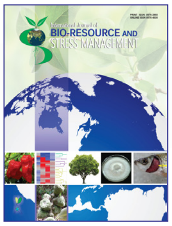

Article AR2095 DOI: HTTPS://DOI.ORG/10.23910/1.2020.2095

International Journal of Bio-resource and Stress Management

June 2020

Crossref

Print ISSN 0976-3988
Online ISSN 0976-4038

IJBSM 2020, 11(3):225-231

Research Article Natural Resource Management

Nutrient Management on the Water Productivity and Profitability of Hyacinth Bean in Baby Corn (*Zea mays* L.) - Hyacinth Bean (*Lablab purpureus* var. *typicus*) Cropping System

R. Preetham[1*], K. Avil Kumar[2], A. Srinivas[3], A. Manohar Rao[4] and T. Ramprakash[5]

[1]Horticultural Research Station, Adilabad, SKLTSHU, Telangana (504 001), India
[2]RARS, Palem, PJTSAU, Telangana (509 201), India
[3]ARI, PJTSAU, Telangana (500 030), India
[4]College of Agriculture, Rajendranagar, PJTSAU, Telangana (500 030), India
[5]AICRP on Weeds, WTC, Rajendranagar, PJTSAU, Telangana (500 030), India

Open Access

Corresponding Author

R. Preetham

e-mail: rachala_p@rediffmail.com

Citation: Preetham et al., 2020. Nutrient Management on the Water Productivity and Profitability of Hyacinth Bean in Baby Corn (*Zea mays* L.) - Hyacinth Bean (*Lablab purpureus* var. *typicus*) Cropping System . International Journal of Bio-resource and Stress Management 2020, 11(3), 225-231. HTTPS://DOI.ORG/10.23910/1.2020.2095.

Copyright: © 2020 Preetham et al. This is an open access article that permits unrestricted use, distribution and reproduction in any medium after the author(s) and source are credited.

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.

Conflict of interests: The authors have declared that no conflict of interest exists.

Acknowledgement: The research was conducted with the kind support of Sri Konda Laxman Telangana State Horticultural University and Professor Jayashankar Telangana State Agricultural University. Authors acknowledge all members of Horticultural Research Station farm, SKLTSHU, Adilabad, Telangana State, India for their sincere cooperation.

Article History

RECEIVED in 24th April 2020 RECEIVED in revised form 26th May 2020 ACCEPTED in final form 30th May 2020

Abstract

The field experiments were conducted in semi-arid region during *rabi* seasons of 2015-16 and 2016-17 to study the effect of integrated nutrient management practices on water productivity and profitability of hyacinth in baby corn – hyacinth bean cropping system. Experiment was laid in Randomized Block Design for baby corn during *kharif* 2015 with seven treatments comprised of 100% recommended dose of fertilizers (RDF 150:27:50 N, P and K kg ha^{-1}), 25% N supplemented through farm yard manure or vermicompost+75% RDF with or without bio-fertilizers *Azospirillum* and *Bacillus megaterium* @ 5 kg ha^{-1} each in addition to control and replicated thrice. Each main treatment was divided into four subplots and the treatments of 100% RDF (20-22 N, P kg ha^{-1}) and 75% RDF with or without *Bradyrhizobium* @ 500 g ha^{-1} (seed treatment) were imposed for hyacinth bean in *rabi* seasons and data was analyzed in split plot design. Integration of 100% RDF in conjunction with *Bradyrhizobium* seed treatment to hyacinth bean resulted in significantly higher water productivity, gross and net returns and maximum B:C during *rabi*compared to 100% RDF, 75% RDF with or without seed treatment. Integration of 75% RDF with 25% N through FYM along with biofertilizers to *kharif* baby corn showed significantly higher water productivity, gross and net returns of hyacinth bean during *rabi*over rest of the treatments of 100% RDF with or without biofertilizers and un-fertilized control but was at par with other organic treatments with or without biofertilizers due to residual effect.

