Effect of nutri- priming on production and quality on blackgram (Vigna Munga)

Abstract

The study "Integrated nutrient management on productivity and quality of black gram *(Vigna mungo L.)*" was undertaken at the Instructional Farm, College of Agriculture of Siksha "O"Anusandhan,n deemed to be a university, Bhubaneswar, In the *rabi season* of 2019-20, with the objectives to study the effect of nutrient management practices on nutrient uptake. The experimental site was located at Chatabara village, which was 45 km from the station and 28 km from the college of agriculture, Siksha "O" Anusandhan, deemed to be a university, with 28.4° N latitude and 27.12° E longitude and at an altitude of 45.0 m above mean sea level. The soil was sandy-loam in texture. The initial status of the soil was pH 5.5, and the and the available N, P, and K were 160, 12, and 181 kg/ha. The organic carbon was 0.45%.Results demonstrated that treatment T4, combining 100% RDF, FYM, and nutrient priming, significantly improved seed yield (741 kg/ha), stover yield, nutrient uptake, and soil fertility. The study concluded that integrated practices, particularly the combination of RDF and FYM, are essential for optimizing black gram growth, yield, and nutrient content while enhancing residual soil fertility. The findings underscore the benefits of organic and inorganic nutrient integration for sustainable agricultural productivity.

Key words: Black gram, productivity, nutri priming, uptake, nutrient management

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Introduction

In India, pulses cover 22.92 million hectares, produce 14.31 million metric tons, and have an average yield of 625 kg/ha. Pulses cover 10.65 million hectares in the Kharif season, with a total production of 4.99 million metric tons and an average productivity of 469 kg/ha; nevertheless, pulses cover around 12.27 million hectares in the red season. Total output is 9.32 million metric tons, with an average yield of 760 kg per hectare. India has the world's greatest growing region of pulses. However, the average yield of pulses is quite low compared to cereals.

Legumes are important crops that help ensure food and nutritional security by providing dietary protein. It also helps maintain soil health by fixing atmospheric nitrogen. The black gram (Vigna mungo L.) is one of the most important legumes grown in India and belongs to the Fabaceae family. Black gram is said to originate from India. It was introduced to other tropical regions mainly by Indian immigrants. Black gram is consumed in different forms, like dali (whole, split, pre-hulled, and shelled).

A branched root system with smooth, round root nodes develops in the taproot. The whole plant is used as livestock feed and is a good green manure and soil conservation crop. Today, this crop is gaining great importance due to its endurance and relative resistance to pests and diseases. It has also

attracted the attention of farmers from dry fields where it is grown on different soils and is drought-tolerant. Black gram has a unique ability to fix atmospheric nitrogen. This is achieved through symbiosis. Black gram is a complete combination of all nutrients, containing proteins (24%), carbohydrates (60%), fats (1–5%), amino acids, vitamins, and minerals, and is much richer than most grains used as concentrates. Black gram bhusa fed to calves ensured a positive balance of nitrogen, calcium, and phosphorus.

Integrated nutrient management ensures higher productivity, minimizes the cost of expensive fertilizers, improves the physical properties of the soil and the effectiveness of the added nutrients, and at the same time ensures good soil health and is also an environmentally friendly approach (Kumpawat, 2010). This includes a rotation of organic fertilizers, green manures, cyanobacteria, biofertilizers, and legumes, and minimal use of chemical fertilizers to obtain optimal yields without compromising soil health. To compensate for shortages and rising prices of chemical fertilizers, the use of domestic sources such as farmyard manure (FYM) has been encouraged and promoted because it provides essential plant nutrients and improves soil physical, chemical, and biological conditions and soil microbial levels, activity, soil structure, water retention capacity, and thus increasing soil fertility and productivity. Farm Yard Manre is a potential source because of its readily available phytonutrients, growth promoters, and several beneficial microorganisms such as nitrogen-fixing, P-soluble, and cellulose-degrading organisms.

