Original Research Article

Nutrient Management Strategies for Groundnut-Blackgram Cropping Sequences

ABSTRACT

Aims: To refine nutrient management practices for the groundnut-blackgram cropping sequence, focusing on enhancing both yield and quality.

Study design: The experiment was conducted in a split-plot design with three replications

Place and Duration of Study: Regional Research Station in Vridhachalam during the Kharif and rabi season of 2016-17.

Methodology: The experimental treatments encompassed various nutrient levels applied to groundnut in the main plots: M1-Control, M2-100% RDF, M3-125% RDF, and M4-150% RDF. Additionally, different nutrient levels were applied to the blackgram subplot: S1-Control, S2-50% RDF, S3-75% RDF, and S4-100% RDF.

Results: Analysis of the results indicated a significantly higher pod yield (2657 kg/ha) for groundnut when 125% RDF. Notably, the control group recorded a significantly lower pod yield. Subsequent blackgram seed yield was notably influenced by inorganic fertilizers applied to the preceding groundnut crop. In blackgram, the application of 75% RDF resulted in a higher number of pods per plant (34.6), No. of branches/plant (7.8) and seed yield (823 kg/ha. This performance was comparable to the application of 100% RDF. Conversely, the control group exhibited a significantly lower seed yield.

Conclusion: The experimental design employed a split-plot layout, replicated three times. These findings underscore the importance of optimizing nutrient management practices, particularly the combination of 125% RDF for groundnut, to enhance pod yield, while the application of 75% RDF demonstrated positive effects on subsequent blackgram seed yield.

Keywords: *Groundnut, Blackgram, fertilizers, Cropping Sequences*

1. INTRODUCTION

The groundnut-blackgram system has played a significant role in bolstering oil and pulses production, contributing to achieving food self-sufficiency and security. However, this system faces imminent threats as crop productivity stagnates or declines, raising concerns about sustainability. Nutrient management on farmlands emerges as a critical factor influencing both crop production and environmental preservation [1]. Oil-bearing crops, being energy-rich, demand substantial nutrition for optimal production. While the use of chemical fertilizers represents a swift response to counteract nutrient depletion from the soil, challenges such as escalating costs, adverse environmental impacts, and unpredictable availability deter farmers from employing the necessary nutrients in balanced proportions [2]. On average, a mere 52.5 kg/ha of nitrogen, phosphorus, and potassium (NPK) nutrients are applied in oilseeds, in stark contrast to the 140 kg/ha for rice and 160 kg/ha for wheat [3]. This discrepancy in fertilization practices, coupled with insufficient replenishment of native soil nutrient reserves, has given rise to multinutrient deficiencies, resulting in reduced factor productivity of applied nutrients and a simultaneous decline in the overall productivity of various crops, including oilseeds, in India [4].

The fertilizer requirements of a crop within a specific cropping system are intricately tied to various factors, including the characteristics of the preceding crop, the nutrient-supplying capacity of the soil, and the types and quantities of manure and fertilizers applied. In Tamil Nadu, the Groundnut-Blackgram cropping sequence has evolved into an established and vital component of the agricultural landscape. Blackgram, with its shallow rooting pattern, demands a generous application of primary nutrients. Conversely, Groundnut exhibits robust growth, efficiently progressing through various phenophases within a short timeframe, and effectively utilizing both applied and residual nutrients due to its deep-rooting growth habit. However, the continuous cultivation of such an exhaustive cropping system can lead to the depletion of nutrients from soil reserves, posing a risk to sustainability without adequate restorative practices. It is imperative to assess the nutrient requirements of the entire cropping system as a holistic entity, moving away from the conventional focus on individual crop fertilizer requirements in the current era of exploitative agriculture [5].

The current practice of uniformly applying fertilizers represents a generalized approach, neglecting the vital carryover effects of manures and fertilizers to subsequent crops. To enhance fertilizer use efficiency, a more targeted strategy involves adopting nutrient management practices that consider the entire cropping system rather than individual crops. The Groundnut-Black Gram cropping system, known for its high productivity and economic returns, demands refined fertilizer requirements. This is crucial not only for increasing productivity but also for fostering sustainability, eco-friendliness, and comparative profitability. In response to these imperatives, efforts have been directed towards developing an integrated nutrient supply system. This initiative aims to optimize the utilization of residual and cumulative soil nutrient balances, combined with judicious applications of added fertilizers within the Groundnut-Black Gram cropping sequence. The objective is to establish a sophisticated nutrient management approach that reflects the comparative capability of the system, paving the way for a more productive, sustainable, and economically rewarding agricultural paradigm.