Keywords: Hyacinth bean, water productivity, gross returns, net returns

1. Introduction

Lablab bean or hyacinth bean is one of the most ancient among the cultivated legumes and is gown throughout the tropical regions of Asia, Africa and America. It has been cultivated in India since earliest times (Purseglove, 1997). The crop is indigenous to India and grown all over the country. The crop is put to multipurpose uses such as pulse, vegetable and fodder. The crop is mainly grown for green pods, while the dry seeds are used in the preparation of various vegetarian dishes and is rich in proteins. The foliage of the crop can be used as silage and green manure. It occupies a unique position as vegetable among the legume crops due to its high nutritive value (Basu et al., 2002). The dwarf, bushy types of hyacinth bean are determinate and are photo insensitive and can be cultivated throughout the year. Dwarf varieties (determinate bush-type) have a potential for more extensive cultivation of the crop, because of the plants require no support system, the pods mature uniformly and the crop is amenable to mechanical harvesting which will reduce cost and labour.The crop has good demand in market as it is being cultivated in limited area and due to its markedly low productivity. Low productivity of this crop is attributed mainly due to inadequate nutrient management practices. Use of chemical fertilizers along with biofertilizers may increase productivity of dolichos bean, soil fertility and reduces the costs of production (Gandhi and Sivakumar, 2010). Bio fertilizer application was helpful to maintain diversity in agricultural ecosystems which are living in rhizosphere environment and are capable of improving plant nutrition and soil fertility through biological fixation of nitrogen, phosphate solubilization, and enhancement of plant growth (Akram et al., 2014). *Bradyrhizobium* inoculation to various legume crops significantly improved nodulation and dry matter production (Mahdi and Mustafa, 2005).

Baby corn is de-husked cob, harvested two or three days after silk emergence. Baby corn proved enormously successful in countries like Thailand, Taiwan, Sri Lanka and Myanmar. Baby corn cultivation is now picking up in Meghalaya, Western Uttar Pradesh, Haryana, Maharashtra, Karnataka and Andhra Pradesh. Baby corn is the high value crop and quality is the prime factor than quantity, integration of organics and bio fertilizers assumes significance.Application of organic manures like farmyard manure and vermicompost proved to be a better alternative to inorganic fertilizers in enhancing growth and yield of the plant (Arora and Maini, 2011; Aleem et al., 2014). Application of chemical fertilizer persist several pros and cons, although their application assist in obtaining maximum production, but keeping in mind the hazardous effect on environmental health as well as growing production cost due to its being expensive, the judicious use of fertilizers from different source as crop will maintain the environmental sustainability for generations without affecting the environmental health (Ranjanet al., 2013); Dadarwal et al.(2009); Kumar et al. (2014). Judicious combination of organic manures (Suri et al., 1997), or bio fertilizers viz., *Azospirillum* (Rai and Gaur, 1982) and phosphobacteria (Dutta et al., 1992) along with in organic fertilizers not only reduce the quantity of chemical fertilizers but also improve the yield and quality of crop produce. Water is an important factor in *rabi* which governs the yield. In view of the above a study was conducted to assess the water productivity and economics of hyacinth bean in baby corn-hyacinth bean cropping system with integrated use of microbial cultures and inorganic fertilizers.

2. Materials and Methods

2.1. Experimental site

Field experiments were carried out during *rabi* seasons of 2015-16 and 2016-17 at Horticultural Research Station, (19°08′ 09″N latitude, 79° 56′ 03″ E longitude and 264 m altitude) Adilabad, Telangana State, India which has a semi-arid climate. The experimental soil was sandy clay loam in texture, neutral in reaction (7.31), medium in available nitrogen (320 kg ha^{-1}), phosphorous (26 kg ha^{-1}) and potassium (240 kg ha^{-1}) and belongs to the order Alfisol of medium depth. The experiment was laid out in randomized block design (RBD) replicated thrice during *kharif*, 2015 with seven treatments comprised of 100% Recommended dose of fertilizer (RDF, 150:27:50 N, P, and K kg ha^{-1}), 25% N supplemented through Farm Yard Manure (FYM) or vermicompost (VC)+75% RDF with or without soil application of *Azospirillum* and *Bacillus megaterium* @ 5 kg/ha each and unfertilized control. During *rabi* season each main treatment was divided into four subplots for hyacinth bean and the treatments of viz.,100% RDF (20 kg N, 22 kg P ha^{-1}) and 75% RDF with or without *Bradyrhizobium* @ 500 g ha^{-1} (seed treatment) were imposed in split plot design.