Methodology

The field trial was conducted during the 2019-2020 *rabi* season at Chatabara village, Institute of Agricultural Sciences (IAS), Siksha "O" Anusandhan, Deemed University, Bhubaneswar, Odisha (28.4' N and 27.12' E and 45.0 m above sea level) The test area was characterized by hot and dry summers and mild and cold winters. June was the hottest month of the year, when the highest air temperature was around 39-40°C; the coldest month was January, when the average air temperature was 7.7°C. The trial crop was sown on November 5, 2019, and the growing period continued until the 3rd week of January. The minimum and maximum temperature for this harvest week varied between 13.2°C and 31.8°C. Average weekly relative humidity ranged from 87 to 97%. Total rainfall (mm) during the period was normal. The soil in the experimental field consisted of sandy loam with a bulk density of 1.58 g/cm3, 0.22 dS/m EC, 0.45% organic carbon, 180 kg/ha available N, 12 kg/ha available P and 181 kg/ha. K. .The experiment was run in a randomized block design (RBD) with three replications. Eight INM treatments viz. T1:100% RDF, T2:T1 FYM, T3:T1 Nutri primer with Mo and P, T4:T1 FYM Nutri primer with Mo and P, T5: 75% RDF, T6: T5 FYM, T7: T5

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Nutri Primer with Mo and P, T8: T5 FYM Nutri Primer with Mo and P. Fertilizer nutrient was supplied with urea, DAP and MOP. The full initial rate of nitrogen, phosphorus and potassium according to the treatment was applied at sowing. The seeds were treated with rhizobiaum according to the standard procedure and sown after six hours of shade drying. The black gram variety (PU-30) was sown in the first week of November with a seed geometry of 30 cm x 10 cm with a seed quantity of 25 kg/ha. Standard agricultural practices were followed to ensure a successful crop. Observations of growth parameters and yield characteristics were recorded. Data were statistically analyzed using standard ANOVA techniques and statistical significance of treatment mean differences was tested with the appropriate critical difference (C.D) value at the 5% significance level (Gomez and Gomez, 1984).

Result and discussion

The nutrient uptake in seed and stover was influenced significantly due to different INM practices but nutrient content did not influencedsignificantly. The maximum N uptake in seed (28.1 kg/ha) and stover (26.3 kg/ha), respectively was recorded in treatment T_4 (100% RDF+FYM+ Nutri-priming with Mo and P), whereas T_5 recorded the minimum uptake of N in seed (13.0 kg/ha) and stover (12.1 kg/ha). The highest total uptake of N (54.5 kg/ha) was recorded in T_4 and the minimum of 25.2 kg/ha was recorded in T_5. The total uptake of N was significantly higher in combined application of RDF & FYM compared to RDF alone. The maximum P uptake in seed (2.80 kg/ha) and stover (4.34 kg/ha) was recorded in treatment T_4, whereas T5 recorded the minimum uptake of P in seed (1.3 kg/ha) and stover (2.18 kg/ha). The total P uptake was influenced significantly due to different nutrient management practices. The maximum total P uptake (7.14 kg/ha) was obtained in treatment T_4, whereas the minimum P uptake (3.47 kg/ha) was recorded in T_5.The maximum K uptake in seed (5.89 kg/ha) and stover (17.49 kg/ha) was recorded in T_4, whereas the T_5 recorded the minimum uptake of K in seed (2.86 kg/ha) and stover (8.53 kg/ha). With the incremental increase in fertilizer level from 75% to 100% RDF, there was a significant increase in K uptake in both seed and stover. The maximum total K uptake (23.37 kg/ha) was recorded in treatment T_4, while the minimum K uptake (11.38 kg/ha) was recorded in T_5. The treatment with organicsources of nutrition gave the better nutrient content and uptake by the crop because organic sources of nutrients help in improve the nutrients availability in soil. Application of organic sources of nutrients improved the physical properties (water and nutrient holding capacity) of soil thus making more availability of nutrients to the plants and would have also

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provided both macro and micro nutrients in soil. Vasanthi and Subramanyam (2004)evaluated the effect of organic manure with NPK fertilizer on the nutrient uptake by crop. The combined application of vermincompost @ 2 t/ha with 100% NPK resulted in highest nutrient content (NPK) and uptake. Our findings are in confirmatory to this.

