were collected from the sites at a depth of 0 to 15 cm before layout of the experiment. The soils are low in available nitrogen (211 kg ha^{-1}), medium in available phosphorus (35.32 kg ha^{-1}) and potassium (256 kg ha^{-1}) with slightly alkaline soil reaction (pH 8.23). The experiment laid out in Randomized Complete Block Design with three replications. It comprised of eight treatments *viz*., T_1, Recommended dose of NPK (RDF) (125:50:125 N: P_2O_5:K_2O kg ha^{-1}); T_2, NPK dose based on STCR approach (Yield target 25% > the highest yield given in POP i.e 31.25 t ha^{-1}) (228:154.6:156 N: P_2O_5:K_2O kg ha^{-1}), T_3, Soil test based NPK (STL method) (150:50:125 N: P_2O_5:K_2O kg ha^{-1}), T_4, Soil test based NPK±25% (156.25:50:125 N: P_2O_5:K_2O kg ha^{-1}), T_5, Soil test based N and K ±50% and 25% P (187.5:50:125 N: P_2O_5:K_2O kg ha^{-1}), T_6, Farmers practice (46:48:60 N: P_2O_5:K_2O kg ha^{-1}), T_7, 25% N through FYM + 75% N, 100% P and K through inorganic fertilizer (74.31:50:125 N: P_2O_5:K_2O kg ha^{-1}), T_8, N and K as per STL + 75% RDP + RD of PSB (150:37.5:125 N: P_2O_5:K_2O kg ha^{-1}). The recommended cultural practices and plant protection measures were adopted to raise a healthy crop. All the data were statistically analysed (Gomez and Gomez 1984). The formula was used for fertilizer application through STCR approach was given below

$FN = 0.98\ T - 0.37\ SN$, $FP_2O_5 = 0.58\ T - 1.43\ SN$ and $FK_2O = 0.67\ T - 0.25\ SN$

Where,

T- Yield target q ha^{-1}

FN, FP_2O_5 and FK_2O – Fertilizer N, P_2O_5 and K_2O in kg ha^{-1}, respectively.

SN, SP and SK - Fertilizer nitrogen, phosphorus and potassium in kg ha^{-1}, respectively (Santhi *et al*., 2002).

Results and Discussion:

Dry matter production: The pre-requisite for getting higher yield in any crop is higher total dry matter and it's partitioning in various plant parts. The amount of dry matter produced is an indicator of overall effect of utilization of resources and better interception of light. The dry matter accumulation may reflect on economical yield in view of the fact that, vegetative part of the plant serves as source of assimilates whereas, bulbs as a sink. In the present investigation, dry matter production in leaf and bulb differ significantly due to nutrient management practices at all the growth stages except at 30 DAS. Significantly higher leaf and bulb dry matter at 60, 90 DAS and at harvest was recorded in T_2 (STCR approach) (1.15, 2.46, 1.92 and 0.92, 4.32 and 6.89 g plant^{-1}, respectively) against rest of the treatments and significantly lower leaf and bulb dry matter was recorded with treatment T_6 (farmer practice) [Table 1 and 2]. Significant improvement in dry matter production might have resulted from better vegetative growth indicated by higher plant height and more number of leaves. Similar results were reported earlier by Rizk (1997) and Mallangouda *et al*. (1995), who reported an increase in the dry matter production up to dose of 160:80:138 NPK kg ha^{-1} in onion crop.

Nutrient content in leaf and bulb: Significantly higher N content with respect to leaf and bulb (2.64 and 3.18 %, respectively) was associated with treatment T_2 (STCR approach) followed by T_5 (2.39 and 2.85 %) compared to rest of the nutrient management treatments. The increase in N content both in leaf and bulb was associated with higher uptake of N. Similar trend was also observed with P and K content (Table. 3).

Treatment T_2 (STCR approach) recorded significantly higher P content with respect to leaf and bulb (0.57 and 0.84 %) followed by T_5 (0.44 and 0.72 %). Higher P both in leaf and bulb in STCR approach (T_2) might be due to higher uptake of P resulted from synergistic interaction with applied nitrogen . Significantly lower P of leaf and bulb (0.31 and 0.50 %) was registered under farmer's practice (T_6). Similar kind of result was reported by Thimmaiah (1989), who reported maximum content of P was noticed with higher application of nitrogen and phosphorous.

With respect to K content, significantly higher content in leaves and bulb (2.35 and 2.58 %) was observed in T_2 (STCR approach) followed by T_5 (2.10 and 2.31 %) compared to rest of the nutrient management practices. The higher K content was mainly associated with higher uptake of K . The increased content of N and K in bulb with increased rate of NPK application was reported by Rizk (1997) in onion.