2.2. Method of data collection

Effective rainfall was calculated as per the water budgeting method described in the FAO irrigation and drainage paper 25 by Dastane, 1974. The quantity of effective rainfall during *rabi*, 2015-16 and 2016-17 was 0.0 mm, 60.4 mm respectively. Amount of water applied to each treatment for irrigation was measured by parshall flume. The total amount of water applied (irrigation water applied+effective rainfall) to hyacinth bean corn crop during *rabi* 2015-16 and 2016-17 was 800.0 and 760.4 mm, respectively. Total number of pods harvested from five randomly selected plants in different pickings was counted and average number calculated. Twenty pods were selected at random from each treatment at each picking and recorded the mean pod length and mean pod weight. To find out the economic viability of the system, the cost of cultivation, gross returns, net returns and benefit cost ratio were worked out. The expenditure incurred from field preparation to harvest of hyacinth bean was worked out and expressed as ₹ ha^{-1}. The crop yield was computed $ha^{-1}$and the total income was worked out based on the market rate which was prevalent during the time of study. The local price of hyacinth bean was Rs.20 per kg during *rabi*, 2015-16 and 2016-17 were considered for computing gross monitory returns. Net realization of each treatment was calculated by deducting the total cost of cultivation from the gross returns and is expressed as Rs. ha^{-1}. Benefit: cost ratio (BCR) of each treatment was calculated by using the following formula suggested by Subbareddy and Raghuram (1966).

B: C ratio = (Gross returns (₹ ha^{-1}) ÷Total cost of cultivation (₹ ha^{-1}))

The data was analyzed statistically using *F*-test following Gomez and Gomez (1984). LSD values at $p<0.05$ were used to determine the significance of difference between treatment means.

3. Results and Discussion

3.1. Variation in Yield attributes (*Pod number, pod length and pod weight*)

Least number of pods $plant^{-1}$, minimum pod length and mean pod weight was produced with application of 75% RDF alone to hyacinth bean. Significantly higher number of pods $plant^{-1}$, maximum pod length and mean pod weight were recorded with 100% RDF in conjunction with *Bradyrhizobium* seed treatment over 100% RDF, 75% RDF and 75% RDF in conjunction with seed treatment (Table 1). These results are in agreement with those of Noor et al. (1992) in hyacinth bean, Dwivedi et al. (2002) in *Dolichos* bean, Datta et al. (2005) in fenugreek and Tagore

Table 1: Effect of integrated nutrient management practices on yield attributes, yield and water productivity (kg mm^{-1}) of hyacinth bean in sequence with *kharif* baby corn.

Treatments	No. of pods $Plant^{-1}$	Mean pod length (cm)	Mean pod weight (cm)	*Yield (kg ha^{-1})	*Water productivity (kg mm^{-1})
Main treatments- (*Kharif*-Baby corn)					
T_1	41.65	9.22	4.22	7816	10.02
T_2	43.05	9.30	4.29	7986	10.24
T_3	41.00	9.10	4.19	7682	9.86
T_4	41.50	9.16	4.23	7793	10.00
T_5	33.70	7.98	3.89	6516	8.36
T_6	35.60	8.41	3.97	6790	8.70
T_7	25.35	7.07	3.59	5944	7.62
SEm±	0.75	0.10	0.04	106	0.14
CD (p=0.05)	2.40	0.29	0.12	326	0.42
Sub-treatments– (*Rabi*-Hyacinth bean)					
S_1-100% RDF	37.85	8.67	4.10	7364	9.45
S_2-75% RDF	34.00	8.33	3.85	6726	8.63
S_3-100% RDF+*Bradyrhizobium* @ 500 g ha^{-1} seed treatment	41.15	8.92	4.26	7647	9.81
S_4-75% RDF+*Bradyrhizobium* @ 500 g ha^{-1} seed treatment	36.70	8.50	4.01	7135	9.15
SEm±	0.63	0.08	0.04	86	0.11
CD (p=0.05)	1.80	0.22	0.10	244	0.31
Interaction between					
Bean treatment means at same level of baby corn INM treatments					
SEm±	1.70	0.20	0.09	226	0.30
CD (p=0.05)	NS	NS	NS	NS	NS
INM treatment means of baby corn at same or different level of bean treatments					
SEm±	1.70	0.20	0.09	223	0.29
CD (p=0.05)	NS	NS	NS	NS	NS