2. MATERIALS AND METHODS

Field experiments was, encompassing both *Kharif* and Rabi seasons (2016-17) conducted at the Regional Research Station of Tamil Nadu Agricultural University in

Vridhachalam (110°30' N, 79°26' E, 42.67 m altitude). The primary objective was to formulate an effective nutrient management package tailored for the groundnut-blackgram cropping system. The average precipitation during the crop-growing seasons totaled 1127 mm, distributed across 48 rainy days. The experimental field's soil, characterized as sandy loam, exhibited low availability of nitrogen (225 kg/ha), moderate availability of phosphorus (12.5 kg/ha), and high availability of potassium (238 kg/ha). The soil pH stood at 6.7, with an organic carbon content of 0.23%.

The field experiment adopted a split plot design with three replications, focusing on the groundnut-blackgram cropping system. Groundnut fertility levels constituted the main plot treatments, including Control, 100% RDF (25:50:75 kg NPK/ha), 125% RDF, and 150% RDF. The blackgram subplot treatments comprised Control, 50% RDF, 75% RDF, and 100% RDF (25:50:25 kg NPK/ha). Sub-plots were sized at 21 m^2 (5 m × 4.2 m), and these treatments were applied to the groundnut crop during the Kharif season. Seed treatment with Rhizobium biofertilizer was integrated into the integrated nutrient management (INM) practices. During the Kharif season, groundnut (VRI 2) was sown in mid-July with a spacing of 30 cm (intra-row) x 10 cm (intra-plant) and a seed rate of 120 kg ha^{-1}. Harvesting occurred in the last week of October. Following this, the experimental site was irrigated for field preparation, and blackgram (VBN 3) was sown in the Rabi season at a spacing of 30 cm x 10 cm with a seed rate of 20 kg ha^{-1}. Crop management practices adhered to the assigned treatments. At harvest, various growth and yield components were assessed, including plant height (cm), dry matter production (DMP) at harvest, number of mature pods per plant, test weight (g), shelling percentage, pod yield (kg/ha). These metrics provided a comprehensive evaluation of the cropping system's performance. The assessment of growth and yield attributes was conducted at harvest by peg-marking five plants in each treatment within all three replications. Groundnut crops were harvested at 105 days, and the pod yield was quantified as the total yield per plot, subsequently transformed into kg/ha for analysis. Statistical analysis followed the methodology outlined by Gomez and Gomez (2010). A two-way analysis of variance (ANOVA) was employed to discern significant differences among the intercropping systems and nutrient management practices.

3. RESULTS AND DISCUSSION

3.1. Groundnut

The significant variations in pod yield attributed to inorganic fertilizers, with the highest yield (2657 kg/ha) recorded in the 125% recommended dose of fertilizers (RDF) treatment. The substantial increase in yield under 125% RDF was attributed to a higher number of mature pods per plant (27.3). The combined application of organic and inorganic nutrient sources enhanced overall crop growth, encompassing dry-matter production, morphological and photosynthetic components, and nutrient accumulation.

This improvement in nutrient availability and metabolites likely contributed to the growth and development of reproductive structures, ultimately resulting in higher individual plant productivity. Consistent with previous research by [6] findings underscore the positive impact of integrated nutrient management on crop productivity.

Furthermore, other growth and yield attributes, such as plant height and dry matter production (DMP) at harvest, exhibited significant improvements with the application of 150% RDF. This treatment recorded higher plant height (78 cm) and increased DMP (57.1 g/plant) at harvest. The notable increase in plant height, attributed to the application of recommended doses of fertilizers, likely stems from cell and internodal elongation, promoting vegetative growth, and positively correlating with the plant's productive potential, as highlighted in previous studies by [7] in groundnut.

3.2. Blackgram

The seed yield data for blackgram exhibited significant variations influenced by different Recommended Dose of Fertilizers (RDF) applied to groundnut and fertilizer doses imposed on blackgram (Table 2). The notably highest seed yield for blackgram was recorded with 75% recommended dose of fertilizers, amounting to 823 kg/ha, followed closely by the 100% RDF treatment yielding 771 kg/ha. The remarkable increase in yield with 75% RDF was attributed to superior growth and yield parameters, including the number of branches per plant (7.8), number of pods per plant (34.6), and number of seeds per pod (7.2). The robust growth, characterized by increased plant height and branch numbers, ensured an ample supply of photosynthates for sink development, reflecting overall enhanced growth performance and higher values of yield attributes under this treatment. Growth regulators played a role in influencing blackgram crop grain yield, as corroborated by [8] who highlighted significant variations in seed yield based on preceding groundnut crop fertilizer application methods. The cumulative effects of improved growth and yield parameters, along with enhanced nutrient uptake, likely contributed to the increased grain yield potential of the crop. Furthermore, an increase in RDF fertilizer levels during Kharif groundnut cultivation resulted in a gradual and significant increase in the seed yield of Rabi blackgram. The application of 125% RDF significantly higher seed yield, while the control treatment exhibited comparatively lower yields in the preceding groundnut crop.

