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Effect of Integrated Nutrient Management in Black Gram for its Yield and Quality in Coimbatore Tamil Nadu, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment on integrated nutrient management practices for the field trial was conducted on a research farm at Karunya Institute of Technology and Sciences School of Agricultural Sciences. This experimental study was carried out in 2022-2023 during the *Rabi* seasons respectively. Black gram is one of the important pulse crops, grown throughout the country. There were 10 different treatment studies were implemented using a randomized block design. The results of the comparative analysis of the various treatments have highly stated that 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria+ Foliar spray of 1% TNAU Pulse wonder @ 30 and 45 DAS T_7 is conducive for the cultivation of Blackgram (Vamban-8) with significant economics of production.

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1. INTRODUCTION

The major effect of the green revolution is that our agriculture has become chemicalized. As the availability of land is decreasing day by day, the application of fertilizers has become necessary to meet the demand for food grains. The effect of prolonged overuse of chemicals on soil has resulted in human health hazards and pollution of the environment.

Food Security, nutritional security, sustainability and profitability are the main focus of present and future agricultural development. With the current food production level of 203 million tonnes (mt), India has to step up food grain production by the next decade to feed the burgeoning population. The production of 1t ha^{-1} of cereal grain means removal of about 20 kg N ha^{-1} and 4 kg P ha^{-1}. With the possibility of horizontal expansion or putting more land under cultivation being remote, future augmentation in yield would have to be harnessed vertically through judicious management of all the input resources.

The basic concept of an integrated plant nutrient system is the maintenance and improvement of soil fertility for sustaining crop productivity on a long-term basis. This may be achieved through the combined use of all-natural resources and nutrients and their scientific management for the optimum growth of crops. This practice not only ensures a reduced burden on chemical fertilizers but also a balanced use of natural resources coupled with chemical fertilizers to supply micronutrients and quality assurance behind maintaining soil fertility.

“Pulses are given second importance after cereals and pulses crop is rich in protein, fibres, vitamins and minerals such as magnesium, iron, and zinc and low in fat, making them a great addition to any diet that plays a very important role in the diet of humans, especially in Indian people which are not able to supply their body protein due to being vegetarian. In the northern part of the country black gram is grown in kharif or summer only while in the eastern and southern parts of India it is grown in the *rabi* season and sometimes grow as a green manuring crop. Black gram stands next to soybean in its dietary protein content and Madhya Pradesh, Uttar Pradesh and Andhra Pradesh are major black gram growing states in India” [1].

“ Black gram is consumed as a peeled and un-peeled form of “daal” with roti and boiled rice or other delicious food items can be prepared like idli, dosa, papad, bara, karhi, pudding, halva and imurthi (sweat), For animal purpose whole black gram plant used as a nutritive fodder. There are numerous reasons responsible for the lower productivity of black gram. Among them, poor weed and fertilizer management are major factors contributing to low yields of black gram. In the current intensive cropping system, it is not easy to maintain productivity and protection of the environment for long. Unless we create a balance between the nutrients removal by crop from the soil and applied nutrients this balance can be made possible by changing our present agricultural system in which our crop is committed to taking nutrition from the different sources. The exact application of fertilizer and manure to the crop is based on the soil testing, field trials and nutrient balances under the specific soil crop situation. Balance nutrition does not mean only adding nutrients from outside but also including that nutrients that are present already in the soil” [1].

“Black gram is an important source of green manure crop when incorporated into the soil to allow the release of nutrients from the green manure and make them available to the later growing crops. Incorporation of black gram leads to several beneficial effects on soil like improvement in soil structure (i.e. by aggregation). Organic matters enhance water infiltration, retention, and soil aeration and reduce erosion. Biofertilizers are products containing one or more carrier-based living species of microorganisms. The living micro-organism is capable of augmenting plant nutrient supplies in one way or another way. Integration of manures and Biofertilizer with inorganic fertilizer proved to be better for higher crop yield as well as maintaining soil health” [1].

