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Green Forage Productivity, Crude Protein Yield, Seed Yield and Production Economics of Dual Purpose Ricebean (*Vigna umbellata*) as Influenced by Different Organic Sources of Nitrogen

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ABSTRACT

A field experiment was conducted at Central Research Farm, Gayeshpur, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal, India during *kharif* (June–September, 2019 and 2020) to evaluate the influence of different organic nitrogen sources on growth, quality, yield and yield parameters and production economics of dual purpose ricebean (*Vigna umbellata*) of Bidhan ricebean-2 variety. The experiment was laid out in Randomized Block Design (RBD) with three replications. The organic nitrogen sources used in the experiment were vermicompost, farm yard manure and biocompost. Experiment results revealed that application of 50% RDN through FYM+50% RDN through Vermicompost gave significantly higher leaf–stem ratio and drymatter accumulation. Among other treatments, with application of 50% RDN through FYM+50% RDN through vermicompost significantly highest green forage yield, dry matter yield was observed. Highest seed yield and yield attributes like pods plant^{-1}, seeds pod^{-1} was observed with application 50% RDN through FYM+50% RDN through vermicompost. Application of 50% RDN through FYM+50% RDN through Vermicompost recorded highest quality parameters like crude protein, crude fat, crude fibre and crude protein yield when compared to other treatments. With respect to economics of different organic and inorganic nitrogen sources, application of 50% RDN through FYM+50% RDN through vermicompost recorded higher gross returns and net returns but higher B-C ratio was noticed with application of 100% RDN through inorganic fertilizers.

KEYWORDS: Dual purpose ricebean, crude protein, organic nitrogen source

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Data Availability Statement: Legal restrictions are imposed on the public sharing of raw data. However, authors have full right to transfer or share the data in raw form upon request subject to either meeting the conditions of the original consents and the original research study. Further, access of data needs to meet whether the user complies with the ethical and legal obligations as data controllers to allow for secondary use of the data outside of the original study.

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1. INTRODUCTION

Livestock plays a vital role in Indian economy by supporting livelihood of more than 2/3rd of rural population. Livestock provides quality animal protein to humans and many value added products through milk. They provide draught power to agricultural operations, organic manure for agricultural production. But livestock productivity goes on declining due to improper nutrition and inadequate availability of green fodder (Dasgupta et al., 2015)

Lack of awareness on potential nutritional and economic use value of underutilized legumes like ricebean and its narrow socio traditional perceptions among most users are observed to be the barriers to its large-scale demand and production. Hence, immediate action for its conversion and utilization is critical to prevent the loss of these multipurpose crops. Legume fodders plays a crucial role for nutritional security as they have high herbage and nitrogen fixing ability, Ricebean is one among them (Joshi et al., 2006). Ricebean [*Vigna umbellata* (Thunb.*)* Ohwi and Ohashi] is a native of South East Asia and also occurs in hilly areas of north eastern India. Ricebean is an annual legume with an erect to semi erect vine that may grow to more than three metres height. Its grain resembles as dehusked rice grains, the trifoliate leaves and stems resemble like green gram hence the name ricebean.

A temperature of 25–35°C and average rainfall of 1000–1500 mm is optimum for healthy growth and development and it can be grown under humid sub-tropical to warm temperate climate. (Jana et al., 2019). In India it is cultivated in West Bengal, Assam, Madhya Pradesh, Jharkhand, Odisha, Haryana, Uttarakhand and hilly areas of Himachal Pradesh. Ricebean, an underutilized legume is gaining popularity among the poor farmers of West Bengal for fodder production and nutrient enrichment in the mango, guava orchards. Ricebean is a N-fixing legume which increases the nitrogen status of the soil and also provides nitrogen to the succeeding crop, so it is beneficial to grow under Rice and wheat–based cropping systems. Ricebean foliage is highly nutritious and fed to cattle in the form of fresh green fodder or in the form of hay which increases the milk production in cattle. Some farmers use it as a cover crop in hilly areas and as a weed smothering crop. Ricebean is photoperiod sensitive crop and flowers in December under the influence of short days, for fodder purpose it can be cut at 70–90 days after sowing at 50% flowering stage (Kundu, 2018). Only one cut is usually taken. Ricebean fodder consists of crude protein, fat and various micronutrients (Qaman et al., 2014).

