ANNALS OF ARID ZONE

Volume 60 | September & December 2021 | Number 3&4

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## Short Communication

Annals of Arid Zone 60(3&4): 75-78, 2021

# Targeted Yield based Integrated Nutrient Management of Cabbage in Torripsamment

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*Received: October 2020*

**Abstract:** Soil test crop response correlation studies were conducted to formulate the fertilizer adjustment equations for cabbage (Pusa drum head) under integrated plant nutrition system in Torripsamment during rabi, 2013-14 following Ramamoorthy's inductive-cum-targeted yield approach. The nutrient requirement for producing one quintal fruit yield of cabbage was 0.31, 0.11 and 0.68 kg of N, $P_2O_5$ and $K_2O$, respectively. The per cent contribution from soil and fertilizer nutrients were found to be 19.90 and 17.70 for nitrogen, 31.11 and 11.93 for phosphorus and 30.13 and 53.50 for potassium, respectively. The per cent organic nutrient contribution of FYM was 22.79 for nitrogen, 12.45 for phosphorus and 27.19 for potassium. As per the IPNS based fertilizer prescription equation, for obtaining 20 t $ha^{-1}$ yield of cabbage on an Torripsammant considering the average soil test values of 100, 30 and 190 kg $ha^{-1}$ of available N, $P_2O_5$ and $K_2O$, respectively the requirement of fertilizer nutrients will be 71.0, 52.1 and 96.5 kg $ha^{-1}$ of N, $P_2O_5$ and $K_2O$, respectively along with 20 t FYM $ha^{-1}$.

**Key words:** Bottle gourd, STCR-IPNS, fertilizer adjustment equation, Torripsamment.

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. Cabbage is an important vegetable crop grown worldwide. India is a major cabbage producing country with 9207 thousand tones production from 397 thousand hectare area having 23.19 t $ha^{-1}$ productivity followed by China. Among the major cabbage growing states, West Bengal ranks first in area and production. In Rajasthan cabbage is cultivated on an area of 120 thousand hectare with 11.69 thousand tons of production with productivity of 9.74 t $ha^{-1}$ (Anonymous, 2019).

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

## Material and Methods

Soil test crop response correlation studies on cabbage (Pusa drum head) was conducted during rabi 2013-14 on a sandy soil, Agricultural Research Station, Beechwal, SKRAU., Bikaner, Rajasthan. The soil was non-calcareous well-drained and slightly alkaline (pH 8.4) in reaction. The alkaline $KMnO_4$-N, Olsen-P and $NH_4OAc$-K of the experimental field were of the ordered of 123.20, 29.23 and 214.48 kg $ha^{-1}$, respectively. The inductive-cum

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*Table 1. Range and mean value of available nutrients in the pre sowing surface soil and yield of cabbage*

| Parameters | Range | Mean |
|---|---|---|
| Soil test values | | |
| $KMnO_4$-N | 120.93-142.26 | 134.49 |
| Olsen-$P_2O_5$ | 25.95-40.04 | 32.20 |
| $NH_4OAc$-$K_2O$ | 211.83-254.04 | 234.52 |
| Cabbage head yield (t $ha^{-1}$) | | |
| Treated plots | 2.71-30.42 | 14.78 |
| Control plots | 2.34-9.50 | 6.41 |
| Nutrient uptake (kg $ha^{-1}$) | | |
| Treated plots | | |
| N uptake | 8.88-94.27 | 46.09 |
| P uptake | 2.89-34.46 | 16.46 |
| K uptake | 17.49-208.17 | 99.78 |
| Control plots | | |
| N uptake | 7.44-29.66 | 19.47 |
| P uptake | 2.27-9.54 | 6.44 |
| K uptake | 15.08-65.70 | 42.91 |

fertility gradient approach of Ramamoorty *et al*. (1967) was followed for conduction of the experiment. Three fertility gradients were created by dividing the experimental with $N_oP_oK_0$, $N_1P_1K_1$, and $N_2P_2K_2$ levels. These fertility gradients were fertilized as Ox: no N, $P_2O$, and $K_2O$, 1x: 40, 62 and 80 kg $ha^{-1}$ and 2x: 80, 124 and 160 kg $ha^{-1}$, N, $P_2O_5$ and $K_2O$, respectively. Clusterbean (RGC-1017) 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 cabbage 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 $ha^{-1}$), $P_2O_5$ (30, 60 and 90 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 cabbage 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 (AOAC, 1990) while phosphorus and potassium were estimated by digesting 1 g dry FYM sample with 10 ml di-acid mixture ($HNO_3$:$HClO_4$). The test crop cabbage (MHBG-8) was sown during July, 2013. The plot-wise fruit yield and biomass yield of cabbage 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 cabbage under NPK as well as with FYM.