In this study at the Karunya farm, an investigation was carried out with the working title "Effect of Integrated Nutrient Management in Blackgram (Vamban-8) for its yield and quality in Coimbatore Tamilnadu". The integrated nutrient management method combines the use of diverse sources of plant nutrients such as

chemical fertilizers, biological sources of nutrients, organic manures, green manure and crop residues aid to in maintaining soil health and sustaining crop output. It also provides practically all the nutrient in judicious method to crop and boost fertilizer use efficiency and so help environment conservation by minimizing pollution.

2. REVIEW OF LITERATURE

In the future, the use of renewable energy sources, which may be a good substitute for chemical fertilizers, will be a major limiting factor in agricultural productivity.

2.1 Effect of Integrated Nutrient Management (INM) on Growth and Yield of Black Gram

When compared to global efficiency, India's poor yields are due to a lack of access to high-value seeds of enhanced and short-term varieties, growing in minimum and less-rich soil with low data sources and without bug and infection across the board, developing under dampness stress, informal post-harvest methods, and capacity under adverse conditions. As a result, the use of inorganic and bio-fertilizers has the potential to increase the yield of this crop. India has made incredible progress in fertiliser production and use over the last four decades.

Chemical fertilizers are not accessible at a reasonable price to farmers due to rising energy costs. Besides, the awkwardness and proceeded with utilization of synthetic manures adversely affect the physical, substance, and organic parts of soil, diminishing yield creation maintainability, as well as representing a well-being and ecological risk. Chemical composts are fundamental for meeting the harvest's nourishing prerequisites. Supplement exhaustion is turning into a more serious issue for maintainable agribusiness. Therefore, limiting the utilization of substance manures while expanding the utilization of organics to keep up with creation and quality standards is basic. Because of their poor nourishing status, organics alone don't bring about a critical improvement in crop yields. Because of the previously mentioned ramifications, dark gram may now be developed utilizing both inorganic and biofertilizers.

Biofertilizers are all the more harmless to the ecosystem in nature. They can assume a key part in fixing climatic nitrogen and plant advancement advertisers, as well as making phosphorus accessible to plants, by causing a good change in the dirt microenvironment, bringing about the solubilization of insoluble natural phosphate sources. Microbial natural acids can disintegrate fixed phosphate and make it available for plants. Since insoluble phosphate, which isn't promptly available to plants, represents 95-99 per cent of complete soil phosphorus, the utilization of bio-composts is basic.

Keeping the factors the objective of this study was framed to be

1. To optimize the yield of black gram by using different nutrient management strategies**.**
2. To work out the economics of black gram under different nutrient management practices.
3. To study the impact of different nutrient management practices on the growth and yield of black gram

3. METHODOLOGY

3.1 Experimental Site

The field trial was conducted during 2022-2023 on the South farm of Karunya Institute of Technology and Sciences. The terrain of the experimental plot is relatively uniform with good drainage. The research area of field experiments was with all physical facilities the analysis was done in the laboratories of the Karunya Institute of Technology and Sciences School of Agricultural Sciences.

3.2 Area of Research

Geographically the Karunya South Farm, Tamil Nadu is located on the south bank of the Noyal River at 10.948' latitude, 74.7465' longitude.

3.3 Climatic Condition

It thrives in areas that are classified as subtropical and include average annual precipitation, warm and muggy summers, and harsh winters. In most years, the monsoon season starts around the third or fourth week of June and continues through September. During the time frame in question, a total of 326.6 millimetres of precipitation was accumulated. The average high temperature was 31.12 degrees Celsius, while the average low temperature was

23.56 degrees Celsius. It was noted that the average maximum relative humidity was 76.35%, while the average lowest relative humidity was 53.49%. The average annual precipitation is around 523 millimetres, with 412.13 millimetres falling between the middle of July and the middle of October and the remaining rainfall occurring in the winter between the third week of December and the first quarter of January. The average maximum temperature in December is 26.18 degrees Celsius, while the average lowest temperature is 19.15 degrees Celsius, making it the coldest month of the year. Temperatures begin to fall during the final two weeks of October and continue until the end of December or the beginning of January when they reach their lowest point. Similarly, it begins to rise towards the end of February and continues to climb until it reaches its highest point in May and June.