Nutrient uptake of leaf and bulb: Nutrient management practices exerted significant influence on N, P and K uptake by leaf and bulb of onion (Table 4). Among the different nutrient management practices, the treatment T_2 (STCR approach) recorded higher uptake of N (22.29 and 96.09 kg ha^{-1}) with respect to leaf and bulb. It is an established fact that, plant removes more nutrients from the soil, as its availability increased by fertilizer application. In this study, initial available soil N status was low (211.0 kg ha^{-1}). The treatment T_2 (STCR approach) comprised nearly 83 per cent more nitrogen than treatment T_1 (RDF) which resulted in increased availability and uptake of N. Significantly lower N uptake by both leaves and bulb (10.39 and 44.04 kg ha^{-1}, respectively) was noticed with farmer's practice (T_6). The reduced uptake in farmer's practice (T_6) was mainly associated with application of lower dose of N compared to other nutrient management practices.

P uptake by both leaf and bulb was significantly higher with T_2 and was closely followed by T_5. The increased P uptake through STCR approach might be due to higher rate of phosphorous application (20.9% more than recommended dose) and its availability. This increased availability may be due to synergistic interaction with the nitrogen. Significantly lower uptake of P was observed under farmer's practice .

Significantly higher uptake of K in leaf (19.86 kg ha^{-1}) and bulb (78.11 kg ha^{-1}) was noticed under T_2 (STCR approach) followed by T_5 compared to rest of the nutrient management practices. The application of higher rate of K through STCR approach (T_2) might have increased the availability of K which resulted in higher uptake as initial soil status was medium in range and responded well with application of higher dose of fertilizer. The lowest uptake of K by leaf (8.15 kg ha^{-1}) and bulb (31.47 kg ha^{-1}) was associated with farmer's practice (T_6). The reason behind reduced uptake of K was mainly associated with imbalanced application of nutrients coupled with lower dose of K. The above results were in line with the findings of Subbiah *et al.* (1982), Deshmukh *et al*. (1984), Thimmaiah (1989) and Mallangouda *et al.* (1995), who reported that combined application of higher dose of N, P and K resulted in higher uptake of N, P and K.

Available status of nutrient: The data on different nutrient management practices revealed that, higher available nitrogen (N) status of soil after harvest of onion crop was recorded with treatment T_2 (STCR approach) (278.63 kg ha^{-1}) compared to rest of the treatments and was on par with T_5 (260.77 kg ha^{-1}). The reason behind higher availability of available soil N status was associated with higher application of nitrogen compared to other nutrient management practices. Significantly lower available nitrogen (160.56 kg ha^{-1}) status was observed in farmer practice

(T_6) because of lower application of N compared to other treatments (Table 5).

With respect to phosphorous, significantly higher available phosphorous (P_2O_5) status in soil after harvest of onion crop was recorded in STCR approach (T_2) (93.24 kg ha^{-1}) compared to other treatments. Higher availability of available soil P_2O_5 status was associated with higher application of P_2O_5 compared to other nutrient management practices. The lower available phosphorous (P_2O_5) status was recorded with T_8 (N and K as per STL + 75% RDP + RD of PSB) (39.60 kg ha^{-1}). These results are in agreement with the findings of Thimmaiah (1989) and Girigowda *et al*., (2005).

Available soil potassium (K_2O) differed significantly with various nutrient management practices. Significantly higher available potassium (K_2O) status was found that RDF T2 (296.6 kg ha^{-1}) compared to farmer's practice, but it was on par with T_2 (284.28 kg ha^{-1}), T_3 (278.49 kg ha^{-1}), T_4 (274.85 kg ha^{-1}) T_5 (272.89 kg ha^{-1}), T_7 (295.36 kg ha^{-1}) and T_8 (280.57 kg ha^{-1}). However, lowest potassium status in soil was associated with farmer's practice (T_6) (246.68 kg ha^{-1}). The lower available soil K_2O status was associated with application of lower dose of K_2O compared to other nutrient management practices.

Nutrient supply through Soil Test Crop Response has resulted in higher bulb yield (25.70 t ha^{-1}) compared to recommended dose of fertilizer (20.21 t ha^{-1}) and was 27.16 % higher. This was economically viable compared to average of other nutrient management practices.

