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# Residual Effect of Integrated Nutrient Management in Finger Millet on Growth and Yield Parameters of Rabi Green Gram under Finger Millet-Green Gram Cropping Sequence

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**ABSTRACT**

*A field experiment was conducted during kharif and rabi seasons of 2013-14 and 2014-15 at Rajendrapur Farm, Hill Millet Research Station, Navsari Agricultural University, Waghai (Dist-Dangs), Gujarat to study the residual effect of integrated nutrient management in finger millet on production potential of succeeding green gram crop under finger millet-green gram cropping system. The five integrated nutrient management treatments viz., $T_1$-General RDF (RDF + FYM @ 10 t/ha), $T_2$-75% RDN through chemical fertilizer + 25% RDN through biocompost, $T_3$ -75% RDN through chemical fertilizer + 25% RDN through vermicompost, $T_4$ -75% RDN through chemical fertilizer + 25% RDN through FYM and T5 -control were given to finger millet in kharif season as main plot treatments replicated four times in randomized block design. During succeeding rabi season on the same field green gram was grown for which each main plot treatment was split into four sub plot treatments with four levels of recommended dose of fertilizers viz., $S_1$ -control, $S_2$ 50% RDF, $S_3$ -75% RDF and $S_4$ -100% RDF resulting in twenty treatment combinations replicated four times in split plot design. The general RDF (RDF + FYM @ 10 t/ha) applied to finger millet reported the significant residual effect on growth, yield attributes, seed and stover yields of succeeding green gram crop followed by 75% RDN through chemical fertilizer + 25% RDN through vermicompost. Thus, application of RDF i.e. 40 kg nitrogen and 20 kg $P_2O_5$ through chemical fertilizer along with 10t/ha FYM reported promising residual effect on yield and yield attributing characters of succeeding green gram crop in finger millet-green gram cropping sequence under hilly area of south Gujarat.*

***Key words:*** *Finger millet-green gram, Cropping sequence, Biocompost, FYM, Grain yield, Vermicompost*

## INTRODUCTION

The cropping system should provide enough food for the family, fodder for cattle and generate sufficient cash income for domestic and cultivation expenses. Many intensive cereal based cropping systems are under practice in the country according to agroclimatic regions.

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Under rainfed condition, particularly in hilly tract of south Gujarat, finger millet-green gram cropping system is predominantly followed. The productivity of the system mainly depends on proper nutrient management practices. Low organic matter content in soil coupled with low and imbalanced application of macronutrients to the crop limits the full potential of yield[1]. Integrating chemical fertilizers with organic manures was quite promising, in maintaining higher productivity. In the finger millet-green gram cropping system, application of vermicompost, biocompost and FYM increased growth attributes, yield parameters and yield of individual crops.

Green gram is an important pulse crop of India as it is grown an area of 2.98 million hectares with total production of 1.61 million tonnes and productivity of 407 kg/ha [2]. In India, major green gram producing states are Odisha, Madhya Pradesh, Rajasthan, Maharashtra, Gujarat and Bihar. In Gujarat, it is cultivated in about 2.3 lakh hectares with an annual production of 1.21 lakh tonnes and average productivity of 526 kg /ha [3].

At present, studies on nutrient utilization in cropping system of different crops are available [4, 5, 6 7] but, effect of organic sources with different levels of inorganic fertilizer applied to finger millet on the performance of succeeding green gram especially on the aspects of residual effect, growth and yield is very meager. Hence the present study on effect of nutrient management on succeeding green gram in finger millet-green gram sequence is need of time.