Yield

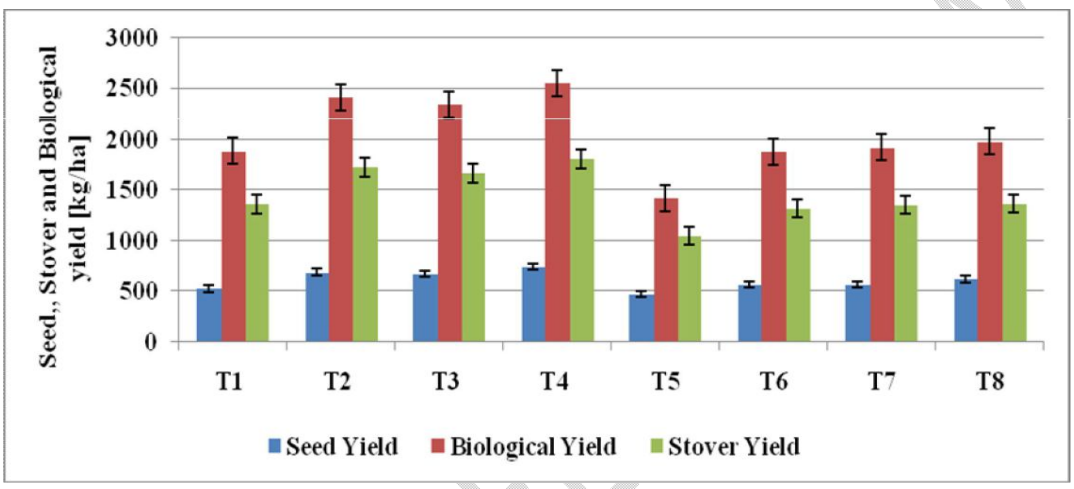

Figure 1: Seed yield, biological yield, stover yield and harvest index of black gram as influenced by nutrient management during *rabi* 2019-20

Seed yield- The final yield depends on the source and sink relationship and on different components of sink *viz.* number of pods/plants, number of seeds/ pods, and test weight. Source components could be the number of leaves, LAI and pre-anthesis assimilate reserves before flowering. The synthesis, accumulation and translocation of photosynthates depend on efficient photosynthetic structure as well as source to sink relation and also plant growth and development during early stage of crop growth.

In the present investigation, the seed yield of black gram differed significantly due to different in-organic fertilizers, organic manures and foliar spray of nutrients. The favorable effect of combined use of organic and in-organic nutrient on sink components could be attributed to better development of plants in terms of plant height and dry matter production leading to increased bearing capacity due to optimum growth and development of plants on account of synergistic effect of combined use of organic and inorganic manures. The maximum seed yield of 741 kg/ha was obtained with T_4 (100%RDF+ FYM +Nutri priming with Mo and P) which was found significantly superior to 100 % RDF and 75% RDF and their combinations. The minimum seed yield of 420 kg/ha was obtained with 75 % RDF. However, it was at par with RDF+FYM (687 kg/ha) and RDF +Nutripriming (673 kg/ha) treatment combinations. Among the treatments with 75% RDF and combinations, maximum yield was obtained in the T_8 receiving 75% RDF+FYM + Nutri-priming with Mo and P but, both 75%RDF + FYM and 75% RDF + Nutri priming were at par with T_8.

The variation in yield due to treatment variations could be attributed to significant variation in growth and yield attributes and differential nutrient uptake. Similar results have been reported by Rajkhowa *et al.* (2002 and 2003), Kinkar (2007) and Vadgave (2010) working with different integrated nutrient management practices in green gram crop. Chaudhary *et al.* (2016) studied the effect of INM on yield and quality of black gram in an Inceptisols at Varanasi and reported that application of RDF with 10 t/ha FYM and seed inoculation resulted in higher seed yield over RDF and other nutrient combinations.

Biological yield Biological yield was significantly influenced due to different nutrient management treatment. The maximum biological yield (2548 kg/ha) was obtained with T_4 (100%RDF+ FYM +Nutri priming with Mo and P) and the minimum biological yield (1420 kg/ha) was obtained with application of 75 % RDF only. Among the treatment with 75% RDF, the maximum yield was obtained in the treatment T_8 receiving 75%RDF+ FYM +Nutri priming with Mo and P, but 75%RDF + FYM and 75% RDF + Nutri priming with Mo and P were at par with 75 %RDF+FYM+ Nutripriming . The biological yield is proportional to increase in plant height, growth, dry matter production and translocation of assimilates to other plant parts. Further, biological yield is a function of seed and stover yield representing reproductive and vegetative growth of the crop. The results of the present investigation indicated that higher productivity of black gram is in close conformity with the findings of Channaveerswami (2005) and many other workers experimenting with pulses (Govindan and Thirumurugan (2005).