Treatments were randomly assigned in three replicates. The preparation of land with the help of a tractor-drawn cultivator and make suitable layout and sowing of crop. oil of the experimental site was slightly calcareous and moderately fertile. All observation related to crop growth takes on different growing stages of the crop with five selected plant of each treatment while soil samples were collected after harvesting of black gram crop from the experimental site and all soil samples were analysed as per the method given by Walkley and Black [2] in soil laboratory for different soil parameters. The result of observed data was analyzed with the standardized principle of statistical ANOVA techniques described by Gomez and Gomez [3] at a 5% level of significance.

3.4 Sowing Season

The experiment was carried out in 2022-2023 during the *Rabi* season at a south farm in Karunya Institute of Technology and Sciences, Division of Agronomy Coimbatore. The following table provides the dates for both planting and harvesting: [4]

Tables 1. Physical composition

S. No	Composition	Percent
1.	Clay	25.62
2.	Silt	21.52
3.	Sand	45.62
4.	Bulk density (gcc^{-1})	1.12
5.	Textural Classification	Silty Clay Loam

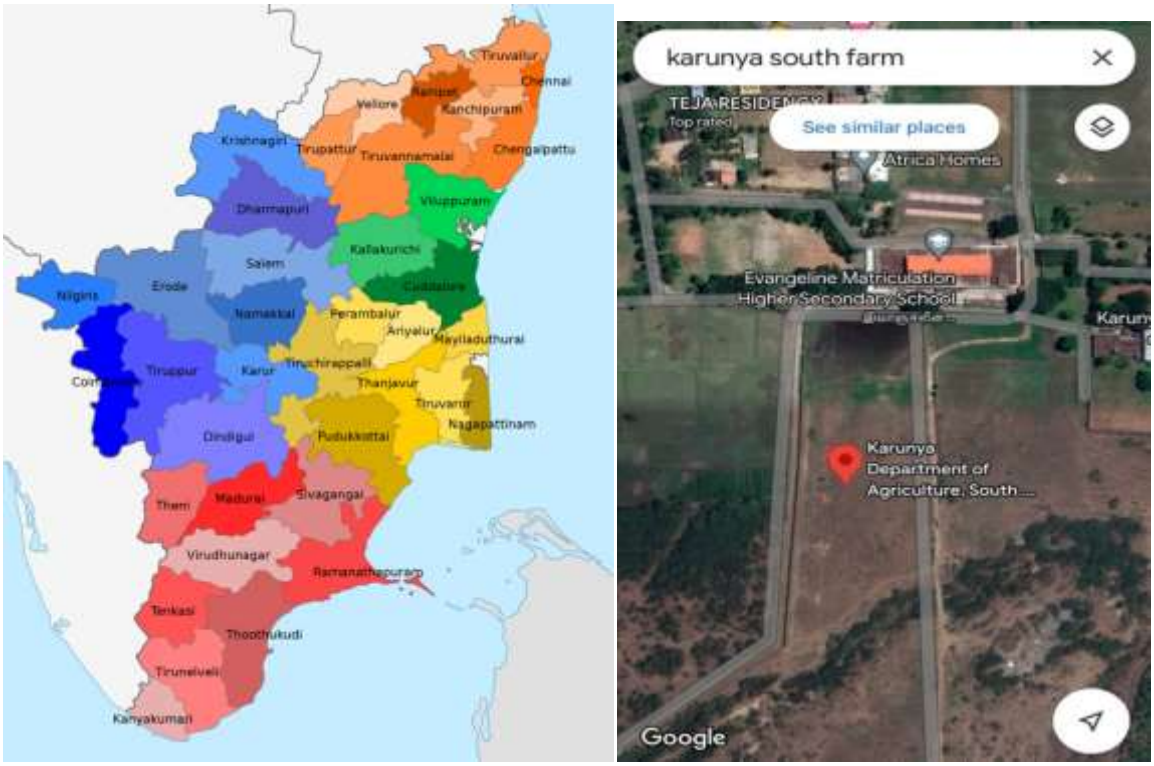

Fig. 1. Experimental Site location During rabi season 2022-2023

Tables 2. Sowing seasons

S.No	Season	Date of Sowing	Year	Date of Harvesting
1.	*Rabi*	04.11.2022	2022-2023	10.01.2023