## MATERIAL AND METHODS

The investigation was conducted during *kharif* and rabi seasons of 2013-14 and 2014-15 at Rajendrapur Farm, Hill Millet Research Station, Navsari Agricultural University, Waghai (Dist-Dangs), Gujarat to study the residual effect of integrated nutrient management in succeeding green gram crop under finger millet-green gram cropping sequence. The soil of the experimental field was clayey in texture and slightly acidic in reaction (pH 6.9), medium in organic carbon (0.68%), available nitrogen (285.80 kg/ha), available phosphorus (49.60 kg/ha) whereas high in available potassium (376.12 kg/ha). The treatments consisted of integrated nutrient management *viz*., $T_1$-General RDF (RDF + FYM @ 10 t/ha), $T_2$ - 75% RDN through chemical fertilizer + 25% RDN through biocompost, $T_3$ -75% RDN through chemical fertilizer + 25% RDN through vermicompost, $T_4$ -75% RDN through chemical fertilizer + 25% RDN through FYM and $T_5$ -control to finger millet in *kharif* season as main plot treatments replicated four times in randomized block design. Organic manures (FYM, bio-compost and vermicompost) were applied to finger millet crop as per treatments and evenly spread and mixed in that particular plot. The 50% dose of nitrogen and full dose of phosphorus were applied at the time of transplanting, remaining half dose of nitrogen was top dressed as urea as per treatment. In case of phosphorus fertilizer, the quantity of phosphorus from bio-compost, vermicompost and FYM was counted and deducted from the quantity of recommended dose of phosphorus and remaining phosphorus was applied in the form of SSP. After the harvesting of finger millet crop the green gram was grown as succeeding crop on 26$^{th}$ November 2013 and 6$^{th}$ October 2014. During rabi season each main plot treatment was split into four sub-plot treatments with four levels of recommended dose of fertilizer *viz*., $S_1$ -control, $S_2$ 50% RDF (10-15-00 kg N-P-K/ha), $S_3$ -75% RDF(15-30-00 kg N-P-K/ha) and $S_4$ 100% RDF (20-40-00 kg N-P-K/ha) to green gram resulting in twenty treatment combinations replicated four times in split plot design. The data recorded were statistically analyzed using MSTATC Software. The purpose of analysis of variance was to determine the significant effect of treatments on finger millet. LSD test at 5 per cent probability level was applied when analysis of variance showed significant effect for treatments [8].

## RESULTS AND DISCUSSION

### Growth

In order to quantify the response observed due to integrated nutrient management to the preceding *kharif* finger millet on green gram, the plant growth and development was assessed on pooled basis in terms of plant height (Table 1). At 60 DAS, treatment receiving application of general RDF (RDF + FYM @ 10 t/ha: $T_1$) produced significantly taller plants further it remained at par with treatment $T_3$ (75% RDN through chemical fertilizer + 25% RDN through vermicompost) at harvest. Application of RDF + FYM @ 10 t/ha ($T_1$) recorded significantly higher number of branches per plant in case of 60 DAS and at harvest, At 60 DAS and at harvest, significantly maximum dry matter accumulation per plant was recorded with application of general RDF (RDF + FYM @ 10 t/ha : $T_1$) which was remained at par with treatment $T_3$ (75% RDN through chemical fertilizer + 25% RDN through vermicompost). The higher nutrient availability under INM treatments resulted into increased conversion of carbohydrates into protein which in turn elaborated into protoplasm and cell wall material increased the size of the cell, which expressed morphologically in terms of plant height, number of branches and ultimately dry matter accumulation. Cellulose is a highly persistent composition material, which requires longer time for decomposition. Thus, FYM, biocompost and vermicompost have not been fully utilized by the finger millet crop in first crop season and notably benefitted the succeeding green gram crop. Similarly, the beneficial residual effect of INM under cropping system on growth attributes of succeeding crops was recorded in sorghum-chickpea [4], forage sorghum-chickpea [5], rice-green gram [6] and maize- green gram [7] cropping sequence.

### Yield and yield attributes

Yield is a function of various yield attributes. Most of the yield contributing characters *viz*., number of pods per plant, seed index and seed yield per plant (Table 2) were significantly influenced in green gram due to residual effect of integrated nutrient management applied in *kharif* finger millet. Significantly maximum values of number of pods per plant, seed index and seed yield per plant were recorded with the application of general RDF (RDF + FYM @ 10 t/ha) over all the treatments. Such effect may be owing to increased availability of nutrient in soil from native pool as well as their residual effect through mineralization and improvement of physico-chemical properties of soil and thereby improving water and nutrient holding capacity of soil, which result in to more growth of crop and resulted in adequate food supply to sink and ultimately reflected in to better yield attributes. These results are in accordance with finding of earlier worker in maize-bengal gram[9], forage sorghum-chickpea[5] and rice-green gram[6] cropping sequence.