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Stover yield- Stover yield was significantly influenced due to different nutrient management treatments. Among the treatment with 100 % RDF and combinations, the maximum stover yield was obtained with T_4 (100%RDF+ FYM +Nutri priming with Mo and P), and 100% RDF recorded the minimum. Application of RDF either with FYM or Nutripriming did not differ among themselves and were at par with each other (Table 1). Among the treatments with 75% RDF, maximum yield was obtained in the treatment T_8 receiving 75%RDF+ FYM +Nutri priming with Mo and P but,75%RDF + FYM and 75% RDF + Nutri priming with Mo and P recorded almost identical stover yield. The findings are in agreement with the observations of Sutaria *et al.* (2010).

Harvest index- Harvest index as influenced due to different nutrient management treatments is given. The max harvest index (29.10%) was obtained at T_4 with 100%RDF+ FYM (5t/ha) +Nutri priming + Nutrient spray (2%DAP). The minimum harvest index (28.4%) was obtained with T5. The harvest index due to application of different nutrient management treatment was non-significant. The harvest index and 1000-grain weight are the most stable attributes of the crop plant which are generally least affected by applied input and management practices. In our investigation, HI was remain on par in applied treatment and similar results were also reported by Sadeghipour*et al*. (2010)

Nutrient content and uptake

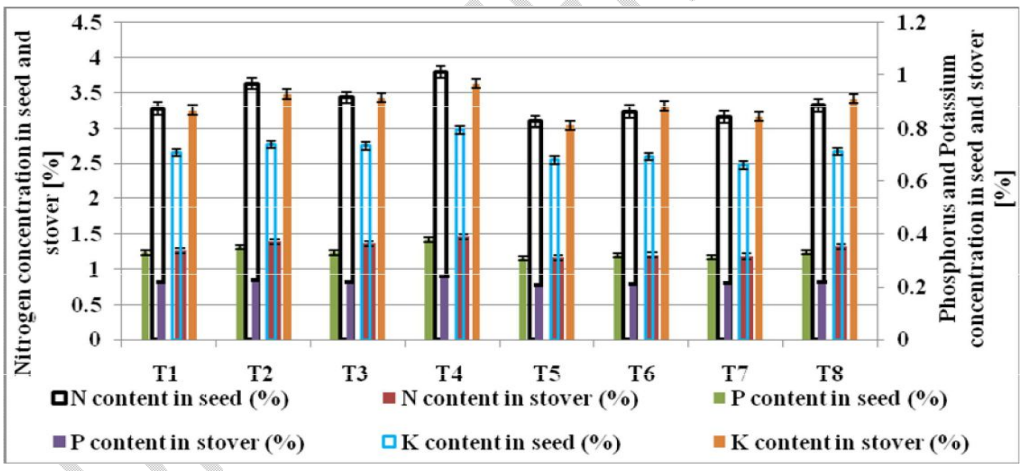

Figure 2.N P K contentin seed and stover black gram as influenced by nutrient management during *rabi* 2019-20

The data pertaining to N, P and K content in grain and stover due to the influence of integrated nutrient management treatment is presented in respectively.

The data was observed that, the concentration of N in grain and stover were maximum in T4 treatment and it was minimum in T_5 treatment. The N content increased with application of FYM in comparison to only 100% RDF and 75% RDF. Nutrient spray with 2% DAP also increased the concentration of N in both seed and stover. The mean N is content in seed and stover was 3.37 and 1.29%, respectively. Whereas for the concentration of P in grain and stover were maximum in T_4 treatment and it was minimum in T_5 treatment. The P content increased with application of FYM in comparison to only 100% RDF and 75% RDF. Nutrient spray with 2% DAP also increased the concentration of P in both seed and Stover. The mean P content in seed and stover was 0.33 and 0.22%, where found respectively.