Nitrogen is basic element of plant life. Nitrogen promotes vegetative growth to crop, gives dark green foliage. It improves the quality of fodder. As Ricebean is a legume, it fixes atmospheric nitrogen and requires nitrogen as starter dose. Organic manures enrich the soil with organic matter, increases the population of soil microfauna and earthworms which play major role in soil health. Over usage of inorganic fertilizers mainly nitrogen fertilizers leads to ground water pollution, eutrophication. It also effects the soil biological properties like reducing the microbial population. (Yadav et al., 2016). Organic sources coupled with inorganic fertilizers not only gives optimum production but also reduces the use of inorganic fertilizers which are costly and have negative impact on the soil health (Rani et al., 2017). So by choosing organic manures (FYM, vermicompost and biocompost) with inorganic fertilizers provide sustainable crop production. Considering all the facts above, the present study was designed with main objective of studying response of ricebean to various nitrogen sources.

2. MATERIALS AND METHODS

2.1. *Experimental site and soil analysis*

The experiment was conducted in the new alluvial zone with sandy loam in texture and neutral soil pH (6.58). The experiment was conducted during *kharif* (June–September 2019 and 2020) at central research farm, Gayeshpur , Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India located at latitude 22°97'N and longitude 88°4'E. Composite sampling was done prior to the experimentation and the physico-chemical properties of the soil was analysed. The initial soil available N was 212 kg ha^{-1} (Alkaline potassium permanganate method), available P was 41 kg ha^{-1} (Olsen's method) and available K was 176 kg ha^{-1} (Flame photometer method). The organic carbon content of the soil was 0.56% (Walkley and Black method).

2.2. *Experiment details*

The experiment was laid out in Randomized Block Design with three replications. The gross plot size was 20 m^2 (5×4 m^2). The treatments comprised of 100% RDN through inorganic fertilizers (T_1), 100% RDN through FYM (T_2), 75% RDN through FYM+25% RDN through Vermicompost (T_3), 75% RDN through FYM+25% RDN through Bio-compost (T_4), 50% RDN through FYM+50% RDN through Vermicompost (T_5), 50% RDN through FYM+50% RDN through Bio-compost (T_6), 75% RDN through FYM (T_7) and 50% RDN through FYM+25% RDN through.

Vermicompost+25% RDN through biocompost (T_8). Bidhan Ricebean 2 variety was sown at a spacing of 20×10 cm^2 at a seed rate of 22.5 kg ha^{-1}. Recommended dose of fertilizers is 20:40:40 N:P_2O_5:K_2O kg ha^{-1}. Organic nitrogenous fertilizers were as applied basal as per treatments while ¾th inorganic nitrogen as basal and ¼th as topdressing in T_1 and application of phosphorus and potassium in the form of single super phosphate and muriate of potash respectively to every treatment at the time of sowing. Recommended and need based agronomic practices were followed successfully to cultivate the ricebean crop during *kharif* season. At 60 DAS, 30 cm cut was made above the ground level for green forage yield and remained the crop for seed purpose and seed was harvested at 145 DAS.

2.3. Biometrical observations and statistical analysis

All the growth and yield parameters were recorded. The crop was harvested at its fully maturity stage. The green forage yield, crude protein yield, seed yield and stover yield were recorded and production economics was worked out. The data recorded were pooled and subjected to Fischer method of Analysis of Variance (ANOVA) and interpretation of data in Randomised Block Design (RBD) as outlined by Gomez and Gomez (1984)

3. RESULTS AND DISCUSSION

3.1. Effect of different organic sources of nitrogen on growth parameters

The data on plant growth parameters such as plant height, dry matter accumulation and leaf stem ratio were presented in table 1. The results revealed that significant difference was recorded in plant growth parameters by the application of different organic sources of nitrogen in dual purpose ricebean. In the present study significantly higher plant (113.2 cm) was recorded in T_1 at 60 DAS followed T_5 (106.1 cm). Dry matter accumulation (705.7 g m^{-2}) and leaf stem ratio (1.42) were significantly influenced by the application of 50% RDN through FYM+50% RDN through Vermicompost followed by T_1 (100% RDN through inorganic fertilizers).