* Pooled data of *Rabi*, 2015-16 and 2016-17; T_1: 25% N through FYM+75% RDF; T_2: 25% N through FYM+75% RDF+*Azospirillum* and *Bacillus megaterium* @ 5 kg ha^{-1} each; T_3: 25% N through VC+75% RDF; T_4: 25% N through VC+75% RDF+*Azospirillum* and *Bacillus megaterium* @ 5 kg ha^{-1} each; T_5: 100% RDF; T_6: 100% RDF+*Azospirillum* and *Bacillus megaterium* @ 5 kg ha^{-1} each T_7: Control (No fertilizer application)

et al. (2013) in chick pea. Application of 100% RDF alone showed significantly higher number of pods plant^{-1}, mean pod length and mean pod weight over 75 % RDF alone and was at par with 75% RDF along with *Bradyrhizobium* seed treatment to hyacinth bean.

Organic and inorganic sources of nutrition in conjunction with biofertilizers to preceding baby corn crop during *kharif* season showed significant higher number of pods plant^{-1}, mean pod length and mean pod weight of hyacinth bean in succeeding *rabi* seasons over un-fertilized control. Among the different treatments imposed to *kharif* baby corn, application of 75% RDF integrated with 25% N through FYM in conjunction with biofertilizers recorded significantly higher number of pods plant^{-1}, maximum pod length and mean pod weight in succeeding hyacinth bean crop during *rabi* and was at par with other organic treatments of integration of 75% RDF with 25% FYM through VC with or without biofertilizers and integration of 75% RDF with 25% N through FYM (Table 1). Application of 100% RDF in conjunction with the biofertilizers to *kharif* baby corn resulted in the record of significantly higher pods plant^{-1}, mean pod length and pod weight in the succeeding *rabi* hyacinth bean over un-fertilized control and was at par with 100% RDF.

3.2. Variation in yield (kg ha^{-1})

Application of 100% RDF to hyacinth bean along with seed treatment with *Bradyrhizobium* resulted in significantly higher pod yield (7647 kg ha^{-1}) during *rabi* over 100% RDF alone, 75% RDF with or without seed treatment (Table 1). Application of 75% RDF in conjunction with seed treatment to hyacinth bean resulted in significantly higher pod yields over 75% RDF alone and was at par with 100% RDF alone. Significantly lower pod yields of hyacinth bean were recorded with the application of 75% RDF alone than rest of the treatments. Significant higher yields in *Bradyrhizobium* inoculated treatment may be due to increased availability of nitrogen, phosphorus and potassium in soil which gave scope for higher plant uptake of nutrients, which in turn might have resulted in higher plant growth and improved yield attributes and ultimately resulted in higher yield. The promising effect of biofertilizers may be attributed to production of biologically active substances like vitamins, nicotinic acid, Indole-acetic acid, gibberellins *etc*., in better germination, root and shoot growth and fixation of atmospheric nitrogen (Dutta and Banik, 1997). Similar results of higher yields with RDF in conjunction with biofertilizer seed treatment were reported by Hunter (1994) in soybean, Abdallah and Omer (2001); Rughheim and Abdelgani (2009) in faba bean, Rudresh et al. (2005) and Bhuiyan et al. (2008) in chick pea, Shehata and Khawas (2003) in sunflower. Imposition of various treatments to preceding *kharif* baby corn resulted in significant variations on the yields of succeeding hyacinth bean during *rabi*due to residual effect. Integration of 75% RDF with 25% N through FYM or VC with or without biofertilizers during *kharif* resulted in significantly higher pod yields of succeeding *rabi* hyacinth bean over 100% RDF with or without biofertilizers and un-fertilized control (Table 1).

Residual effect due to application of 100% RDF with or without biofertilizers during *kharif* to baby corn showed significantly higher pod yields of hyacinth bean in the succeeding *rabi,* over 100% RDF alone and un-fertilized control though these were significantly lower than the treatments having organic manures. Reducing 25% of inorganic fertilizers resulted in significant reduction in yield of hyacinth bean; however seed treatment with *Bradyrhizobium*compensated the loss of yield and was at par with 100% RDF.Residual effect of FYM applied to baby corn was higher compared to VC on the succeeding hyacinth bean. Presence of persistent material, *i.e.,* cellulose in FYM which required longer time for complete decomposition, thus nutrients released from FYM for longer periods might had notable benefits on succeeding hyacinth bean.