The data also indicated, the concentration of K in grain and Stover were maximum in T_4 treatment and it was minimum in T_5 treatment. The K content increased with application of FYM in comparison to only 100% RDF or 75% RDF. Nutrient spray with 2% DAP also increased the concentration of K in both seed and Stover. The mean K content in seed and stover were 0.714 and 0.891%

The application of inorganic fertiliser and organic manure results in more availability of nutrients in the soil as a result the concentration of nutrients in grains and stover also increases. In this case, the concentration of NPK in grain and stover increased with increase in the level of recommended NPK from 75% to 100%. Besides, with the supplementation of organics also helped in increasing the content of NPK in grain and stover. Vasanthi and Subramanyam (2004) also reported a higher concentration of NPK in grain and stover by applying RDF with organic in comparison to control and only RDF. It can be observed in the given

Uptake of N, P and K in grain and stover and total NPK uptake

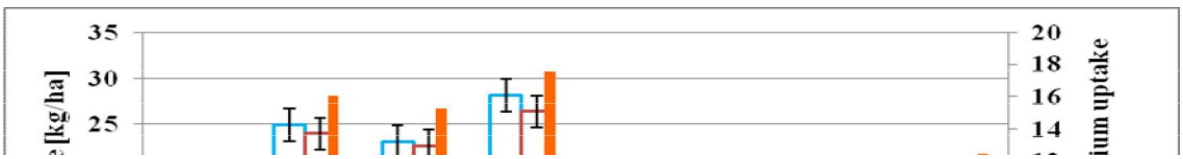

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Figure 3. N P K uptake in seed and stover black gram as influenced by nutrient management during *rabi* 2019-20

The data pertaining to uptake of N, P and K in grain and stover and total uptake of N, P and K due to influence of nutrient management treatment is presented, respectively.

The data revealed that the N uptake in seed and stover was influenced significantly due to different nutrient management treatment. The maximum N uptake of 28.18 and 26.38 kg/ha in seed and stover, respectively was recorded in T4 treatment, while in T5, the uptake was minimum of 13.04 and 12.18 kg/ha in seed and stover, respectively. Similarly, a maximum total uptake of N of 54.55 kg/ha was obtained in T4 treatment and the minimum of 25.21 kg/ha was obtained in T5 treatment. There was mean uptake of N of 36.8 kg/ha.

The P uptake in seed and stover was influenced significantly due to different nutrient management treatment. The maximum P uptake of 2.80 and 4.34 was obtained in T4 treatment and it was minimum of 1.3 and 2.18 kg/ha respectively in seed and stover in T5 treatment. With the increase of fertilizer level from 75% to 100% RDF, there was significant increased P uptake both in grain and stover. The total p uptake was influenced significantly due to influence of nutrient management treatment. The maximum total P uptake 7.14 kg/ha was recorded in T4 treatment, while the minimum P uptake of 3.47 kg/ha was recorded in T5 treatment. There was mean uptake of P of 5.1 kg/ha.

The K uptake in seed and stover was influenced significantly due to different nutrient management treatment. The maximum K uptake of 5.89 and 17.49 in seed and stover, respectively was obtained in T4 treatment and it was minimum of 2.86 and 8.53 kg/ha in T5. With the increase of fertilizer level from 75% to 100% RDF, there was significant increased K uptake both in grain and stover. The total K uptake was influenced significantly due to influence of nutrient management treatment. The maximum total K uptake of 23.37 kg/ha

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was recorded in T4 treatment, while the minimum K uptake of 11.38 kg/ha was recorded in T5 treatment. There was mean uptake of K of 17.1 kg/ha.

The positive effect of FYM, nutri-priming and foliar fertilization on N concentration over only application of recommended fertilizer was observed in this study. This indicates that dependency on biological nitrogen fixation for N nutrition of legume is not a good strategy to achieve higher productivity and grain nutritional quality (protein content).

