Targetted yield approach for fertilizer requirements of onion in Vertisols

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Abstract

A field experiment on fertility gradient approch was conducted on onion (c.v. N-2-4-1) to develop fertilizer prescription equations for making fertilizer recommendations to farmers. The data on onion yields, NPK uptake by onion, soil available NPK and fertilizer NPK applied were used for calculating nutrient requirement, contribution from soil and fertilizer nutrients. From these parameters fertilizer prescription equations were derived as:

$$FN = 5.40\ T - 0.54\ SN,$$

$$FP_2O5 = 4.00\ T - 4.32\ SP,$$

$$FK_2O = 3.10\ T - 0.13\ SK$$

Where FN, FP_2O5, FK_2O = fertilizer N, P_2O5, K_2O, kg ha^{-1}; T = yield target, Mg ha^{-1}; SN, SP, SK = soil available NPK, kg ha^{-1}, respecttively.

These equations were tested for their validity by conducting field trials on two soils (Typic Chromusterts and Vertic Ustropepts). There were 30, 40 and 50 Mg ha^{-1} of onion yield targets with control, general recommended fertilizer dose and as per soil testing laboratory recommendation treatments. The results showed that onion yield targets of 30,40 and 50 Mg ha^{-1} were achieved with 5-10% variation, The highest percent increase in yield over control on both the soils (128.3 and 137.5) and highest percent increase in monetary returns over control (129.4 and 137.1) were obtained under 50 Mg ha^{-1} targetted yield treatment. The targetted yield treatments of 40 and 50 Mg ha^{-1} of onion were superior to general recommended fertilizer and as per soil testing laboratory recommendation in respect of onion yields and profits. The results showed very close relationship between yields targetted and the yields actually obtained and is an evidence of usefullness of targetted yields through balanced fertilization. In This method it is also possible to make fertilizer recommendations for onion to the farmers considering their financial conditions.

Keywords: fertilizer recommendation, targetted yield approach, soil testing, onion

Introduction

Farmers are likely to use too little or too much of fertilizers. Soil testing for fertility helps them to eliminate the guess work and apply fertilizers according to the needs of the crop. Scientific fertilizer use takes into account both soil fertility status and crop requirements. In this regard, targetted yield approach (Ramamoorthy *et al.,* 1967; Dev *et al.,* 1978) has received considerable attenntion. Kanwar (1971) pointed out that soil testing would become a useful tool only if it is based on intimate knowledge of the soil-crop-variety -fertilizer-climate-management interactions for a given situation. Fertilizer use for targetted yield is a recent approach which takes into account crop needs and nutrients in soil (Velayutham, 1979) This is primarily meant for obtaining specific yield through rational fertilizer use. This approch can be used not only for individual field but also as a better approximation for planning the requirement of fertilizers on an area basis for a given level of crop production.

Onoin (Allium cepa) is an important cash crop of Maharashtra, India. No reseach data are available on fertilizer requirements of onoin based on targetted yield approach. Hence field experiments were conducted for developing targetted yield equations for onion and were tested for their validity under field conditions.

Materials and Methods

A standard field experiment was conducted on onion (cv. N-2-4-1) using fertility gradient approach on Typic Chromusterts (Kanwar, 1971). A field was divided into four strips and four fertility gradients were created by applying graded levels of N, P_2O_5 and K_2O fertilizers viz. (0: 0: 0, 100: 75:75, 200: 150: 150 and 400: 300: 300 kg ha^{-1}). Maize for fodder was grown to stableilize soil test values in four fertility trips. After harvest of maize fodder each strip was divided into 27 plots and onion seedlings were planted superimposed with 21 selected treatement combinations outof 5 levels of N (0, 50, 100, 150 and 200 kg ha^{-1}), 4 levels of P_2O_5 (0, 50, 100 and 150 kg ha^{-1}) and 3 levels of K_2O (0, 50 and 100 kg ha^{-1}) with 6 treatments without fertilizers (control). Initial surface soil samples were drawn from each plot before fertilizer application to onion and analysed for alkaline $KMnO_4$, Olsen-P and NH_4OAc-K (Jackson, 1973.) Onion bulbs and leaves yields were recorded at harvest and the samples analysed for NPK by standard methods and uptake calculated. The data on yield, NPK uptake by onion, soil available NPK and NPK fertilizers appllied were used for calculation of basic data (Dev *et al.,* 1978) on nutrient requirement (NR), contribution from soil nutrients (CS) and contribution from fertilizer nutrients (CF). From these parameters fertilizer prescription equations were derived for N, P_2O_5 and K_2O using following equation (Dev. *et al.,* 1978).