Table 3. Treatment details

Sl.NO	TREATMENTS
T_1	RDF (25:50:25 kg of N, P_2O_5 & K_2O ha^{-1} applied as basal)
T_2	RDF + Foliar spray of 1% TNAU Pulse wonder (@ 5 kg ha^{-1} at peak flowering)
T_3	RDF + Foliar spray of 1% urea @ 30 and 45 DAS
T_4	RDF + Foliar spray of 1% Nano urea @ 2ml $litre^{-1}$ 30and 45 DAS
T_5	RDF + Foliar spray of 2% DAP @ 30 and 45 DAS
T_6	75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria
T_7	75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria+ Foliar spray of 1% TNAU Pulse wonder @ 30 and 45 DAS
T_8	75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of 1% urea @ at 30 and 45 DAS
T_9	75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of 1% Nano urea@ 2ml $litre^{-1}$ 30 and 45 DAS
T_{10}	75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of 2% DAP @ 30 and 45 DAS

4. RESULTS AND DISCUSSION

4.1 Effect of Foliar and Soil Application of Nutrients on Plant Height (cm) of Irrigated Black Gram (*Vigna mungo*)

Height typically grows during the many phases of the crop's development, reaching its peak when it is ready to be harvested. It was found that the same thing happened periodically at 20, 40, and 60 DAS. These findings have been compiled [5].

The given above explains the plant growth that was attained based on the differences of treatment given in the study. The maximum height of the nodule dry height was significantly higher in the T_7 treatment which has both the combination of 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria+ Foliar spray of 1% TNAU Pulse wonder [6].

The control group has a significantly lower growth rate when compared to any other treatment involved in the study which was measured to be at 18.42 at 20 DAS, 28.3 at 40 DAS and 37.2 at 60 DAS. The application of the 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria+ Foliar spray of 1% TNAU Pulse wonder has made significant differences with the control group but the values of the growth are significantly below than the T_7 treatment that has attained the highest growth rate [7].

4.2 Effect of foliar and Soil Application of Nutrients on Dry Matter Production (kg ha^{-1}) of Irrigated Black Gram (*Vigna mungo*)

The observed data about the mean dry matter production of black gram crop, which was modified by integrated nutrients management, was collected on a periodic basis and has been provided here [8].

The table given above explains the plant weight that was attained based on the differences of treatment given in the study. The maximum weight of the nodule dry weight was significantly higher in the T_7 treatment which has both the combination of 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria+ Foliar spray of 1% TNAU Pulse wonder [9].

The control group has significantly lower weight when compared to any other treatment involved in the study which was measured to be at 407at 20 DAS, 1242 at 40 DAS and 4205 at 60 DAS. The application of the 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria+ Foliar spray of 1% TNAU Pulse wonderT_7 has made significant differences with the control group but the values are not changed [10].

Table 4. Effect of foliar and soil application of nutrients on plant height (cm) of irrigated black gram (*Vigna mungo*)

Treatments	20 DAS	40 DAS	60 DAS
T_1 - RDF (25:50:25 kg of N, P_2O_5 & K_2O/ha applied as basal)	16.5	23.9	29.3
T_2 - RDF + Foliar spray of 1% TNAU Pulse wonder @ 5 kg ha^{-1} at 30 and 45 DAS	17.4	25.4	34.7
T_3 - RDF + Foliar spray of 1% urea at 30 and 45 DAS	16.9	25.1	33.3
T_4 - RDF + Foliar spray of Nano urea @ 2ml $litre^{-1}$ of water at 30and 45 DAS	16.8	26.5	32.5
T_5 - RDF + Foliar spray of 2% DAP @ 30 and 45 DAS	17.3	24.7	35.2
T_6 - 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria	17.5	25.6	30.7
T_7 - 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of 1% TNAU Pulse wonder at 30and 45 DAS	18.4	28.3	37.2
T_8 - 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of 1% urea at 30 and 45 DAS	17.7	27.6	36.3
T_9 - 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of Nano urea @ 2ml $litre^{-1}$ of water at 30 and 45 DAS	18.1	28	36.8
T_{10} - 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of 2% DAP @ 30 and 45 DAS	17.8	27.5	35.9
Mean	17.4	26.3	34.2
SE d	0.69	1.36	1.62
CD (p=0.05)	1.44	2.86	3.40

