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Targeted Yield Based Integrated Nutrient Management of Egg plant in Torripsamment

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Abstract

Soil test crop response correlation studies were conducted to formulate the fertilizer adjustment equations for egg plant (Var. Kanhaya F_1 hybrid) under integrated plant nutrition system in Torripsamment during kharif 2010 following Ramamoorthy's inductive-cum-targeted yield approach. The nutrient requirement for producing one quintal fruit yield of egg plant was 0.31, 0.05 and 1.31 kg of N, P_2O_5 and K_2O, respectively. The per cent contribution from soil and fertilizer nutrients were found to be 44.98 and 13.57 for nitrogen, 23.75 and 3.06 for phosphorus and 21.97 and 26.68 for potassium, respectively. The per cent organic nutrient contribution of FYM was 29.14 for nitrogen, 10.06 for phosphorus and 30.28 for potassium. As per the IPNS based fertilizer prescription equation, for obtaining 250 q ha^{-1} fruit yield of egg plant on an Torripsammant considering the average soil test values of 110, 40 and 25 kg ha^{-1} of available N, P and K, respectively the requirement of fertilizer nutrients will be 98.4, 31.6 and 59.1 kg ha^{-1} of N, P_2O_5 and K_2O, respectively along with 15 t FYM ha^{-1}.

Key words: *Egg plant, STCR-IPNS, fertilizer adjustment equation, Torripsamment*

Introduction

Integrated nutrient management strategies that include site-specific knowledge of crop nutrient requirements, soil nutrient supply and recovery efficient of applied fertilizer are required to sustain high yields and maintain or build-up of soil fertility at a level that ensures maximum efficiency from nutrient inputs. Several approaches have been used for fertilizer recommendation based on chemical soil test so as to attain maximum yield per unit of fertilizer use. Among the various approaches, the targeted yield approach (Troug 1960; Ramamoorthy *et al*. 1967) has gaining popularity in India. Targeted yield concept is based on quantitative idea of the fertilizer needs based on yield and nutritional requirement of the crop, per cent contribution of the soil available nutrient and that of the applied fertilizer. This method not only estimates soil test based fertilizer dose but also the level of yield the farmer can achieve with that particular dose. Application of fertilizers by the farmers in the field without information on crop requirement may cause adverse effects on soils and crops owing to either over use or inadequate use of fertilizers. Further, exorbitant cost of fertilizers also demands a more comprehensive approach for fertilizer utilization incorporating soil tests, field research and economic evaluation of result. Egg plant is important vegetable crop grown worldwide for culinary and medicinal purpose. India is a major egg plant producing country with 13444 thousand tones production from 722 thousand hectare area having 18.6 t ha^{-1} productivity followed by China. Among the major egg plant growing states, West Bengal ranks first in area (161 thousand hectare) and production (2965.60 thousand tones) with productivity of 18.42 t ha^{-1}. In Rajasthan egg plant is cultivated on an area of 5.55 thousand hectare with 28.38 thousand tons of production with productivity of 5.11 t ha^{-1} (Anonymous, 2013).

The fertilizer application practices based on targeted yield approach indicated the possibility of enhancing production potential of egg plant. Hence, the present study was undertaken to develop balanced fertilizer schedule with or without FYM application for desired yield targets of egg plant on Torripsamment of Western Rajasthan.

Material and Methods

Soil test crop response correlation studies on egg plant (Var. Kanhaya F1 hybrid) was conducted during kharif-2010 on a sandy soil, Agricultural Research Station, Beechwal, S.K.R.A.U., Bikaner, Rajasthan. The soil was non-calcareous well-drained and slightly alkaline (P^H 8.4) in reaction. The alkaline $KMnO_4$-N, Olsen-P and NH_4OAc-K of the experimental field were of the ordered of 97.70, 19.30 and 167.57 kg ha^{-1}, respectively. The inductive-cum fertility gradient approach of Ramamoorty *et al*. (1967)