Organic manures (FYM and VC), apart from serving as source of nutrients (Macro and micro) to a certain extent, their decomposition might have produced ligands capable of complex ion nutrient elements. Such complexes might have remained and are more available to plant roots as complex shields than against immobilization in soil. In addition several indirect effects of organic matter on improvement of soil fertility have been well documented like increased availability of phosphorus (Stevenson, 1982), acceleration in the availability of several micro nutrients like iron, manganese etc., (Katyal, 1986) and improvement in soil microorganisms. All these factors might have helped in better growth, yield attributes and yield of hyacinth bean.

3.3. Variation in water productivity (kg mm^{-1})

Significant variations were observed in water productivity of hyacinth bean due to the treatments imposed during *rabi*and residual effect by the treatments imposed in the preceding *kharif* baby corn. The interaction between hyacinth bean treatments means at same level of INM treatments and INM treatment means of baby corn at same or different level of hyacinth bean treatments for water productivity were found non-significant.Application of 100% RDF along with seed treatment with *Bradyrhizobium* to hyacinth bean resulted in significantly higher water productivity of 9.81kg mm^{-1} which is 3.8, 7.2 and 13.7% more over 100% RDF alone, 75% RDF with or without seed treatment respectively (Table 1). Application of 75% RDF along with seed treatment showed at par water productivity of hyacinth bean with 100% RDF alone and was significantly superior over 75% RDF alone.Significant variations were observed in the water productivity of hyacinth bean due to residual effect of treatments imposed to *kharif* baby corn. Integration of 75% RDF with 25% N through FYM along with biofertilizers showed significantly higher water productivity over rest of the treatments of 100% RDF with or without biofertilizers and un-fertilized control but was at par with other organic treatments with or without biofertilizers. Use of 100% RDF along with biofertilizers to *kharif* baby corn resulted in significantly higher water productivity of hyacinth bean in the succeeding *rabi* over 100% RDF and un-fertilized control.

3.4. Economics

Significant variations were noticed among the different treatments means in the gross returns and net returns of *rabi*hyacinth bean due to the treatments imposed to preceding *kharif* baby corn and succeeding *rabi* hyacinth bean.

3.4.1. Variation in gross and net returns

Integration of 100% RDF in conjunction with *Bradyrhizobium* seed treatment to hyacinth bean resulted in significantly higher gross and net returns (₹ 152940 ha^{-1} and ₹ 113499 ha^{-1}, respectively) over 100% RDF, 75% RDF with or without seed treatment. The increase in gross returns was to the tune of 3.85, 7.18 and 13.7% and the increase in net returns was 4.98, 9.2 and 18.46% over 100% RDF and 75% RDF with and without bacterial inoculation respectively. Similar results of higher net returns were reported by Stephan et al. (2017) with *Rhizobium* inoculation to cow pea. Higher gross and net returns are due to higher pod yields of hyacinth bean. Application of 75% RDF in conjunction with seed treatment to hyacinth bean resulted in significantly higher gross and net returns over 75% RDF alone and was at par with 100% RDF (Table 2). Significantly lower gross and net returns of ₹ 134510 ha^{-1} was observed

Table 2: Effect of integrated nutrient management practices on economics (gross returns, cost of cultivation, net returns and B:C ratio) of hyacinth bean in sequence with *kharif* baby corn