Table 5. Effect of foliar and soil application of nutrients on dry matter production (kg ha^{-1}) of irrigated black gram (*Vigna mungo*)

Treatments	20 DAS	40 DAS	60 DAS
T_1 - RDF (25:50:25 kg of N, P_2O_5 & K_2O/ha applied as basal)	335	803	2962
T_2 - RDF + Foliar spray of 1% TNAU Pulse wonder @ 5 kg ha^{-1} at 30 and 45 DAS	390	1201	3715
T_3 - RDF + Foliar spray of 1% urea at 30 and 45 DAS	357	1013	3487
T_4 - RDF + Foliar spray of Nano urea @ 2ml $litre^{-1}$ of water at 30and 45 DAS	360	988	3554
T_5 - RDF + Foliar spray of 2% DAP @ 30 and 45 DAS	368	945	3496
T_6 - 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria	353	912	3307
T_7 - 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of 1% TNAU Pulse wonder at 30and 45 DAS	407	1242	4205

T_8 - 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of 1% urea at 30 and 45 DAS	370	1170	3782
T_9 - 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of Nano urea @ 2ml litre^{-1} of water at 30 and 45 DAS	386	1208	4043
T_{10} - 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of 2% DAP @ 30 and 45 DAS	374	1169	3871
Mean	370	1065	3642
SE d	24.9	46.8	194.9
CD (p=0.05)	52.3	98.4	409.5

4.3 Effect of foliar and soil application of nutrients on Crop growth rate (CGR) of irrigated black gram (*Vigna mungo*)

The results of the different types of nutrient management that were performed on CGR were documented, and both the results and the observations have been reported in following table [11].

The maximum growth rate was considerably greater in the T_7 treatment, which contains both the mixture of 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria+ Foliar spray of 1% TNAU Pulse wonder. this treatment has made it possible to achieve statistically significant changes in the growth rate of the crop at 20-40 DAS, the growth rate of the crop was estimated to be 5.22 grams. This was confirmed by growth of 4.64 grams at 40 - 60 DAS [12].

4.4 Effect of Foliar and Soil Application of Nutrients on Number of Branches plant^{-1} of Irrigated Black Gram (*Vigna mungo*)

The study has observed the number of branches let out by the plant based on the differences in the treatment that were provided using different combinations of foliar spray and bio-fertilizers [13].

Table 6 : Effect of foliar and soil application of nutrients on Crop growth rate (CGR) of irrigated black gram (*Vigna mungo*)

Treatments	20 – 40 DAS	40 – 60 DAS
T_1 - RDF (25:50:25 kg of N, P_2O_5 & K_2O/ha applied as basal)	3.18	2.12
T_2 - RDF + Foliar spray of 1% TNAU Pulse wonder @ 5 kg ha^{-1} at 30 and 45 DAS	4.96	4.38
T_3 - RDF + Foliar spray of 1% urea at 30 and 45 DAS	3.39	3.33
T_4 - RDF + Foliar spray of Nano urea @ 2ml litre^{-1} of water at 30and 45 DAS	4.02	3.07
T_5 - RDF + Foliar spray of 2% DAP @ 30 and 45 DAS	3.65	3.51
T_6 - 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria	3.58	3.40
T_7 - 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of 1% TNAU Pulse wonder at 30and 45 DAS	5.22	4.64
T_8 - 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of 1% urea at 30 and 45 DAS	4.37	4.19
T_9 - 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of Nano urea @ 2ml litre^{-1} of water at 30 and 45 DAS	4.63	4.45
T_{10} - 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of 2% DAP @ 30 and 45 DAS	4.51	4.27
Mean	4.15	3.74
SE d	0.21	0.23
CD (p=0.05)	0.43	0.49