$$FD = NR / CS \times 100\ T - CS / Cf \times STV.$$

Where FD=fertilizer, kg ha^{-1}; T=yield target, t ha^{-1};
STV=soil test values for available NPK, kg ha^{-1}.

Using above method fertilizer presecription equations for onion were developed viz.

$$FN = 5.40\ T - 0.54\ SN,$$

$$FP_2O_5 = 4.00\ T - 4.32\ SP,$$

$$FK_2O = 3.10\ T - 0.13\ SK$$

Where FN ,FP_2O_5, FK_2O = fertilizer N, P_2O_5 , K_2O , kg ha^{-1} ;

T = yield target, t ha^{-1}; SN, SP, SK = soil available NPK, kg ha^{-1} respectively.

These equations were tested for their validity by conducting field trials on two soils (Typic Chromusterts and Vertic Ustropapts). There were 30, 40 and 50 t ha^{-1} of onion yield targets with control, general recommended fertilizer dose and as per soil testing laboratory recommendation.

Results and Discussion

The fertilizer rates based on targetted yield concept hinges upon three parameters viz. Nutrient requirement (NR), contribution from soil available nutrients (CS) and contribution from fertilizer nutrients (CF) (Table 1). In the present investigation onion crop required 1.134 kg N, 1.172 kg P_2O_5 and 2.040 kg K_2O to produce one tonne of onion. Percent contribution from soil indicated efficency of soil nutrient which was 11.25, 55.35 and 7.37 % of alkaline $KMnO_4$, Olsen-P and NH_4OAc-K respectively for onion. The pecent efficiency of N, P_2O_5 and K_2O from fertilizer was 21.01, 29.35 and 66.18 respectively. Ramamoorthy *et al.,* (1967) reported that economics of fertilizer application was dependent on these parameters. It was on this basis that prescription method of making fertilizer recommendations for targetted yields of corn was advocated by Troug (1960).

Table 1 Basis data for onion based on targetted yield approach.

Particular	N	P_2O_5	K_2O
Nutrient requrement (NR) kg Mg^{-1}	1.134	1.172	2.040
Contribution from soil (CS)%	11.25	55.35	7.37
Contribution from fertilizer (C) %	21.1	29.35	66.18

Fertilizer prescription equations

F N = 5.4 T - 0.54 SN

F P_2O_5 = 4.0 T - 4.32 SP

F K_2O = 3.1 T - 0.13 SK

Where FN, FP_2O_5, F K_2O are fertilizer N, P_2O_5 and K_2O, kg ha^{-1}; T is yield target, Mg ha^{-1}; and SN SP, SK are soil available N, P and K, kg ha^{-1}, respectively.

The basic data on NR, CS and CF for onion were transformed into simple workable equations for calculating fertilizer rates for targetted yields of onion based on initial soil test values (Table 1). From these equations ready tables were prepared for recommending fertilizer rates for spacific yield targets of onion based on soil with varying soil test values (Table 2). Fertilizer rates increased as yield targets of onion increased and the fertilizer rates decreased as the soil test levels increased. Thus in the targetted yield concept yield potential and soil test levels were taken into account while making fertilizer recommendations.

The targetted yields of 30, 40 and 50 Mg ha^{-1} of onion were achived by applying fertilizers based on targetted yield concept. The highest percent increase in yield over control on both the soils (128. 3 and 137.1) were obtained under 50 Mg ha^{-1} targetted yield treatment (Table 3). The targetted yield treatments particularly 40 and 50 Mg ha^{-1} of onion were superior to general recommended fertilizer and as per soil testing laborattorytreatments in respect of yields and profits.The present increase in monetary returns over control increased yield targets from 30 to 50 Mg ha^{-1} on both the soils.

