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Assessing the residual effect of Integrated Plant Nutrient Supply System (IPNSS) on growth and yield of rice fallow blackgram

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ABSTRACT

The study was conducted during the year 2021 – 2022 at the experimental farm, Department of Agronomy to investigate the residual effect of IPNSS practices on the growth and yield of rice fallow blackgram ADT 5. The experiment was conducted with eight treatments with different quantities of nitrogen, green manure, pressmud biocompost, goat manure, seaweed extract and phosphate solubilizing bacteria on the base crop of rice and the residual study was conducted using the blackgram. The results of the study indicated that among the different treatments, 100% RDN + 25% N as Pressmud biocompost + PSB applied plots resulted in higher morphological characters, including plant height (25.87 cm), leaf area index (5.16), dry mater production (2309 kg/ha), number of branches/plant (6.86) and yield characteristics, including number of pods/plant (13.67), number of seeds/pod (5.52), grain yield (719 kg/ha) and haulm yield (1671 kg/ha) of rice fallow residual blackgram. Multiple parameters in the control treatment scenario indicated lower production and inadequate growth and development. The study revealed that application of 100% RDN + 25% N as Pressmud biocompost + PSB for base crop rice could be considered a better option for achieving the growth and yield attributes of ADT 5 under residual rice fallow condition.

Key words : *Residual effect, Integrated Plant*

Introduction

Pulses are known as "Poor Man's Meat" because they play an essential role in everyday diet and are one of the most cost-effective sources of dietary protein (Hamjah, 2014). Rice is traditionally cultivated under transplanted condition, which necessitates a large amount of water throughout the growing process. As a result, the moisture and nutrients provided to the rice crop are sufficient for raising the short duration pulse crop under fallow conditions, providing farmers with an additional revenue source. Among the pulses, blackgram is well suited to its restricted moisture availability and is also resistant to water logging during the crop's early growth stages (Raja and Sathish, 2018). Farmers in Tamil Nadu's Cauvery Delta Zones (CDZ) have traditionally followed the cropping sequence of rice fallow pulses, particularly blackgram farming. Because it successfully utilizes the soil moisture and nutrients added to the previous rice crop.

The United Nations declared 2016 to be the "International Year of Pulses" (IYP) in order to create more public awareness of the nutritional benefits of

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pulses as part of sustainable agricultural production targeted at food security and nutrition. According to global food and nutritional security, Blackgram plays a key role and is planted as a food legume because it is a short-season crop that flourishes in all seasons as a solo crop, intercrop, and fallow crop. It accounts for up to 60% of state pulse production, which is grown on 3.6 lakh acres with varied levels of productivity each year in CDZ (Area, Crop, and Production Report, TN Government, 2021).

The first crop rice which is fertilised, and the fallow pulse crop is cultivated without fertiliser. In this scenario, the pulses successfully use the residual nutrients for growth and development. Nutrient management is one of numerous management practises that must be sound in order to achieve production targets on a sustainable basis (Saptagiri *et al.,* 2020). Nutrient management has played an important part in maintaining the physical condition of the soil and supplying all the macro and micro nutrients necessary to crops for balanced nutrition. Inoculation of legume crops with biofertilizers promotes quick seed germination and enhances biological nitrogen fixing in soil (Neo *et al.,* 2012; Sarkar *et al.,* 2021).

Continuous and indiscriminate use of inorganic fertilisers has had a negative impact on soil structure, soil health, and the environment in recent years. Intensive cultivation, monocropping, imbalanced fertilisation, and limited use of organic manures and biofertilizers have resulted in soils that are not only deficient in nutrients but also have deteriorated soil health, resulting in a decrease in crop response to the recommended dose of fertilisers (Latha *et al.,* 2020). Due to poor fertiliser management, the yield potential of blackgram planted as a fallow crop is not fully realised, and it produces only very low yields. If suitable integrated nutrient management practises for the preceding rice crop are followed by providing organics, inorganics as well as biofertilizers, it will undoubtedly boost the residual soil nutrient status as well as the growth and yield of succeeding rice fallow blackgram (Sivakumar, 2020). Keeping these factors in mind, the current study was designed to evaluate the optimal integrated plant nutrient supply system practises for residual rice fallow blackgram in order to achieve maximum growth, development and yield.

Materials and Methods

Field experiments were conducted at the Experimental Farm of the Department of Agronomy at Annamalai University, Tamil Nadu, India, during the cropping year 2021-2022, to assess the residual effect of integrated plant nutrition supply on blackgram ADT 5 under rice fallow conditions. The experimental site is located at 11°24'N latitude and 79°44'E longitude, at an elevation of +5.79 m above mean sea level. The experiment used a randomised block design with eight treatments, and it was replicated thrice. T_1 was the Absolute Control (No application), T_2 was 125% RDN + 25% N as Pressmud Biocompost + PSB, T_3 was 125% RDN + 25% N as Green Manure + PSB, T_4 was 125% RDN + 25% N as Goat Manure + PSB, T_5 was 100% RDN + 25% N as Pressmud Biocompost + PSB, T_6 was 100% RDN + 25% N as Green Manure + PSB, T_7 was 100% RDN + 25% N as Goat manure + PSB. The rice crop was fertilised with urea, pressmud biocompost, seaweed extract, green manure, and goat manure at varying levels, whereas the fallow blackgram was cultivated without fertilisation and with the soil's residual nutrient and moisture. The observations were made at random in each plot at the crop's harvest stage. The data were statistically analysed in accordance with Gomez and Gomez, (2010). Wherever treatment differences were found to be significant, critical differences were calculated at 5% probability level and tabulated.