Table 7 . Effect of foliar and soil application of nutrients on Number of branches plant^{-1} of irrigated black gram (*Vigna mungo*)

Treatments	60 DAS
T_1 - RDF (25:50:25 kg of N, P_2O_5 & K_2O/ha applied as basal)	3.66
T_2 - RDF + Foliar spray of 1% TNAU Pulse wonder @ 5 kg ha^{-1} at 30 and 45 DAS	5.77
T_3 - RDF + Foliar spray of 1% urea at 30 and 45 DAS	5.09
T_4 - RDF + Foliar spray of Nano urea @ 2ml litre^{-1} of water at 30and 45 DAS	5.21
T_5 - RDF + Foliar spray of 2% DAP @ 30 and 45 DAS	5.33
T_6 - 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria	4.96
T_7 - 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of 1% TNAU Pulse wonder at 30and 45 DAS	5.81
T_8 - 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of 1% urea at 30 and 45 DAS	5.61
T_9 - 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of Nano urea @ 2ml litre^{-1} of water at 30 and 45 DAS	5.72
T_{10} - 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of 2% DAP @ 30 and 45 DAS	5.62
Mean	5.28
SE d	0.27
CD (p=0.05)	0.57

5. YIELD ATTRIBUTES

5.1 Effect of Foliar and Soil Application of Nutrients on Pods Plant $^{-1}$, Length of the Pod, and 1000 Grain Weight

The various attributes of the crop yield are estimated based on the treatment effects on the Blackgram (Vamban-8) and this will enable us to examine the best treatment for the growth of the crop [14].

The yield attributes of the Blackgram reveal variations in treatment that were attained in the research was presented using the graph and table that have been provided above. The Pods Plant^{-1}, Length of the Pod, and 1000 grain Weight were considerably higher in the T_7 treatment, which contains both the mixture of 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of 1% TNAU Pulse wonder [15].

Table 8. Effect of foliar and soil application of nutrients on pods plant $^{-1}$, length of the Pod, and 1000 grain weight

Treatment Details	Pods Plant $^{-1}$	Length of the Pod	1000 grain Weight
T_1	15.53	4.18	4.08
T_2	20.44	4.85	4.53
T_3	16.08	4.33	4.35
T_4	16.84	4.27	4.13
T_5	17.49	4.45	4.26
T_6	18.45	4.57	4.30
T_7	21.22	4.98	4.62
T_8	19.12	4.80	4.41
T_9	20.13	4.90	4.54
T_{10}	19.57	4.84	4.38
Mean	18.49	4.62	4.36
SE d	0.98	0.12	0.30
CD (p= 0.05)	2.06	0.26	0.63

5.2 Effect of Foliar and Soil Application of Nutrients on Grain Yield, Stover Yield and Harvest Index of Black Gram

The production of black gram was subjected to statistical analysis, and the results of this investigation have been compiled into the table [16].

The black gram variety tested with the various treatments has given significant results for determining the best chance to optimize the outputs. The above table has presented the grain yield, stover yield and harvest index of the crop involved in the study based on various treatments designed. The study has revealed that the mixture of 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria+ Foliar spray of 1% TNAU Pulse wonder framed as T_7 has been most effective among the choices [17].

5.3 Effect of Foliar and Soil Application of Nutrients on Economics of Production

The calculations and statistical examinations of data about gross return, net profit, and B:C ratio have been carried out [18].

5.3.1 Cost of cultivation

The black gram variety tested with the various treatments has given significant cost involved in the various types of treatment involved in the study [19]. The above table has presented the economics of products which involves cost of production, gross return, net return and B: C ratio attained based on differential treatments [20].

5.3.2 Gross return

The black gram variety tested reveals that the gross return of T_7 is higher when compared to the other treatment that are part of the study [21]. The role of bio-fertilizers and foliar spray plays a vital role in improving the yield and gross return of the crop. The overall gross return is significantly higher in the T_7 which is described by the outcome of the study [22].