The application of inorganic fertliser and organic manure results in more availability of nutrients in the soil as a result the concentration of nutrients in grains and stover also increased. In this case the concentration of NPK in grain and stover increased with increase in the level of recommended NPK from 75% to 100%. Besides, with the supplementation of organics also helped in increasing the content of NPK in grain and stover. The higher uptake of NPK in black gram in RDF+FYM (T2) and T_4 (100%RDF+ FYM +Nutri priming with Mo and P) and other similar treatments is due to more availability of nutrients to the plant, which resulted in higher biomass and grain yield resulting higher uptake of the NPK nutrients

Vasanthi and Subramanyam (2004) evaluated the effect of organic manure with NPK fertilizer on the nutrient uptake and crude protein content in black gram. The combined application of vermincompost @ 2 t/ha with 100% NPK resulted in highest crude protein, content NPK and uptake. Athokpam*et al.* (2009) observed that the total uptake of nutrients by the black gram was associated with higher dry biomass production. Vasanthi and Subramanyam (2004) reported a higher concentration of NPK in grain and stover resulting higher uptake by applying RDF with organic in comparison to control and only RDF.

Protein content

The data pertaining to protein content in seed of black gram due to influence of nutrient management treatment is presented. It was revealed that the protein content of the seed was influenced considerably with nutrient application.The data revealed that the protein content in seed was influenced considerably due to different nutrient management practices. The maximum protein content of 23.78% in seed was recorded in T4 treatment, while in T5, it was minimum of 19.41%there was 5.7 % higher protein content in 100% RDF over 75% RDF. The mean protein content of seed was 21.09%. A similar trend with respect to N uptake and protein content was observed by Vasanthi and Subramanyam (2004).

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Malik *et al*. (2003) studied the effect of varying levels of nitrogen (0, 25 and 50 kg/ha) and phosphorus levels (0, 50, 75 and 100 kg/ha) on the yield and quality of mung bean during the year 2001 at Faisalabad (Pakistan). Results indicated that fertilizer combination of 25:75 kg NP/ha resulted in maximum seed yield (1113 kg/ha).However, maximum protein content (25.6%) was obtained from plots fertilized @ 50:75 kg NP/ha followed by protein content of 25.1% obtained from plots fertilized @25:75 kg NP/ha. Javed and Panwar (2013) observed a higher protein content under integrated nutrient management practices.

Soil Nutrient Status

The data pertaining to residual soil fertility after harvest of black gram as influenced by nutrient management practices and initial nutrient status of the soil before experiment is presented. The initial status of the soil was pH, 5.5, available N, P and K were 160, 12 and 181 kg/ha, respectively. There was positive influence due to influence of some treatments with respect to residual soil fertility status. The treatment receiving recommended dose of fertliser +FYM +Nutripriming with Mo and P resulted in maximum values of organic carbon, available N, P and K, which was 11.1, 9.6, 5.0 and 4.1 % higher than the initial soil fertility. Similarly, with the application of recommended dose, there was marginal increase in the status of these fertility parameters. Nutrient management has played very significant role in providing the physical condition of soil and supplying all the macro and micro nutrients which are required by crop for balanced nutrition. (Gaur *et.al.*, 1990 ;Patil*et. al*., 2010; Singh *et al.* 2005 studied residual effect of INM in potato-moong cropping sequence andreported that highest value of all the yield attributes and grain yield of moong was observed with the residual effect of combined application of 100% RDF and FYM @ 15 t/ha. They also quoted that direct effect of NPK application to moong was more pronounced over residual effect.

Summary

To summarise the aforementioned research study. The concentration of nitrogen in grain and stover was highest in T4 treatment and lowest in T5 treatment. When FYM was used instead of 100% or 75% RDF, the N content rose. T4 treatment (T1+ FYM + Nutri priming with Mo and P) yielded the highest N content in both seed and stover. The average nitrogen concentration in seed and stover was 3.37 and 1.29%, respectively.
The content of P in grain and stover was highest in T4 treatment and lowest in T5 treatment. When FYM was used instead of 100% or 75% RDF, the P content rose. The average P content in seed and stover was 3.37 and 1.29%, respectively.

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The concentration of K in grain and stover were maximum in T4 treatment and it was minimum in T5 treatment. The K content increased with application of FYM in comparison to only 100% RDF or 75% RDF. The mean K is content in seed and stover was 3.37 and 1.29%, respectively.