## Result and Discussion

### *Soil available nutrients and fruit yield of bottle gourd*

The initial $KMnO_4$-N ranged from 120.93 to 142.26 kg $ha^{-1}$ with mean of 134.49 kg $ha^{-1}$, Olsen-P from 25.95 to 40.04 kg $ha^{-1}$ with a mean of 32.20 kg $ha^{-1}$ and $NH_2OAc$-K from 211.83 to 254.04 kg $ha^{-1}$ with a mean of 234.52 kg $ha^{-1}$. The range and mean values of head yield, and total nutrient uptake of treated and control plots are furnished in Table 1. The head yield of cabbage in treated plots ranged from 2.71 to 30.42 t $ha^{-1}$ with a mean of 14.78 t $ha^{-1}$ whereas in control plots it ranged from 2.34 to 9.50 t $ha^{-1}$ with a mean of 6.41 t $ha^{-1}$. Total N, P and K uptake in treated plots were ranged from 8.88 to 94.27 kg $ha^{-1}$, 2.89 to 34.46 kg $ha^{-1}$ and 17.49 to 208.17 kg $ha^{-1}$ with mean of 46.09, 16.46 and 99.78 kg $ha^{-1}$, respectively. However, in control plots, N, P and K uptake ranged from 7.44 to 29.66 kg $ha^{-1}$, 2.27 to 9.54 kg $ha^{-1}$, and 15.08 to 65.70 kg $ha^{-1}$ with a mean of 19.47, 6.44 and 42.91 kg $ha^{-1}$, respectively.

The above data clearly indicated that a wide variability existed in the soil test values, cabbage head 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.



*Table 2. Nutrient requirement, per cent contribution from soil, fertilizer and FYM for cabbage (Pusa drum head)*

| Parameters | N | $P_2O_5$ | $K_2O$ |
|---|---|---|---|
| Nutrient requirement (kg $q^{-1}$) | 0.31 | 0.11 | 0.68 |
| Soil nutrient utilization efficient (%) | 19.90 | 31.11 | 30.13 |
| Fertilizer nutrient utilization efficiency (%) | 17.70 | 11.93 | 53.50 |
| Organic nutrient contribution (%) | 22.79 | 12.45 | 27.19 |

*Table 3. Soil test based fertilizer prescription for targeted yield of cabbage*

| |
|---|
| FN = 1.75 (T x 10) - 1.12 SN - 1.29 ON |
| F $P_2O_5$ = 0.92 (T x 10) - 2.61 S $P_2O_5$ - 1.04 OP |
| F $K_2O$ = 1.27 (T x 10) - 0.56 S $K_2O$ - 0.51 OK |
| Note: FN, F $P_2O_5$ and F $K_2O$: Fertilizer N, $P_2O_5$ and $K_2O$ in kg $ha^{-1}$, respectively. ON, OP and OK denotes N, $P_2O_5$ and $K_2O$ applied, respectively through organic manure. T-Yield target in t $ha^{-1}$ |

## Basic Parameters

The basic parameters viz., the nutrient requirement for producing one quintal of fruit yield of cabbage (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 are 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, 0.11 and 0.68 kg N, $P_2O_5$ and $K_2O$, respectively. The per cent contributions of soil were 19.90, 31.11 and 30.13 for N, $P_2O_5$ and $K_2O$, respectively. The per cent contribution of fertilizer nutrients were 17.70 for nitrogen, 11.93 for phosphorus and 53.50 for potassium, respectively. Similarly, the per cent contribution of N, $P_2O_5$, and $K_2O$ from FYM were 22.79, 12.45 and 27.19, respectively.

### *Fertilizer prescription equations for desired yield targets of cabbage*

Soil test based fertilizer prescription equations for target yield of cabbage on Torripsamment were formulated using the basic parameters (Table 3). On the basis of these equations a ready reckoner was prepared for an average range of soil test values cabbage head yield targets of 20 t $ha^{-1}$ (Table 4).

Fertilizer N, $P_2O_5$ and $K_2O$ requirements decreased with an increase in soil test values. For producing 20 t fruit yield of cabbage on Torripsamment, the fertilizer doses required for the average soil test values of 100, 30 and 190 kg $ha^{-1}$ of N and K, respectively were 71.0, 52.1 and 96.5 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; Gulati *et al*., (2006) for clusterbean in entisols; Kadam and Sonar (2006) for onion on vertisols; Singh *et al*. (2005) for maize and chickpea in alluvial soil of Indo-Gangetic plains and Gulati *et al*. (2016) for pearl millet in entisols.

*Table 4. Ready-recknower of fertilizer doses at varying soil test values for specific yield target for 20 t $ha^{-1}$ of cabbage*

| Soil test values (kg $ha^{-1}$) | | | Fertilizer requirement with 20 t $ha^{-1}$ organics | | |
|---|---|---|---|---|---|
| N | $P_2O_5$ | $K_2O$ | N | $P_2O_5$ | $K_2O$ |
| 90 | 30 | 190 | 76.5 | 52.1 | 96.5 |
| 100 | 35 | 210 | 71.0 | 42.7 | 85.9 |
| 110 | 40 | 230 | 65.5 | 33.3 | 75.3 |
| 120 | 45 | 250 | 60.0 | 23.9 | 64.7 |
| 130 | 50 | 270 | 54.5 | 20.0 | 54.1 |
| 140 | 55 | 290 | 49.0 | 20.0 | 43.5 |
| 150 | 60 | 310 | 43.5 | 20.0 | 32.9 |

## Conclusion

The foregoing results revealed that targeted yield concept could effectively be adopted to bring in site specificity in fertilizer use and achieve high yield of cabbage on the Torripsamments of Rajasthan. Also, the fertilizer application rate will be subsequently curtailed with combine use of fertilizes and organic manure.

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Printed in December 2021