Table 2 Nutrient requirement of onion for different yield targets with varying soil test values.

Soil available nutrient kg ha^{-1}		Onion	Yield target	Mg ha^{-1}		
Nitrogen	----------	---------	Fert. N, kg ha^{-1}	---------	---------	----------
100	81	108	135	162	189	216
120	70	97	121	151	178	205
140	59	86	113	140	167	194
160	49	76	103	130	157	184
180	38	65	92	119	146	173
200	27	54	81	108	135	162
220	16	43	70	97	124	51
240	05	32	59	86	113	140
260	00	22	49	76	103	130
Phosphorus	----------		Fert.P_2O_5, kg ha^{-1}	---------	---------	----------
08	65	85	105	125	145	165
12	48	68	88	108	128	148
16	31	51	71	91	111	131
20	14	34	54	74	94	114
24	00	16	36	56	76	96
28	00	19	19	39	59	79
32			00	22	42	62
Potassium	----------		Fert.K_2O, kg ha^{-1}	---------	---------	----------
200	51	67	82	98	113	129
250	45	60	75	91	106	122
300	38	54	69	85	100	106
350	32	47	63	78	94	110
400	25	41	56	72	87	103
450	19	34	50	65	81	96
500	12	28	43	59	74	90
550	06	21	37	52	68	83
600	00	15	30	46	61	77

This might be due to efficiency factor tended to increase with increase in crop yields (Sekhon *et al.,* 1977).Similar results were also reported by Hariprakasha Rao and Subramanian (1994) in vegetablele crops and Kadu *et al*. (1997) in preseasonal sugarcane. From these studies it is possible to make fertilizer recommendations for onion crop to the farmers considering their financial conditions. A slightly lower yield target may be considered for a poor farmer who is interested in maximum profit per rupee spent on fertilizer while a higher yield target for rich farmer who is interested in maximum production ha^{-1} of land.

Table 3 Fertilizer use for targetting on onion (cv. N-2-4-1) yields on Vertisols.

Treatment	Fertilizer N	Applied P_2O_5	kg ha^{-1} K_2O	Onion yield Mg ha^{-1}	Yield increase over control(%)	Increase in returns over control (%)
Typic Chromusterts						
Control	00	00	00	23.6	–	–
Recom. Fertilizer	150	50	50	34.4	45.7	49.8
As per soil test	125	62	25	36.8	55.9	59.1
30 Mg ha^{-1} target	49	60	62	32.1	36.0	39.9
40 Mg ha^{-1} target	103	100	73	43.5	84.0	87.9
50 Mg ha^{-1} target	160	120	106	53.3	128.3	129.1
C.D. at 5%						
Vertic Ustropets						
Control	00	00	00	22.8	–	–
Recm. Fert. dose	100	50	50	35.2	54.8	54.4
As per soil test	125	50	25	37.9	66.2	62.9.
30 Mg ha^{-1} target	55	21	46	33.0	44.7	44.5
40 Mg ha^{-1} target	109	60	77	43.8	92.1	91.9
50 Mg ha^{-1} target	163	100	108	54.2	137.7	137.7
C.D. at 5%				2.83		

Typic Chromusterts = Available N 210, P 13.8, K 392 kg ha^{-1}
Vertic Ustropepts= Available N 198, P 23.2, K 538 kg ha^{-1}
Rates = Fertilizer N 7.2, P_2O_5 18.00, K_2O 7.15 Rs. Kg^{-1}, onion bulb Rs. 3,000 Mg^{-1}

Conclusion

Targetted yield concept was found to bo the best for fertilizer requirements of onion for yield targets of 40 and 50 Mg ha^{-1}. Targetted yield approach works well for onion in Vertisols of Western India. It is also possible to make fertilizer recommedations to the farmers considering their financial conditions.

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