5.3.3 Net return

When it comes to increasing both the yield and the net return of the crop, the bio-fertilizers and foliar spray play a significant part in the process. According to the findings of the research, the T_7 has a total net return that is much greater than the general average [23].

5.3.4 B: C ratio

The above table suggests that treatment 2 is effective but the returns can be increased in the T_7 based on economies of scale which is considered to be higher income generation among all treatment. The B:C also suggests T_7 has significant impact on the economics of the crop [24].

Table 9. Effect of foliar and soil application of nutrients on grain yield, stover yield and harvest index of black gram

Treatment Details	Grain Yield, Stover Yield and Harvest Index of Blackgram (Vamban-8)		
	Grain Yield	Stover Yield	Harvest Index
T_1	570	2068	21.6
T_2	752	2592	22.4
T_3	772	2408	24.2
T_4	845	2349	26.4
T_5	890	2251	28.3
T_6	886	2148	29.2
T_7	1185	2734	30.2
T_8	988	2567	27.7
T_9	1116	2642	29.6
T_{10}	995	2606	27.6
Mean	899	2437	26.72
SE d	42.5	133.2	3.02
CD (p= 0.05)	89.3	279.9	4.87

Table 10. Effect of foliar and soil application of nutrients on economics of production

Treatment Details		Cost of Cultivation	Grain Yield	Gross return	Net return	B:C
T_1	RDF (25:50:25 kg of N, P_2O_5 & K_2O ha^{-1} applied as basal)	30017	570	37050	7033	1.23
T_2	RDF + Foliar spray of 1% TNAU Pulse wonder (@ 5 kg ha^{-1} at peak flowering)	36034	752	48880	12846	1.35
T_3	RDF + Foliar spray of 1% urea @ 30 and 45 DAS	38074	772	50180	12106	1.31
T_4	RDF + Foliar spray of 1% Nano urea @ 30and 45 DAS	40354	845	54925	14571	1.36
T_5	RDF + Foliar spray of 2% DAP @ 30 and 45 DAS	42754	890	57850	15096	1.35
T_6	75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria	53690	886	57590	11167	1.24
T_7	75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria+ Foliar spray of 1% TNAU Pulse wonder @ 30and 45 DAS	64415	1185	77025	28062	1.57
T_8	75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of 1% urea @ at 30 and 45 DAS	58565	988	64220	14097	1.24
T_9	75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of 1% Nano urea@ 30 and 45 DAS	63505	995	64675	13272	1.25
T_{10}	75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria + Foliar spray of 2% DAP @ 30 and 45 DAS	60970	1116	72540	19797	1.37

6. CONCLUSION

As a result of this trial, it was discovered that the application of 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria+ Foliar spray of 1% TNAU Pulse wonder was successful for the growing of blackgram with the highest possible yield.

While in terms of economics, net return as well as BC ratio were found to be maximum with another treatment which is equivalent to the T_7, the most effective treatment for the growth and economics of Blackgram (Vamban-8) can be the application of 75 % RDF + Soil application of 2 kg each of Rhizobial culture and Phosphobacteria+ Foliar spray of 1% TNAU Pulse wonder. This is seen as being efficient in terms of both costs and productivity.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Meena H, Bharati V, Meena BL, Choudhary R, Rai S, Subba S. Effect of integrated nutrient management on black gram (Vigna mungo (L.) growth, yield and subsequent soil fertility in middle gangetic plains of India. The Pharma Innovation Journal 2022; 11(4): 2065-2068
2. Walkley, A., and Black, I. A. (1934). An examination of the Degtjareff method for determining soil organic matter, and a proposed modification of the chromic acid titration method. Soil science, 37(1), 29-38.
3. Gomez, K. A., & Gomez, A. A. (1984). Statistical procedures for agricultural research. John wiley & sons.
4. Akande1 MO, Oluwatoyinbo FI, Makinde EA, Adepoju AS, Adepoju IS. Response of okra to organic and inorganic fertilization. Nature and Science. 2010;8(11):261-266.
5. Aulakh MS, Adhya TK. Impact of agricultural activities on emission of greenhouse gases-Indian perspective. In