Significantly higher seed and stover yields of green gram (Table 2) was recorded under application of general RDF (RDF + FYM @ 10 t/ha: $T_1$) in average of two years. It may be ascertained to the increased availability of nutrients due to mineralization of organic materials, release of $CO_2$ increasing fertilizer use efficiency, accumulation of organic carbon and improvement of soil physical properties. The increased green gram seed yield might be due to addition of FYM or biocompost or vermicompost to preceding finger millet resulting in improvement in soil structure which reduced the soil crusting and also serves as a source of energy for soil microflora which resulted in better root nodulation and nitrogen fixation. Significantly, higher stover yield under above treatments might be due to increase in vegetative growth in terms of plant height, number of branches and dry matter accumulation. The persistent material in organic manures (FYM, biocompost and vermicompost) requires more time for its decomposition, hence, about 25 to 33% of nitrogen and small fraction of phosphorus and potassium in FYM, biocompost and vermicompost may be available to immediate crop *i.e.* finger millet and rest to subsequent crops which sustain the productivity[10]. Similar results reported earlier by in sorghum-chickpea[4], sorghum-chickpea [5] and maize-bengal gram[9] cropping sequence.

**Table 1: Residual effect of integrated nutrient management in finger millet on growth parameters of rabi green gram (2 year Pooled data)**

| Treatments | Plant height (cm) | | | Mean number of branches/plant | | | Dry matter accumulation/plant (g) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 30 DAS | 30 DAS | At harvest | 30 DAS | 60 DAS | At harvest | 30 DAS | 60 DAS | At harvest |
| **(I). Main plot treatment (*kharif* finger millet)** | | | | | | | | | |
| $T_1$: General RDF (RDF + FYM @ 10 t /ha) | 23.75 | 53.28 | 89.49 | 2.16 | 4.79 | 4.88 | 3.81 | 19.16 | 26.60 |
| $T_2$: 75% RDN through chemical fertilizer + 25% RDN through biocompost | 23.49 | 49.29 | 86.46 | 2.14 | 4.43 | 4.53 | 3.69 | 17.89 | 25.07 |
| $T_3$: 75% RDN through chemical fertilizer + 25% RDN through vermicompost | 23.73 | 50.69 | 87.97 | 2.16 | 4.52 | 4.61 | 3.75 | 18.53 | 25.84 |
| $T_4$: 75% RDN through chemical fertilizer + 25% RDN through FYM | 23.37 | 47.97 | 84.95 | 2.14 | 4.31 | 4.43 | 3.63 | 17.26 | 24.32 |
| T5: Control | 23.18 | 44.67 | 81.51 | 2.11 | 4.03 | 4.23 | 3.50 | 15.58 | 22.29 |
| SEm± | 0.39 | 0.63 | 0.98 | 0.03 | 0.07 | 0.07 | 0.09 | 0.40 | 0.48 |
| CD (P=0.05) | NS | 1.82 | 2.83 | NS | 0.21 | 0.20 | NS | 1.23 | 1.47 |
| CV (%) | 10.21 | 7.74 | 6.92 | 9.39 | 9.77 | 9.08 | 7.06 | 9.01 | 7.71 |
| **(II). Sub plot treatment (*rabi* green gram)** | | | | | | | | | |
| $S_1$ : Control | 22.61 | 39.03 | 74.65 | 2.09 | 3.60 | 3.81 | 3.23 | 14.52 | 21.02 |
| $S_2$ : 50 % RDF | 23.18 | 45.66 | 82.27 | 2.12 | 4.15 | 4.30 | 3.53 | 17.31 | 24.37 |
| $S_3$ : 75 % RDF | 23.83 | 53.71 | 91.11 | 2.17 | 4.78 | 4.86 | 3.87 | 18.87 | 26.19 |
| $S_4$ : 100 % RDF | 24.41 | 58.33 | 96.28 | 2.20 | 5.14 | 5.18 | 4.08 | 20.04 | 27.70 |
| SEm± | 0.34 | 0.53 | 0.76 | 0.03 | 0.06 | 0.06 | 0.07 | 0.30 | 0.36 |
| CD (P=0.05) | 0.95 | 1.48 | 2.13 | 0.09 | 0.17 | 0.17 | 0.19 | 0.86 | 1.04 |
| **Interaction (M x S)** | | | | | | | | | |
| SEm± | 0.73 | 1.12 | 1.62 | 0.07 | 0.13 | 0.13 | 0.15 | 0.68 | 0.81 |
| CD (P=0.05) | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| CV (%) | 9.26 | 6.84 | 5.66 | 9.09 | 8.67 | 8.78 | 8.03 | 7.66 | 6.55 |
| General mean | 23.51 | 49.18 | 86.08 | 2.14 | 4.42 | 4.53 | 3.68 | 17.68 | 24.82 |