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was followed for conduction of the experiment. Three fertility gradients were created by dividing the experimental with $N_0P_0K_0$, $N_1P_1K_1$, and $N_2P_2K_2$ levels. These fertility gradients were fertilized as 0x: no N, P_2O_5 and K_2O, 1x: 150:62:80 kg ha^{-1} and 2x: 300:124:160 kg ha^{-1}, N, P_2O_5 and K_2O, respectively. Barley var.(RD-2508) was grown as on gradient crop so that the fertilizers could undergo transformations in the soil with plant and microbial agencies. By growing the exhaustive gradient crop the operational range of soil fertility was created in the fertility strips which was evaluated in terms of variations in yield, nutrient uptake and soil test values. After the harvest of exhaust crop, the main experiment on egg plant was conducted. Each strip was divided into 24 equal size plots. Twenty one selected fertilizer treatments comprising different combinations of N (60, 120 and 180 kg ha^{-1}), P_2O_5 (40, 80 and 120 kg ha^{-1}) and k_2O (30, 60 and 90 kg ha^{-1}) were randomly distributed in each strip along with three control ($N_0P_0K_0$) plots. The FYM levels (0, 15 and 30 t ha^{-1} were imposed across each fertility gradient strips. The initial soil samples before transplantation of egg plant were collected and analyzed for $KMnO_4$-N (Subbiah and Asija 1956), Olsen-P (Olsen *et al*., 1954) and neutral normal NH_4OAc-K (Hanway and Heidal, 1952). The FYM used in the experiment was analyzed for total nitrogen by H_2SO_4 digestion using macro-Kjeldhal method (A.O.A.C., 1990) while phosphorus and potassium were estimated by digesting 1 g dry FYM sample with 10 ml di-acid mixture (HNO_3:HC_1O_4). The test crop egg plant (Var. Kanhaya F_1 hybrid) was transplanted during September 2010. The plot-wise fruit yield and biomass yield of egg plant were recorded. Plant samples (fruit and biomass) from each plot were analyzed for total N, P and K content (Piper, 1966) and the total uptake was computed using fruit and biomass yield data. Using the data on fruit yield, nutrient uptake, initial soil available nutrients and fertilizer doses applied, the basic parameters viz., nutrient requirement (kg q^{-1}), contribution of nutrients from soil (C_s), contribution of fertilizers (C_f) and contribution of nutrients from FYM were estimated as described by Ramamoorthy *et al*. (1967). These parameters were used for the formulation of fertilizer adjustment equation for deriving fertilizer doses and the soil test based fertilizer recommendations were prescribed in the form of a ready reckoner for desired fruit yield targets of egg plant under NPK as well as with FYM.

Result and Discussion

Soil Available Nutrients and fruit yield of Egg plant:

The initial $KMnO_4$-N ranged from 97.70 to 135.20 kg ha^{-1} with mean of 119.83 kg ha^{-1}, Olsen-P from 19.30 to 35.08 kg ha^{-1} with a mean of 27.95 kg ha^{-1} and NH_4OAc-K from 167.57 to 245.58 kg ha^{-1} with a mean of 207.3 kg ha^{-1}. The range and mean values of fruit yield, and total nutrient uptake of treated and control plots are furnished in table 1. The fruit yield of egg plant in treated plots ranged from 6.26 to 40.51 q ha^{-1} with a mean of 21.73 q ha^{-1} whereas in control plots it ranged from 5.68 to 12.90 q ha^{-1} with a mean of 8.51 q ha^{-1}. Total N, P and K uptake in treated plots were ranged from 15.60 to 103.30 kg ha^{-1}, 4.30 to 29.57 kg ha^{-1} and 15.90 to 108.16 kg ha^{-1} with mean of 55.16, 15.64 and 55.97 kg ha^{-1}, respectively. However, in control plots, N, P and K uptake ranged from 14.09 to 32.38 kg ha^{-1}, 3.86 to 9.03 kg ha^{-1}, and 14.20 to 32.76 kg ha^{-1} with a mean of 21.27, 5.92 and 21.51 kg ha^{-1}, respectively.

The above data clearly indicated that a wide variability existed in the soil test values, egg plant fruit yield and total nutrient uptake in treated and control plots, which is a prerequisite for calculating the basic parameters and fertilizer adjustment equations for calibrating the fertilizer doses for specific yield targets.