The improvement of plant height might be attributed due to readily available nitrogen in inorganic fertilizers than other treatments leading increased growth. Higher dry matter with T_5 treatment was due to better soil physical properties and prolonged nitrogen availability throughout the crop growth period due to application of nitrogen through both vermicompost and FYM. Similar results were reported with Mathur (2000) and Yadav et al. (2019).

3.2. Effect of different organic sources of nitrogen on yield attributes and seed yield

The yield attributes like number of pods plant^{-1}, number of seeds pod^{-1}, test weight were recorded, statistically analysed and presented in table 1. Among all the treatments, highest number of pods plant^{-1} (52.2) were obtained with T_5 [50%

Table 1: Effect of different organic nitrogen sources on growth parameters, yield attributes, seed yield, green forage yield and dry matter yield of dual purpose ricebean

Treatments	Plant height at 60 DAS (cm)	Dry matter accumulation at 60 DAS (g m^{-2})	Leaf-stem ratio	No. of pods plant^{-1}	No. of seeds pod^{-1}	Test weight (g)	Seed yield (kg ha^{-1})	Green forage yield (t ha^{-1})	Dry matter yield (t ha^{-1})
T_1: 100% RDN through inorganic fertilizers	113.2	685.1	1.30	50.4	7.8	48.7	447.0	32.81	6.43
T_2:100% RDN through FYM	92.2	642.9	1.16	44.5	7.6	49.2	392.0	29.85	5.86
T_3: 75% RDN through FYM+25% RDN through vermicompost	99.0	664.7	1.24	49.2	7.7	47.2	425.0	32.37	6.12
T_4: 75% RDN through FYM+25% RDN through Bio-compost	91.7	627.0	1.13	43.7	7.5	46.2	386.0	29.22	5.79
T_5: 50% RDN through FYM+50% RDN through vermicompost	106.1	705.7	1.42	52.2	8.1	48.7	494.0	34.87	6.92
T_6: 50% RDN through FYM+50% RDN through Bio-compost	89.7	592.2	1.04	43.2	7.4	46.6	354.0	27.88	5.34
T_7: 75% RDN through FYM	84.8	564.0	0.91	42.6	7.3	45.9	348.0	25.86	5.00
T_8: 50% RDN through FYM+25% RDN through vermicompost+ 25% RDN through biocompost	97.8	647.1	1.17	47.7	7.5	47.8	401.0	31.07	5.89
SEm±	2.15	5.9	0.04	1.89	0.29	1.79	6.8	1.26	0.21
CD (p=0.05)	4.6	12.9	0.09	4.06	0.62	NS	20.37	3.77	0.59

FYM: Farm yard manure; DAS: Days after sowing, RDN: Recommended dose of fertilizer

Table 2: Effect of different organic nitrogen sources on quality parameters of dual purpose ricebean (Pooled value of two years)

Treatments	Crude protein (%)	Crude fibre (%)	Crude fat (%)	Crude protein yield (t ha^{-1})
T_1: 100% RDN through inorganic fertilizers	18.73	45.91	1.42	1.20
T_2:100% RDN through FYM	17.03	41.64	1.15	0.99
T_3: 75% RDN through FYM+25% RDN through vermicompost	17.67	43.41	1.31	1.07
T_4: 75% RDN through FYM+25% RDN through Bio-compost	16.67	40.34	1.12	0.96
T_5: 50% RDN through FYM+50% RDN through vermicompost	20.93	50.09	1.71	1.45
T_6: 50% RDN through FYM+50% RDN through Bio-compost	16.45	37.68	0.98	0.88
T_7: 75% RDN through FYM	16.01	33.31	0.93	0.79
T_8: 50% RDN through FYM+25% RDN through vermicompost +25% RDN through biocompost	17.32	42.45	1.20	1.02
SEm±	0.38	1.03	0.07	0.08
CD (p=0.05)	0.81	2.21	0.15	0.22

RDN through FYM+50% RDN through Vermicompost] followed by T_1 [100% RDN through inorganic fertilizers] (50.4) and T_7 i.e., 75% RDN through FYM recorded lowest number of pods plant^{-1} (42.6). Seeds pod^{-1} also followed the same trend as pods plant^{-1}.