Treatments	*Gross returns ₹ ha^{-1} (US \$ ha^{-1})**	*Cost of cultivation ₹ ha^{-1} (US \$ ha^{-1})**	*Net returns ₹ ha^{-1} (US \$ ha^{-1})**	*B:C
Main treatments- (*Kharif*-Baby corn)				
T_1	156310 (2445.2)	39038 (610.8)	117272 (1834.4)	4.01 (4.00)
T_2	159710 (2499.4)	39038 (610.8)	120672 (1888.6)	4.09 (4.09)
T_3	153640 (2403.6)	39038 (610.8)	114602 (1792.8)	3.94 (3.94)
T_4	155850 (2438.0)	39038 (610.8)	116812 (1827.2)	4.00 (3.99)
T_5	130310 (2040.9)	39038 (610.8)	91272 (1430.1)	3.34 (3.34)
T_6	135790 (2126.7)	39038 (610.8)	96752 (1515.9)	3.48 (3.48)
T_7	118880 (1860.0)	39038 (610.8)	79842 (1249.2)	3.05 (3.05)
SEm±	2112 (33.2)		2112 (33.2)	
CD (*p*=0.05)	6508 (102.3)		6508 (102.3)	
Sub-treatments– (*Rabi*-Hyacinth bean)				
S_1-100% RDF	147270(2304.5)	39241 (614.0)	108029 (1690.5)	3.76 (3.75)
S_2-75% RDF	134510 (2105.3)	38704 (605.5)	95806 (1499.8)	3.48 (3.48)
S_3-100% RDF+Bradyrhizobium @ 500 g ha^{-1} Seed treatment	152940 (2393.0)	39441 (617.1)	113499 (1775.9)	3.88 (3.88)
S_4-75% RDF+Bradyrhizobium @ 500 g ha^{-1} Seed treatment	142700 (2233.6)	38769 (606.6)	103931 (1627.0)	3.68 (3.68)
SEm±	1707 (26.5)		1707 (26.5)	
CD (*p*=0.05)	4872 (75.5)		4872 (75.5)	
Interaction between				
Bean treatment means at same level of baby corn INM treatments				
SEm±	4516 (70.1)		4516 (70.1)	
CD (*p*=0.05)	NS		NS	
INM treatment means of baby corn at same or different level of bean treatments				
SEm±	4466 (69.4)		4466 (69.4)	
CD (*p*=0.05)	NS		NS	

* Pooled mean data of *Rabi*, 2015-16 and 2016-17; **1 US \$ = ₹ 60.38 (2015-16), 1 US \$ = ₹ 67.96 (2016-17) at harvesting time

with application of 75% RDF alone. Reduction in 25% RDF (From 100% RDF to 75 % RDF) resulted in significantly lower gross and net returns, which was very well compensated by the use of *Bradyrhizobium* @ 500 g ha^{-1} for seed treatment (Table 2). Conjunctive use of RDF with 25% N through FYM or VC with or without biofertilizers in preceding *kharif* baby corn resulted in significantly higher gross and net returns in the succeeding hyacinth bean crop of *rabi* over rest of the treatments of 100% RDF with or without biofertilizers and un-fertilized control.

Maximum gross and net returns (₹ 159710 & ₹ 120672 ha^{-1}) in *rabi* respectively were noticed with integration of 75% RDF with 25% N through FYM in conjunction with biofertilizers in preceding *kharif* baby corn and was at par with other organic treatments of 75% RDF combined with 25% N through VC with or without biofertilizer and 75% RDF with 25% N through FYM. Similar results of increased gross and net returns were reported by Sinha., 2017 in horse gramwith application of chemical fertilizers along with FYM to baby corn over only chemical fertilizers. Srinivasan et al., 2014 also reported increased net returns in baby corn due to residual effect of 100% RDF along with organic manures applied to preceding cabbage crop. Least gross and net returns were recorded due to residual effect of un-fertilized control.Use of microbes (*Azospirillum* and *Bacillus megaterium*) along with 100% RDF to preceding *kharif* baby corn resulted in significantly higher gross and net returns in the succeeding hyacinth bean during *rabi* over 100% RDF and un-fertilized control.

3.4.2. Variation in B:C ratio

Use of 100% RDF in conjunction with *Bradyrhizobium* seed treatment of hyacinth bean, recorded maximum B:C ratio (3.88) during *rabi*compared to application of 75% or 100% RDF alone and integration of 75% RDF with biofertilizers for seed treatment (Table 2). Application of 100% RDF alone to hyacinth bean during *rabi* resulted in higher B:C ratio in comparison with 75% RDF alone and integration of 75% RDF with the use of *Bradyrhizobium* for seed treatment.