Basic Parameters

The basic parameters viz., the nutrient requirement for producing one quintal of fruit yield of egg plant (kg q^{-1}), the per cent contribution of nutrients from soil (C_s), per cent contribution of fertilizer (C_f) and per cent contribution of nutrient from FYM (C_{fym}) have been calculated as described by Reddy *et al*. (1964) and Subba Rao and Shrivastava (1999) and furnished in table 2. These basic parameters ere used for formulating the fertilizer prescription equation under NPK alone and along with FYM.

The nutrient requirements per quintal of fruit yield were computed as 0.31, 0.05 and 1.31 kg N, P_2O_5 and K_2O, respectively. The per cent contributions of soil were 44.98, 23.75 and 21.97 for N, P_2O_5 and K_2O, respectively. The per cent contribution of fertilizer nutrients were 13.57 for nitrogen, 3.06 for phosphorus and 26.68 for potassium, respectively. Similarly, the per cent contribution of N, P_2O_5 and K_2O from FYM were 29.14, 10.06 and 30.98, respectively.

Fertilizer Prescription Equations for Desired Yield Targets of egg plant

Soil test based fertilizer prescription equations for target yield of egg plant on Torripsamment were formulated using the basic parameters (Table3). On the basis of these equations a ready reckoner was prepared for an average range of soil test values and egg plant fruit yield targets of 250 q ha^{-1} (Table 4).

Fertilizer N, P_2O_5 and K_2O requirements decreased with an increase in soil test values. For producing 250 q ha^{-1} fruit yield of egg plant on Torripsamment, the fertilizer doses required for the average soil test values of 100, 35 and 300 kg ha^{-1} of N and K, respectively were 131.5, 70.3 and 79.6 kg ha^{-1} of N, P_2O_5 and K_2O, respectively. However, in order to produce 250 q ha^{-1} fruit yield of egg plant with the above soil test values with 15t FYM ha^{-1}, the fertilizer requirement would be 76.7, 37.4 and 56.4 kg ha^{-1} of N, P_2O_5

and K_2O, respectively.

The application of fertilizer nutrient based on targeted yield approach may not be highly economical during first season of crop. But consistent fertilizer application based on targeted yield approach for every year will be highly economical and viable technology considering soil health and desired yield targets. Similar results were also reported by Santhi *et al*. (2002) for onion on Inceptisols and Singh *et al*. (2005) for maize and chickpea in the alluvial soil of Indo-Gangetic plains.

The foregoing results revealed that targeted yield concept could effectively be adopted to bring in site specificity in fertilizer use and achieve high yields of egg plant on the Torripsamments of Rajasthan. Also, the fertilizer application rates will be subsequently curtailed with conjoint use of fertilizers and organic manure.

Table 1. Range and mean values of available nutrients in the pre-sowing surface soil and yield of Egg plant (var. F_1 Hybrid Kanhaya)

Parameters	Range	Mean
Soil test values		
$KMnO_4$-N	97.70-135.20	119.83
Olsen-P	19.30-35.08	27.95
NH_4OAc-K	167.57-245.58	207.3
Egg Plant Yield (q ha^{-1})		
Treated Plots	6.26-40.51	21.73
Control Plots	5.68-12.90	8.51
Nutrient Uptake (kg ha^{-1})		
Treated Plots		
N uptake	15.60-103.30	55.16
P uptake	4.30-29.57	15.64
K uptake	15.90-108.16	55.79
Control Plots		
N uptake	14.09-32.38	21.27
P uptake	3.86-9.03	5.92
K uptake	14.20-32.76	21.51

Table 2. Nutrient requirement, per cent contribution from soil , fertilizer and FYM for Egg plant (var. F_1 Hybrid Kanhaya)

Parameters	N	P_2O_5	K_2O
Nutrient requirement (kg q^{-1})	0.31	0.05	0.31
Soil Nutrient utilization Efficiency (%)	44.98	23.75	21.97
Fertilizer nutrient utilization Efficiency (%)	13.57	3.06	26.68
Nutrient contribution (%) from organic source	29.14	10.06	30.98

Table 3. Soil test based fertilizer prescription for targeted yields of egg plant

FN = 2.28 T 3.31 SN 2.15 ON
F P_2O_5 = 1.63 T- 7.76 SP_2O_5 3.29 OP
F K_2O = 1.16 T 0.82 SK_2O 1.16 OK

Note: FN, F P_2O_5 and F K_2O: Fertilizer N, P_2O_5 and K_2O in kg ha^{-1}, respectively: T- Yield target in q ha^{-1};
SN, S P_2O_5 and SK_2O $KmnO_4$-N, Olsen-P and NH2OAc-K in kg ha^{-1} respectively:
ON, OP and OK denote N, P_2O_5 and K_2O content in Organic Manure