**Table 2: Residual effect of integrated nutrient management in finger millet on yield of summer green gram (2 year Pooled data)**

| Treatment | Number of pods/plant | Seed index (g) | Seed yield/plant(g) | Seed yield (kg/ha) | Stover yield (kg/ha) | Harvest index (%) |
|---|---|---|---|---|---|---|
| **(I). Main plot treatment (*kharif* finger millet)** | | | | | | |
| General RDF (RDF + FYM @ 10 t/ha) | 22.17 | 4.21 | 5.18 | 1023 | 2603 | 28.13 |
| % RDN through chemical fertilizer + 25% RDN through biocompost | 20.43 | 3.93 | 4.72 | 943 | 2373 | 28.35 |
| : 75% RDN through chemical fertilizer + 25% RDN through vermicompost | 21.07 | 4.00 | 4.91 | 972 | 2422 | 28.54 |
| $T_4$: 75% RDN through chemical fertilizer + 25% RDN through FYM | 19.80 | 3.87 | 4.53 | 915 | 2323 | 28.14 |
| $T_5$: Control | 18.36 | 3.73 | 4.10 | 851 | 2212 | 27.73 |
| SEm± | 0.27 | 0.06 | 0.08 | 13.97 | 30.38 | 0.38 |
| CD (P=0.05) | 0.78 | 0.17 | 0.22 | 40.47 | 87.98 | NS |
| CV (%) | 8.40 | 9.20 | 10.09 | 9.06 | 9.32 | 9.25 |
| **(II). Sub plot treatment (*rabi* green gram)** | | | | | | |
| $S_1$ : Control | 15.55 | 3.48 | 3.25 | 726 | 2011 | 26.58 |
| $S_2$ : 50 % RDF | 18.75 | 3.79 | 4.21 | 869 | 2262 | 27.82 |
| $S_3$ : 75 % RDF | 22.49 | 4.15 | 5.32 | 1035 | 2552 | 28.90 |
| $S_4$ : 100 % RDF | 24.68 | 4.36 | 5.97 | 1133 | 2722 | 29.41 |
| SEm± | 0.25 | 0.05 | 0.06 | 12.12 | 34.62 | 0.41 |
| CD (P=0.05) | 0.71 | 0.15 | 0.17 | 34.09 | 97.40 | 1.14 |
| **Interaction (M x S)** | | | | | | |
| SEm± | 0.54 | 0.11 | 0.13 | 25.76 | 1.33 | 0.87 |
| CD (P=0.05) | NS | NS | NS | NS | NS | NS |
| CV (%) | 7.63 | 8.43 | 8.39 | 8.25 | 7.56 | 8.12 |
| General mean | 20.37 | 3.95 | 4.69 | 941 | 28.08 | 28.18 |

## CONCLUSION

On the basis of experimental results, finger millet crop should be nourished with RDF i.e. 40 kg nitrogen and 20 kg $P_2O_5$ through chemical fertilizer along with 10t/ha FYM reported promising residual effect on yield and yield attributing characters of succeeding green gram crop in finger millet-green gram cropping sequence under hilly area of south Gujarat.

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