Integration of 75% RDF with organics (FYM or VC) with or without biofertilizers (*Azospirillum and Bacillus megaterium*) during *kharif* resulted in the realization of higher B:C ratio's due to residual effect in the succeeding *rabi*in contrast to 100% RDF with or without the use of microbes and un-fertilized control (Table 2). Residual effect of biofertilizers (*Azospirillum and Bacillus megaterium*) applied to *kharif* baby corn along with 100% RDF resulted in maximum B:C ratio compared to 100% RDF (alone) and un-fertilized control in the succeeding hyacinth bean crop during *rabi*. Integration of VC (25% N) with 75% RDF to *kharif* baby corn resulted in higher B:C ratio in the succeeding *rabi* hyacinth bean compared to 100% RDF with or without biofertilizer and un-fertilized control and combined use of 75% RDF with 25% N through FYM.

4. Conclusion

Integration of 100% RDF in conjunction with *Bradyrhizobium* seed treatment to hyacinth bean is recommended for hyacinth bean during *rabi* and application of vermicompost (25% N) in combination with 75% recommended dose of fertilizer along with bio-fertilizers during *kharif* for baby corn for higher water productivity, gross and net returns and benefit to cost ratio in baby corn- hyacinth bean cropping system.

5. Acknowledgement

The research was conducted with the kind support of Sri Konda Laxman Telangana State Horticultural University and Professor Jayashankar Telangana State Agricultural University. Authors acknowledge all members of Horticultural Research Station farm, SKLTSHU, Adilabad, Telangana State, India for their sincere cooperation.

6. References

Abdallah, M.H., Omar, S.A., 2001. Survival of *Rhizobia* / *Bradyrhizobia* and rock phosphate solubilizing fungus *Aspergillus niger* on various carriers from some agro-industrial wastes and their effects on nodulation and growth of faba bean and soya bean. Journal of Plant Nutrition 24, 261−272.

Akram, J.F., Tayeb, S.N.,Mojadam, M., 2014. Effect of different methods of *Rhizobium b*acteria inoculation on biological nitrogen fixation in broad bean. International journal of plant, animal and environmental science 4(2), 346−352.

Aleem, M.O., Alamu, L.O., Olabode, S.O., 2014. Allelopathic effect of some selected tree species on the germination and growth of cowpea (*Vigna unguiculata* L. Walp.). Journal of Forestry 4(4), 47742-5.

Arora, N., Maini, P., 2011. Anaerobic digested slurry-an input for sustainable agriculture. Asian Journal of Experimental Science 25(1), 59−62

Basu, A.K., Samantha, S.K., Sasmala, A.C., 2002. Genetic analysis for some seed parameters in Lablab bean. Vegetable Science 32(2), 129−132.

Bhuiyan, M.A.H., Khanam, D., Hossain, M.F., Ahmed, M.S., 2008. Effect of *Rhizobium* inoculation on nodulation and yield of chick pea in calcareous soil. Bangladesh Journal of Agricultural Research 33(3), 549−554.

Dadarwal, R.S., Jain, N.K., Singh, D., 2009. Integrated nutrient management in baby corn (*Zea mays*). Indian Journal of Agricultural Sciences 79(12), 1023−1025.

Dastane, N.G., 1974. Effective rainfall in irrigated agriculture. F.A.O Irrigation and drainage paper 25, Food and Agriculture Organization of the United Nations, Rome, Italy.

Datta, S., Chattarjee, R., Mukharjee, S., 2005. Variability, heritability and path analysis studies in fenugreek. Indian Journal of Horticulture 62(2), 96−98.

Dutta, M., Banik, S., 1997. Comparative efficacy of different phosphatic fertilizers and phosphor bacterium (*Bacillus firmus*) on rice (*Oryza sativa*) in acid soil. Indian Journal of Agricultural Sciences 67, 545−547.

Dutta, M., Banik. S., Laskar, S., 1992. Effect of inoculation of phosphate dissolving bacteria on rice (*Oryza sativa*) in acid soils. Indian Journal of Agricultural Sciences 62, 482−485.

Dwivedi, Y.C., Kushwah, S.S., Sengupta, S.K., 2002. Studies on nitrogen, phosphorus and potash requirement of *Dolichos* bean. Jawaharlal Nehru Krishi Vishwa Vidyalaya Research Journal 36(1-2), 47−50.

Gandhi, A., Sivakumar, K., 2010. Impact of Vermicompost carrier based bio-inoculants on the growth, yield and quality of rice (*Oryza sativa*) cv. NLR-145. The Ecoscan 4(1), 83−88.