4. Conclusion

Based on the study, it is evident that both the direct and residual effects of inorganic fertilizer sources play a pivotal role in significantly increasing pod yield and seed yield. Notably, the treatment that stood out was the one receiving 125% Recommended Dose of Fertilizer (RDF). In the case of blackgram, the application of 75% RDF yielded the most favorable results. Conversely, the control group exhibited the lowest pod and seed yields. These findings highlight the critical importance of optimizing nutrient management practices. Specifically, the synergistic application of 125% RDF proves to be highly beneficial for enhancing groundnut pod yield. Simultaneously, the application of 75% RDF demonstrates positive effects on subsequent blackgram seed yield. In conclusion, the study underscores the significance of tailored nutrient management strategies, emphasizing the need for a balanced approach involving inorganic fertilizers. These insights can guide farmers and agricultural practitioners in maximizing crop yields and ensuring sustainable and efficient farming practices.

REFERENCES

1. Prasad R. Efficient fertilizer use: The key to food security and better environment. Journal of Tropical Agriculture, 2009, 47 (1–2):1–17
2. Babu S, Rana DS, Yadav GS, Singh R, Chettri T K. Effect of sunflower stover and nutrients management on soil biological properties and available nitrogen and phosphorus at different stages of pigeonpea growth under pigeonpea-sunflower cropping system. African Journal of Plant Sciences, 2015. 9 (6):264–73.
3. Tiwari K N. Future plant nutrition research in India. Journal of the Indian Society of Soil Science, 2008, 56 (4):327–36
4. Suresh G, Murthy I Y L N, Sudhakara Babu S N, Varaprasad K S. An overview of Zn use and its management in oilseed crops. Journal of SAT Agricultural Research, 2013. 11:1–11.
5. Fustec, J, Lesuffleur F, Mahieu S, Cliquet J B. Nitrogen rhizodeposition of legumes. A Review. Agronomy for Sustainable Development, 2010, 30:57–66.
6. Premalatha BR, Angadi V V. Influence of integrated nutrient management and leaf color chart (LCC) based nitro-gen management in rice (Oryza sativa L.) yield and yield attributes, nitrogen uptake and soil available nitrogen status. Environment and Ecology 35(3B): 2017, 2,012–2,020
7. Bharath T, Vidyasagar GE, Ch Rao VP, Reddy SN, Madhavi A. Residual effect of organic manures and fertilizer levels to preceding maize on the nutrient uptakes of succeeding groundnut. International Journal Pure Applied Bioscience.2017;5(4):409-417
8. Geetha P, Velayutham A. Yield attributes, yield and uptake of nutrients as influenced by basal and foliar application of nutrients on rice fallow blackgram, Indian Journal of Agricultural Research, 2016, 50 (2): 122-125

Table 1. Effect of nutrient management practices on the growth, yield attributes and nutrient status of groundnut under groundnut – blackgram cropping system

Treatments	Plant height (cm)	DMP at harvest	No. of mature pods/plant	Test weight (g)	Shelling %	Pod yield (kg/ha)
Nutrient levels of groundnut						
Control	48.3	40.6	20.2	42.6	71.5	1372
100% RDF	58.6	46.0	24.6	44.2	72.9	2557
125 % RDF	64.5	48.6	27.3	44.7	74.2	2657
150% RDF	71.7	52.5	22.7	45.4	74.0	2107
S.Ed.	1.07	0.85	0.48	0.73	1.94	40.65
CD (0.05)	2.67	2.12	1.25	NS	NS	101.40
Nutrient levels of blackgram						
Control	52.1	37.6	20.0	43.8	72.2	1990
50% RDF	60.5	46.6	22.2	44.0	72.8	2112
75% RDF	63.6	50.4	24.4	44.4	74.2	2231
100 % RDF	66.2	52.9	28.2	44.8	73.5	2360
S.Ed.	1.76	1.31	0.66	0.63	2.92	60.25
CD (0.05)	3.63	2.73	1.41	NS	NS	125.0

Table 2. Effect of nutrient management practices on the growth, yield attributes and nutrient status of blackgram under groundnut – blackgram cropping system

Treatments	Plant height (cm)	No. of branches/ plant	No. of pods/ plant	No. of seeds/ pod	Test weight (g)	Grain yield (kg/ha)
Nutrient levels of groundnut						
Control	20.1	6.0	21.4	5.9	4.4	443
100% RDF	27.0	7.4	29.6	6.8	4.6	671
125 % RDF	30.3	7.7	34.2	7.1	4.6	710
150% RDF	33.1	7.4	28.4	6.7	4.6	640
S.Ed.	0.45	0.16	0.53	0.16	0.08	12.79
CD (0.05)	1.15	0.44	1.23	0.40	NS	32.09
Nutrient levels of blackgram						
Control	22.1	5.7	20.1	5.5	4.4	338
50% RDF	27.4	7.3	26.9	6.8	4.6	540
75% RDF	29.4	7.8	34.6	7.2	4.7	823
100 % RDF	30.5	7.7	32.1	7.0	4.7	771
S.Ed.	0.74	0.25	0.77	0.24	0.13	17.57
CD (0.05)	1.55	0.53	1.60	0.51	NS	36.45