The N uptake in seed and stover was influenced significantly due to different nutrient management treatment. The maximum N uptake of 28.18 and 26.38 kg/ha in seed and stover respectively was recorded in T4 treatment, while in T5, the uptake was minimum of 13.04 and 12.18 kg/ha in seed and strover respectively. The total uptake of N of 54.55 kg/ha was obtained in T4 treatment and the minimum of 25.21 kg/ha was obtained in T5 treatment. Total uptake of N was significantly higher in RDF+FYM than only application of RDF.

The P uptake in seed and strover was influenced significantly due to different nutrient management treatment. The maximum P uptake of 2.80 and 4.34 was obtained in T4 treatment and it was minimum of 1.3 and 2.18 kg/ha respectively in seed and stover in T5. Within the increase of fertilizer level from 75% to 100% RDF there was significant increased P uptake both in grain and stover. The total p uptake was influenced significantly due to influence if nutrient management treatment. The maximum total p uptake 7.14 kg/ha was recorded in T4 treatment, while the minimum P uptake of 3.47 kg/ha was recorded in T5. There was mean uptake of P of 5.1 kg/ha

The K uptake in seed and stover was influenced significantly due to different nutrient management treatment. The maximum K uptake of 5.89 and 17.49 in seed and stover, respectively was obtained in T4 treatment and it was minimum of 2.86 and 8.53 kg/ha in T5. With the increase of fertilizer level from 75% to 100% RDF, there was significant increased K uptake both in grain and stover. The total K uptake was influenced significantly due to influence of nutrient management treatment. The maximum total K uptake 23.37 kg/ha was recordedin T4 treatment, while the minimum K uptake of 11.38 kg/ha was recorded in T5 treatment.

The protein content in seed was influenced considerably due to different nutrient management practices. The maximum protein content of 23.78% in seed was recorded in T4 treatment, while in T5, the it was minimum of 19.41 %. There was 5.7 % higher protein content in 100% RDF over 75% RDF.

The initial status of the soil was - pH, 5.5, available N, P and K were 160, 12 and 181 kg/ha. There was positive influence on nutrient content due to influence of treatments with respect

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to final soil fertility status. The treatment receiving recommended dose of fertliser+FYM +Nutripriming with Mo and P, resulted maximum values of organic carbon, available N, P and K, which was 11.1, 9.6, 5.0 and 4.1 % higher than the initial soil fertility.

Conclusion

The study concluded that residual soil fertility in rabi blackgram was better under treatment T4. The content of N, P, and Kin grain and stover was highest in this treatment and lowest in the T5 treatment. FYM enhanced the N, P, and K content as compared to 100% RDF or 75% RDF. T4 treatment (T1+ FYM + Nutri priming with Mo and P) yielded the highest N content in both seed and stover. The average nitrogen, phosphorus, and potassium content in seed and stover was 3.37 and 1.29%, respectively.T4 treatment had the highest grain and stover content, whereas T5 treatment had the lowest.

The total N, P, and K absorption in seed and stover was considerably impacted by several nutrition management treatments. T4 had the highest N uptake of 28.18 and 26.38 kg/ha in seed and stover, P uptake of 2.80 and 4.34, and K uptake of 5.89 and 17.49, respectively, whereas T5 had the lowest N uptake of 13.04 and 12.18 kg/ha in seed and strover, P uptake of 1.3 and 2.18 kg/ha, and K uptake of 2.86 and 8.53 kg/ha.

The total intake of nitrogen was 54.55 kg/ha. The highest total p uptake was 7.14 kg/ha, the maximum total K uptake was 23.37 kg/ha, and the minimum of 25.21 kg/ha was reached in the T5 treatment. P uptake was 3.47 kg/ha, and K uptake was 11.38 kg/ha. The total consumption of N was considerably greater in RDF+FYM compared to RDF alone.

It was observed that the soil had an initial pH of 5.5, with accessible N, P, and K levels of 160, 12, and 181 kg/ha, respectively. The treatments had a beneficial effect on nutrient content in relation to the ultimate soil fertility condition. The treatment receiving the prescribed dosage of fertilizer, FYM, and nutri-priming with Mo and P resulted in the highest values of organic carbon, accessible N, P, and K, which were 11.1, 9.6, 5.0, and 4.1% greater than the initial soil fertility.

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