Gomez, K.A., Gomez, A.A., 1984. Statistical Procedure for Agricultural Research John-Wiley and Sons Inc., New York. 258−259.

Hunter, W.J., 1994. Increased nodulation of soybean by a strain of *Bradyrhizobium japanicum* with altered tryptophan metabolism. Journal of Applied Microbiology 18(6), 340−342.

Katyal, L.C., 1986. Research achievements of All India Co-ordinated Scheme of micronutrients in soil and plants. Fertilizer News 30, 67−70.

Kumar, A., Meena, R.N., Yadav, L., Gilotia, Y.K., 2014. Effect of organic and inorganic sources of nutrient on yield, yield attributes and nutrient uptake of rice cv. PRH-10. The Bioscan 9, 595−597.

Mahdi, A.A., Mustafa, E.M.A., 2005. Response of guar to *Bradyrhizobium* inoculation and to nitrogen and phosphorus fertilization. U.K. The Journal of Agricultural Science 13, 97−100.

Noor, S., Huq, M.S., Yasmin, I., 1992. Effect of fertilizer and organic manure on the yield of hyacinth bean (*Dolichos lablab* L.) Legume Journal of Asian Horticulture 7(2), 95−98.

Purseglove, J.W., 1977. Tropical Crops Dicotyledons, Longman, London, 273–276.

Rai, S.N., Gaur, A.C., 1982. Nitrogen fixation by *Azospirillum* spp. and effect of *Azospirillum lipoferum* on the yield and N uptake of wheat crop. Plant and Soil 69, 233−238.

Ranjan, J.K., Ahmed, N., Das, B., Ranjan, P., Mishra, B.K., 2013. Green technology for production of baby corn (*Zea mays* L.) under north-west Himalayan conditions. International Journal of Chemical Technology Research 5(2), 880−885.

Rudresh, D.L., Shivaprakash, M.K., Prasad, R.D., 2005. Effect of combined application of *Rhizobium,* phosphate solubilizing bacterium and *Trichoderma* spp. on growth, nutrient uptake and yield of chickpea (*Cicer aritenium* L.). Applied Soil Ecology 28(2), 139−146.

Rughheim, A.M.E., Abdelgani, M.E., 2009. Effects of *Rhizobium, Bacillus megatherium* var *phosphaticum* strains and chemical fertilizers on symbiotic properties and yield of faba bean (*Vicia faba* L.). Advances in Environmental Biology 3(3), 337−346.

Shehata, M.M, El-Khawas, S.A., 2003. Effect of two bio-fertilizers on growth parameters, yield characters, nitrogenous components, nucleic acids content, minerals, oil content, protein profiles and DNA banding pattern of sunflower yield. Pakistan Journal of Biological Sciences 6(14), 1257−1268.

Sinha, A.K., 2017. Effect of sowing schedule and integrated nutrient management on productivity, profitability and soil health in rainfed baby corn (*Zea mays)*-horse gram *(Macrotyloma uniflorum)* cropping sequence. Indian Journal of Agronomy 62(4), 417−423.

Srinivasan, R., Jeevan Rao, K., Sailaja, V., Kalaivanam, D., 2014. Influence of organic manures and fertilizers on nutrient uptake, yield and quality in cabbage – baby corn cropping sequence. Journal of Horticultural Science 9(1), 48−54.

Stephan, K.B., Canon, E.N., Savala., Chikove, D., Abaidoo, R., 2017. Growth and yield responses of cowpea to inoculation and phosphorous fertilization in different environments. Frontier Plant Science 8, 646.

Stevenson, F.J., 1982. Variations in the relative distribution of amino sugar with depth in some soil profiles. Soil Science Society of American Proceedings 32, 590−598.

Subba Reddy, S.,Raghuram, P., 1966. Agricultural finance and management. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 213.

Suri, V.K., Jha, S., Verma, T.S., 1997. Efficient and economic fertilization of rainfed maize for its specific yields through soil testing and integrated nutrient management. Crop Research 13, 59−67.

Tagore, G.S., Namdeo, S.L., Sharma, S.K., Narendra Kumar., 2013. Effect of *Rhizobium* and phosphate solubilizing bacterial inoculants on symbiotic traits, nodule leghemoglobin and yield of chickpea genotypes. International Journal of Agronomy, 1-8.

© 2020 PP House