'International Conference on Soil, Water and Environmental Quality - Issues and Strategies', (Indian Society of Soil Science: New Delhi), 2005, 319-335.
6. Aulakh MS, Pasricha NS. Interaction effect of sulphur and phosphorus on growth and nutrient content of moong. Plant and Soil. 1978;47:341-350.
7. Baroowa B, Gogoi N. Effect of induced drought on different growth and biochemical attributes of black gram (Vigna mungo L.) and green gram (Vigna radiate L.). J. Env. Res. and Dev. 2012;6:584-593.
8. Divyavani Bhumi, Dhanuka Dhanendra, Ganesh V. Effect of integrated nutrient management on growth and yield in black gram (Vigna mungo L. Hepper) under doon valley condition. Journal of Pharmacognosy and Phytochemistry. 2020;9:2928-2932.
9. ESI. The Economic Survey 2014–15. The Economic Survey of India, New Delhi, 2015.
10. Govindan K, Thirumurugan V. Synergistic association of Rhizobium with phosphate-solubilizing bacteria under different sources of nutrient supply on productivity and soil fertility in soybean (Glycine max). 2005;50:214-217.
11. growth, yield and quality of lentil genotypes. Annals of Plant and Soil Research. 2013;15(2):134-137.
12. Justin CGL, Anandhi P, Jawahar D. Management of major insect pests of black gram under dry land conditions. J. of Ent. and Zool. Studies. 2015;3:115-121.
13. Khosro M, Yousef S. Bacterial Biofertilizers for Sustainable Crop Production: A Review. Journal of Agricultural and Biological Science. 2012;7(5):308-316.
14. Maitra D, Sarkar Surja, Saha S, Tripathi M, Majumdar Bijan, Saha Amit. Effect of phosphorus and farmyard manure applied to sunnhemp, (Crotalaria juncea) on yield and nutrient uptake of sunnhemp-wheat (Trticum aestivum) cropping system and fertility status in a Typic Ustocrept of Uttar Pradesh. Indian Journal of Agricultural Sciences. 2008;78:70-74.
15. Nandal DP, Malik DS, Singh KP. Effect of phosphorus levels on Dry matter accumulation of kharif pulses. Legume Research. 1987;19(1):31-33.
16. Rathi BK, Jain AK, Kumar S, Panwar JDS. Response of Rhizobium inoculation with Sulphur and Micronutrients on yield and yield attributes of blackgram [Vigna mungo (L.) Hepper] Legume Res. 2009;32(1):62-64.
17. Sarangi BK, Mudliar SN, Bhatt P, Kalve S, Chakrabarti T, Pandey RA. Compost from Sugar mill press mud and distillery spent wash for sustainable agriculture. Dynamic Soil, Dynamic Plant. 2009;2(1):35-49.
18. Shrikant M, Vadgave. Studies on integrated nutrient management on seed yield, quality and storability in greengram [Vigna radiata (L.) Wilczek]-Thesis, 2010.
19. Singh R, Rai RK. Yield attributes, yield and quality of soybean (Glycine max) as influenced by integrated nutrient management. 2004;49:271-274.
20. Singh Sudhir, Singh Y, Tomar Sagar. Review on climatic abnormalities impact on area, productivity of central India and strategies of mitigating technology on yield and benefits of black gram, 2018, 7.
21. Singh Yogendra, Singh Praveen, Sharma RD, Marko GS, Namdeo KN. Effect of organic sources of nutrients on
22. Thakur RC, Negi S. Effect of fertilizers and rhizobium inoculation in blackgram. Indian journal of Agronomy. 1985;30(4):501-504.
23. Tolessa D, Friesen DK. Effect of enriching farm yard manure with mineral fertilizer on grain yield of maize. In: Seventh Eastern and Southern Africa Regional Maize Conference, 11th -15th February, Western Ethiopia at Banko, 2001, 335-337.
24. Tyagi PK, Singh VK. Effect of integrated nutrient manatgement on growth, yield and nutrients uptake of summer blackgram. Annals of Plant and Soil Research. 2019;21(1):30-35.

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