Results and Discussion

Growth attributes

The treatments had a big impact on growth factors such plant height, leaf area index (LAI), number of branches/plant, dry matter accumulation. The treatment T_2 - 100% RDN + 25% N as Pressmud Biocompost + PSB recorded the highest levels of plant height (25.87 cm), leaf area index (5.16), dry mater production (2309 kg/ha), number of branches/plant (6.86), among the treatments evaluated. This treatment was followed by T_3 - 100% RDN + 25% N as Seaweed Extract + PSB (Table 1). This could be owing to the use of pressmud biocompost, inorganic fertiliser, and biofertilizer in lowland rice, which leads to a higher level of residual nitrogen uptake in the soil and contributes to the improved growth characteristics of the rice fallow blackgram condition. Because of the greater significance of N in cell division and enlargement, the application of mineral and organic N aids in increasing growth

Table 1. Effect of IPNSS on plant height, leaf area index, dry mater production, number of branches plant^{-1} at harvest stage of the crop

Treatment	Plant height (cm)	Leaf area index	Dry mater production (kg/ha)	Number of branches/ plant
T_1 - Control	14.95	3.45	1397	4.91
T_2 – 125% RDN + 25% N as Pressmud Biocompost + PSB	26.27	5.20	2397	6.92
T_3 – 125% RDN + 25% N as Green Manure + PSB	24.53	4.93	2252	6.60
T_4 – 125% RDN + 25% N as Goat Manure + PSB	22.80	4.65	2113	6.28
T_5 – 100% RDN + 25% N as Pressmud Biocompost + PSB	21.07	4.37	1969	6.15
T_6 – 100% RDN + 25% N as Green Manure + PSB	19.37	4.09	1829	5.96
T_7 – 100% RDN + 25% N as Goat manure + PSB	17.63	3.59	1683	5.61
S.Ed	0.76	0.15	56.67	0.13
CD	1.70	0.26	122.98	0.29

characteristics (Sathish *et al.*, 2010 and Ramesh *et al.*, 2011).

According to Singh and Shivay (2013), organic manures in conjunction with biofertilizers aid in the production of particular phytohormones and vitamins that stimulate crop growth and development. This could have aided in the consistent and balanced availability of both native and applied nutrients, allowing the leaf area duration to extend, allowing the plants to increase the photosynthetic rate, resulting in higher drymatter accumulation (Siddaram *et al.*, 2011). Increases in many metrics may be linked to greater availability of nutrients over lengthy periods of time, which had a positive influence on plant development. Meena (2013) and Singh and Singh (2017) findings support the conclusions.

Yield attributes

Among the IPNSS practices, yield attributes like number of pods/plant, number of seeds/pod, grain yield and haulm yield were significantly influenced by the treatment T_2 – 100% RDN + 25% N as Pressmud Biocompost + PSB recored the maximum number of pods/plant (13.67), number of seeds/ pod (5.52), grain yield (719 kg/ha) and haulm yield (1671 kg/ha) of rice fallow blackgram. This treatment was followed by T_3 - 100% RDN + 25% N as Seaweed Extract + PSB (Table 2). This could be due to the integrated application of inorganic and organic manures which highly influenced the yield characteristics of the succeeding crop. Similar results were found by Kumar *et al.* (2020) and Zannat *et al.* (2020).

The reason for increased yield attributes could be due to the microbial stimulation effect of organic manures and long-term supply of essential plant nutrients through gradual mineralization, which provided enough nutrients to match the uptake pattern of succeeding crop throughout the growth period and thus increased photosynthate assimilation, which in turn helped better source and sink relation-

Table 2. Effect of IPNSS on number of pods/plant, number of seeds/pod, grain yield and haulm yield at harvest stage of the crop

Treatment	Number of Pods/ plant	Number of Seeds/pod	Grain yield (kg/ha)	Haulm yield (kg/ha)
T_1 - Control	9.61	4.96	442	1110
T_2 – 125% RDN + 25% N as Pressmud Biocompost + PSB	14.74	6.32	889	1773
T_3 – 125% RDN + 25% N as Green Manure + PSB	14.26	6.17	831	1670
T_4 – 125% RDN + 25% N as Goat Manure + PSB	13.78	6.01	778	1569
T_5 – 100% RDN + 25% N as Pressmud Biocompost + PSB	13.31	5.75	720	1468
T_6 – 100% RDN + 25% N as Green Manure + PSB	12.82	5.57	667	1364
T_7 – 100% RDN + 25% N as Goat manure + PSB	12.34	5.28	607	1262
S.Ed	0.20	0.05	25.13	39.53
CD	0.45	0.13	54.55	85.79

ship and ultimately led to higher yield attributes of blackgram. The improved yield characteristics might be attributed to larger fertiliser doses, which could have created a suitable soil environment and sustenance for better plant growth for the subsequent crop under rice fallow conditions. These results are conformity with the finding of Meena *et al.* (2016) and Mainu *et al.* (2016)

Conclusion

Considering the foregoing results, it is evident that the integrated application of 100% RDN + 25% N as Pressmud Biocompost + PSB prescribed to the rice looks to be more promising for the succeeding fallow blackgram crop. As a result, integrated plant nutrient supply system practises would aid in producing a higher yield as well as a healthier soil-plant relationship in the sustainable manner. As a consequence of this, integrated use of organic and inorganic fertilizers often leave a substantial residual effect on succeeding cropping sequence.

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