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Table 1. Effect of nutrient management practices on dry matter production of leaf at different stages of crop growth in drill sown onion under rainfed conditions

Treatment	Dry matter production (g $plant^{-1}$) in leaf			
	30 DAS	60 DAS	90 DAS	At harvest
T_1 : RDF (125:50:125 N: P_2O_5:K_2O kg ha^{-1})	0.20	0.92	1.84	1.51
T_2 : NPK dose based on STCR approach (228:154.6:156 N: P_2O_5:K_2O kg ha^{-1})	0.23	1.15	2.46	1.92
T_3 : Soil test based NPK dose (STL method) (150:50:125 N: P_2O_5:K_2O kg ha^{-1})	0.21	0.99	2.02	1.65
T_4 : Soil test based NPK±25% (156.25:50:125 N: P_2O_5:K_2O kg ha^{-1})	0.22	1.00	2.06	1.70
T_5 : Soil test based N and K ± 50% and 25% P (187.5:50:125 N: P_2O_5:K_2O kg ha^{-1})	0.22	1.05	2.11	1.72
T_6 : Farmer practice (46:48:60 N: P_2O_5:K_2O kg ha^{-1})	0.19	0.76	1.53	1.25
T_7 : 25% N through FYM + 75% N, 100% P and K through inorganics (74.31:50:125 N: P_2O_5:K_2O kg ha^{-1})	0.20	0.97	1.87	1.53
T_8 : N and K as per STL + 75% RDP (soil test medium) + RD of PSB (150:37.5:125 N: P_2O_5:K_2O kg ha^{-1})	0.21	0.98	1.99	1.63
S.Em±	0.01	0.04	0.08	0.06
CD at 5%	NS	0.11	0.25	0.18

Table 2. Effect of nutrient management practices on dry matter production of bulb at different stages of crop growth in drill sown onion under rainfed conditions

Treatment	Dry matter production (g $plant^{-1}$) in bulb			
	30 DAS	60 DAS	90 DAS	At harvest
T_1 : RDF (125:50:125 N: P_2O_5:K_2O kg ha^{-1})	0.22	0.72	3.47	5.38
T_2 : NPK dose based on STCR approach (228:154.6:156 N: P_2O_5:K_2O kg ha^{-1})	0.24	0.92	4.32	6.89
T_3 : Soil test based NPK dose (STL method) (150:50:125 N: P_2O_5:K_2O kg ha^{-1})	0.22	0.79	3.76	5.93
T_4 : Soil test based NPK±25% (156.25:50:125 N: P_2O_5:K_2O kg ha^{-1})	0.21	0.80	3.81	6.01
T_5 : Soil test based N and K ± 50% and 25% P (187.5:50:125 N: P_2O_5:K_2O kg ha^{-1})	0.23	0.82	3.89	6.19
T_6 : Farmer practice (46:48:60 N: P_2O_5:K_2O kg ha^{-1})	0.21	0.62	2.88	4.50
T_7 : 25% N through FYM + 75% N, 100% P and K through inorganics (74.31:50:125 N: P_2O_5:K_2O kg ha^{-1})	0.21	0.73	3.49	5.47
T_8 : N and K as per STL + 75% RDP (soil test medium) + RD of PSB (150:37.5:125 N: P_2O_5:K_2O kg ha^{-1})	0.22	0.77	3.67	5.84
S.Em±	0.01	0.03	0.13	0.20
CD at 5%	NS	0.08	0.39	0.61

Table 3. Effect of nutrient management practices on nutrient concentration in onion crop at harvest

Treatments	Nutrient content (%)					
	Nitrogen		Phosphorous		Potassium	
	Leaf	Bulb	Leaf	Bulb	Leaf	Bulb
T_1 : RDF (125:50:125 N: P_2O_5:K_2O kg ha^{-1})	2.12	2.48	0.35	0.60	1.75	1.82
T_2 : NPK dose based on STCR approach (228:154.6:156 N: P_2O_5:K_2O kg ha^{-1})	2.64	3.18	0.57	0.84	2.35	2.58
T_3 : Soil test based NPK dose (STL method) (150:50:125 N: P_2O_5:K_2O kg ha^{-1})	2.33	2.75	0.39	0.66	2.02	2.23
T_4 : Soil test based NPK±25% (156.25:50:125 N: P_2O_5:K_2O kg ha^{-1})	2.35	2.78	0.42	0.67	2.04	2.26
T_5 : Soil test based N and K ± 50% and 25% P (187.5:50:125 N: P_2O_5:K_2O kg ha^{-1})	2.39	2.85	0.44	0.72	2.10	2.31
T_6 : Farmer practice (46:48:60 N: P_2O_5:K_2O kg ha^{-1})	1.90	2.24	0.31	0.50	1.48	1.59
T_7 : 25% N through FYM + 75% N, 100% P and K through inorganics (74.31:50:125 N: P_2O_5:K_2O kg ha^{-1})	2.14	2.52	0.36	0.61	1.76	1.83
T_8 : N and K as per STL + 75% RDP (soil test medium) + RD of PSB (150:37.5:125 N: P_2O_5:K_2O kg ha^{-1})	2.29	2.70	0.37	0.62	1.99	2.20
S.Em±	0.08	0.10	0.02	0.03	0.08	0.08
CD at 5%	0.23	0.31	0.07	0.10	0.23	0.24