Table 4. Ready Reckoner of fertilizer doses at varying soil test values for specificyield target

Soil Available Nutrients (kg ha^{-1})			Fertilizer nutrient required (kg ha^{-1}) with 15 & 30 t ha^{-1} FYM for yield target of 250 q ha^{-1}					
			15 t ha^{-1}			30 t ha^{-1}		
N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
90	25	150	164.7	147.8	126.5	57.7	82.2	85.9
100	30	175	131.6	109	105.9	24.2	43.4	65.4
110	35	200	98.5	70.3	85.5	40	27	44.9
120	40	225	65.4	31.6	64.9	40	27	24.4
130	45	250	40	27	44.5	40	27	20
140	50	275	40	27	20	40	27	20

FYM composition: N 0.333, P_2O_5 0.133, K_2O 0.233

References

Anonymous. 2013. Indian Horticulture Database.

AOAC. 1990. Official Methods of Analysis of the Association of Analytical Chemists, 12th edn. Washington D.C.

Balasabramaniam, P., Subramanian, S., Durairaj, Muthiah, N. and Mahendran, P.P. 2005. Modeling of response functions and calibration of NPK based on soil fertility for lowland rice grown in Typic Haplustalf. *Journal of the Indian Society of Soil Science*: 53, 203-206.

Hanway, J.J. and Heidal, H. 1952. Soil analysis methods used in Iowa State College of Agriculture Bulletin, 57, 1-31.

Kadam, B.S. and Sonar, K.R. 2006. Targeted yield approach for assessing the fertilizer requirements of onion in vertisols. *Journal of the Indian Society of Soil Science*: 54, 513-515.

Olsen, S.R., Cole, C.V., Watanbe, F.S. and Dean, L. 1954. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. United States Department of Agriculture Circular 939.

Piper, C.S. 1966. Soil and Plant Analysis, Hans Publications, Bombay.

Ramamoorthy, B., Narasimhan, R.L. and Dinesh, R.S. 1967. Fertilizer application for specific yield targets of sonara 64, *Indian Farming*, 17: 43.

Ray, P.K. Jana, A.K. Maitra, D.N. Saha, M.N., Chaudhary, J., Saha, S. and Sha, A.R. 2000. Fertilizer prescriptions on soil test basis for June rice and wheat in Typic Ustrchrept. *Journal of the Indian Society of Soil Science*, 48: 79-84.

Reddy, K.C.K., Velayutham, M. and Maruthi Sankar, G.R. 1964. Extension Bulletin of All India Co-ordinated Soil Test Crop Response Correlation Project, CRIDA, Hyderabead.

Santhi, R., Naesan, R. and Selvakumari, G. 2002. Soil test crop response correlation studies under integrated plant nutrition system for onion (*Allium cepa* L. var. aggregatum) in Inceptisols of Tamil Nadu. *Journal of the Indian Society of Soil Science*, 50: 489-492.

Singh, J., Bajaj, J.C. and Pathak, H. 2005. Quantitative estimation of fertilizer requirement for maize and chickpea in the alluvial soil of the Indo-Gangetic Plains. *Journal of the Indian Society of Soil Science*, 53: 101-106.

Subba Rao, A. and Srivastava, S. 1999. An overview of fertilizer recommendations based on STCR fertilizer adjustment (targeted yield) equations. *Fertiliser News*,44: 83.

Subbiah, B.V. and Asija, G.L. 1956. A rapid procedure for determination of available nitrogen in soils. *Current Science*, 25: 229.

Tamboli, B.D., Patil, Y.M., Somawanshi, R.B. and Sonar, K.R. 1996. Soil test based fertilizer recommendations for targeted yields of *kharif* groundnut in Vertisols of Maharashtra. *Journal Maharashtra Agriculture University*, 21: 321-324.

Troug, E. 1960. Fifty years of soil testing. Transactions of 7th International of Soil Science, Madison Wisconsin, USA, Part III and IV, 36-45.