Response of test weight (g) of ricebean crop to different organic sources of nitrogen was non-significant (NS). The result was due to grain size which is a genetically controlled character and varietal specific, thus influenced little by management practices.

Application of T_5 [50% RDN through FYM+50% RDN through Vermicompost] recorded significantly higher seed yield (494 kg ha^{-1}) followed by T_1 i.e., 100% RDN through inorganic fertilizers (447 kg ha^{-1}). This result was due to better physical conditions, growth and yield contributing parameters, prolonged availability of nutrients, beneficial soil microorganisms and good source and sink relationship with vermicompost, create better environment for higher growth and yield attributing characters like number of pods plant^{-1}, seeds pod^{-1} which finally increases seed yield. These results were in conformity with Kumar and Pandita, (2014) and Sharma and Bhandari (2002).

3.3. Effect of different organic sources of nitrogen on green forage and drymatter yield

Significantly higher green forage yield (34.87 t ha^{-1}) was recorded with T_5 i.e., 50% RDN through FYM+50% RDN through Vermicompost followed by T_1 i.e. 100% RDN through inorganic fertilizers (32.81 t ha^{-1}) which was statistically on par with T_3 i.e. 75% RDN through FYM+25% RDN through vermicompost (32.37 t ha^{-1}) and lowest green forage yield (25.88 t ha^{-1}) with application of 75% RDN through FYM , was presented in table 1. This might be due to increased availability of soil nitrogen, other macro and micro nutrients that might have enhanced meristematic growth and resulted in higher green forage yield. This was in accordance with the findings of Kumar et al. (2009).

Green forage yield and dry matter yield data was analysed statistically and presented in table 3. Significantly higher green forage yield (34.87 t ha^{-1}) was recorded with T_5 i.e. 50% RDN through FYM+50% RDN through Vermicompost followed by T_1 i.e. 100% RDN through inorganic fertilizers (32.81 t ha^{-1}) which was statistically on par with T_3 i.e. 75% RDN through FYM+25% RDN through vermicompost (32.37 t ha^{-1}) and lowest green forage yield (25.88 t ha^{-1}) with application of 75% RDN through FYM. This might be due to increased availability of soil nitrogen, other macro and micro nutrients that might have enhanced meristematic growth and resulted in higher green forage yield. This was in accordance with the findings of Tennarasu et al. (2014) and Kumar et al. (2009). Dry matter yield was significantly higher (6.92 t ha^{-1}) with T_5 i.e. 50% RDN through FYM+50% RDN through Vermicompost followed by T_1 i.e. 100% RDN through inorganic fertilizers (6.43 t ha^{-1}) which was statistically on par with T_3 i.e. 75% RDN through FYM+25% RDN through vermicompost (6.12 t ha^{-1}) and lowest dry matter yield (5.0 t ha^{-1}) was observed with [T_7] 75% RDN through FYM. This result might be due to higher macro and micro nutrients, plant growth regulators in vermicompost, leading to higher photosynthetic rate and overall dry matter yield.

3.4. Effect of different organic sources of nitrogen on quality parameters

The data regarding the quality parameters were presented in table 2. Crude protein percentage of 20.93% was recorded with application of 50% RDN through FYM+50% RDN

Table 3: Effect of different organic nitrogen sources on production economics of dual purpose ricebean (Mean value of two years)

Treatments	Costof cultivation (₹)	Gross returns (₹)	Net returns (₹)	B:C ratio
T_1: 100% RDN through inorganic fertilizers	47210	138943	91732	2.94
T_2:100% RDN through FYM	53277	123455	70177	2.32
T_3: 75% RDN through FYM+25% RDN through vermicompost	54555	133935	79379	2.46
T_4: 75% RDN through FYM+25% RDN through Bio-compost	53790	121363	67572	2.26
T_5: 50% RDN through FYM+50% RDN through Vermicompost	55832	151589	95756	2.72
T_6: 50% RDN through FYM+50% RDN through Bio-compost	54485	113011	58525	2.07
T_7: 75% RDN through FYM	51777	108792	57015	2.10
T_8: 50% RDN through FYM+25% RDN through vermicompost +25% RDN through biocompost	55487	127102	71614	2.29

through Vermicompost [T_5] followed by T_1 i.e. 100% RDN through inorganic fertilizers (18.73%) and T_3 i.e. 75% RDN through FYM+25% RDN through vermicompost (17.67%) and lower crude protein of 16.01% was noticed with application of [T_7] 75% RDN through FYM. Crude protein yield, Crude fibre and crude fat followed the same trend as crude protein.