Table 4. Effect of nutrient management practices on nutrient uptake by onion at harvest

Treatments	Nutrient uptake (kg ha^{-1})								
	Nitrogen			Phosphorous			Potassium		
	Leaf	Bulb	Total	Leaf	Bulb	Total	Leaf	Bulb	Total
T_1 : RDF (125:50:125 N: P_2O_5:K_2O kg ha^{-1})	13.94	58.79	72.73	2.30	14.19	16.48	11.50	42.90	54.40
T_2 : NPK dose based on STCR approach (228:154.6:156 N: P_2O_5:K_2O kg ha^{-1})	22.29	96.09	118.38	4.81	25.25	30.07	19.86	78.11	97.97
T_3 : Soil test based NPK dose (STL method) (150:50:125 N: P_2O_5:K_2O kg ha^{-1})	16.89	71.53	88.42	2.85	17.11	19.96	14.65	57.86	72.51
T_4 : Soil test based NPK±25% (156.25:50:125 N: P_2O_5:K_2O kg ha^{-1})	17.52	73.44	90.95	3.13	17.70	20.83	15.25	59.85	75.10
T_5 : Soil test based N and K ± 50% and 25% P (187.5:50:125 N: P_2O_5:K_2O kg ha^{-1})	18.07	77.32	95.40	3.31	19.44	22.75	15.87	62.56	78.44
T_6 : Farmer practice (46:48:60 N: P_2O_5:K_2O kg ha^{-1})	10.39	44.04	54.44	1.70	9.84	11.54	8.15	31.47	39.62
T_7 : 25% N through FYM + 75% N, 100% P and K through inorganics (74.31:50:125 N: P_2O_5:K_2O kg ha^{-1})	14.32	60.51	74.83	2.43	14.75	17.18	11.87	43.77	55.64
T_8 : N and K as per STL + 75% RDP (soil test medium) + RD of PSB (150:37.5:125 N: P_2O_5:K_2O kg ha^{-1})	16.35	69.11	85.46	2.61	15.86	18.47	14.21	56.22	70.43
S.Em±	0.60	4.02	4.05	0.22	0.79	0.85	0.64	2.50	2.63
CD at 5%	1.82	12.18	12.30	0.67	2.40	2.58	1.95	7.59	7.97

Table 5.Effect of nutrient management practices on available nutrient status (kg ha^{-1}) after harvest of onion crop

Treatments	Available nutrient status (kg ha^{-1})		
	Nitrogen	Phosphorous	Potassium
T_1 : RDF (125:50:125 N: P_2O_5:K_2O kg ha^{-1})	221.27	53.46	296.60
T_2 : NPK dose based on STCR approach (228:154.6:156 N: P_2O_5:K_2O kg ha^{-1})	278.63	93.24	284.28
T_3 : Soil test based NPK dose (STL method) (150:50:125 N: P_2O_5:K_2O kg ha^{-1})	236.58	50.32	278.49
T_4 : Soil test based NPK±25% (156.25:50:125 N: P_2O_5:K_2O kg ha^{-1})	238.85	48.73	274.85
T_5 : Soil test based N and K ± 50% and 25% P (187.5:50:125 N: P_2O_5:K_2O kg ha^{-1})	260.77	47.57	272.89
T_6 : Farmer practice (46:48:60 N: P_2O_5:K_2O kg ha^{-1})	160.56	54.78	246.68
T_7 : 25% N through FYM + 75% N, 100% P and K through inorganics (74.31:50:125 N: P_2O_5:K_2O kg ha^{-1})	219.54	52.95	295.36
T_8 : N and K as per STL + 75% RDP (soil test medium) + RD of PSB (150:37.5:125 N: P_2O_5:K_2O kg ha^{-1})	245.54	39.60	280.57
S.Em±	12.38	2.84	11.70
CD at 5%	37.56	8.61	35.49

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