3.5. Effect of different organic sources of nitrogen on production economics

The data of Production economics were included in table 3. Among the all nitrogen management interventions higher B:C ratio with T_1 i.e.100% RDN through inorganic fertilizers) was due to higher yield coupled with lower cost of inorganic fertilizers. Although T_5 [50% RDN through FYM+50% RDN through Vermicompost] treatment recorded higher gross returns but increased cost of cultivation with application of organic manures resulted in relatively lower B:C ratio. Similar results were also recorded by and Yadav and Malik (2010).

4. CONCLUSION

Application of 50% RDN through FYM+50% RDN through vermicompost recorded highest green forage yield, seed yield and quality parameters like crude protein, crude fibre etc, with a good B:C ratio of 2.72.

5. REFERENCES

Dasgupta, P., Goswami, R., Ali, N., Chakraborthy, S., Saha, S.K., 2015. Multifunctional role of integrated farming system in developing countries. International Journal of Bio-resource and Stress Management 6(3), 424–432.

Gomez, K.A., Gomez, A.A., 1984. Statistical procedures for agricultural research. An international rice research institute book, John Wiley & Sons, New York, 680.

Jana, K., Kundu, C.K., Mondal, R., Mondal, K., Banerjee, S., De, D.K., 2019. Contributed article productivity enhancement of food–forage cropping system for sustainability and livelihood security of resource poor farming community in West Bengal under changed climate. Progressive Agricultural Sciences, 37–47.

Joshi, K.D., Bhandari, B., Gautam, R., Bajracharya, J., Hollington, P.A., 2006. Ricebean a multi-purpose underutilized legume. In: 5th International Symposium on New Crops and Uses their roles in a rapidly changing world, University of Southampton, U.K., 23–28.

Kumar, M.D., Devaraju, K.M., Madaiah, D., Shivakumar K.V., 2009. Effect of integrated nutrient management on yield and nutrient content by cardamom (*Elettaria cardamomum* L. *Maton*.). Karnataka Journal of Agricultural Sciences 22(5), 1016–1019.

Kumar, A., Panditha, V.K., 2014. Effect of integrated nutrient management on seed yield and quality in cowpea. Legume Research 9(3), 448–452.

Kundu, C.K., 2018. Ricebean. Forage crops of world. In: Hedayetullah, Md., Zaman, P. (Eds.), Apple Academic Press, Florida, U.S.A., 199–212.

Qaman, I.A., Ahmad, M., Riaz, G., Khan, S., 2014. Performance of summer forage legumes and their residual effect on subsequent oat crop in subtropical sub humid Pothwar, Pakistan. Pakistan Journal of Agriculture Research 27(1), 14–20.

Rani, Y.S., Triveni, U., Patro, T.S.S.K., 2017. Integrated nutrient management for enhancing soil health, yield and quality of little millet (*Panicum sumatrense*).

International Journal of Bio-resource and Stress Management 8(1), 26–31.
Sharma, S.R., Bhandari, S.C., 2002. Effect of organic manure and nutrients on symbiotic efficiency in cowpea. Indian Journal of Pulses Research 15(2), 156–160.
Yadav, S.K., Babalad, H.B., Sharma, S.K., Choudary, R.S., Naresh, K., 2016. Impact of organic nutrient management practices on yield attributes and yield of summer mungbean. International Journal of Bio-resource and Stress Management 7(5), 1136–1139.
Yadav, R.D., Malik, C.V.S., 2010. Effect of rhizobium inoculation and various sources of nitrogen on growth and yield of cowpea (*Vigna unguiculata* (L.) *Walp.*). Legume Research–An International Journal 28(1), 38–41.