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Contribution of starter dose and seed inoculation in yield and economics of black gram under Hathras condition

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Abstract

Front line demonstrations on Black gram were conducted during *Kharif* seasons of 2012-13 and 2015-16 at farmer's fields. The demonstrations were laid out in five villages in three blocks of Hathras District of Uttar Pradesh. Total 14 Frontline Demonstrations were conducted in 5.6 hectare land in order to have better impact of the demonstrated technologies on the farmers and field level extension functionaries. The cluster of black gram growing farmers was selected in villages where crop covered a handsome area to increase the impact of demonstrations. Each demonstration was conducted in a block of 0.2 to 0.4 ha area in order to have better impact of the technologies demonstrated against the local checks. The best suitable nutrient management technique (100 kg/ha DAP along with *Rhizobium* and PSB culture as seed treatment) in Blackgram for Hathras district was demonstrated through Front Line Demonstration conducted on the farmer's field in five villages of three blocks in Hathras District of Uttar Pradesh, India. The demonstrated technology gave higher grain yield (11.00q/ha) and net return of Rs. 36,775/ha with benefit cost ratio 3.32 as compared to grain yield 8.75q/ha and net return of Rs. 29,025/-ha with benefit cost ratio 3.24 from farmer's practice. On the basis of the experimental findings, it was concluded that the application of 100 kg/ha Di Ammonium Phhosphate with *Rhizobium* and PSB culture as seed treatment enhanced the grain, straw, and biological yield of black gram than the farmers practice and also increased the gross return, net return and B: C ratio. Thus the result of the experiment focussed the need of the use of biofertilizer (*Rhizobium*) with DAP to ensure the higher productivity at farmer's field with low cost input.

Keywords: INM, *Rhizobium*, PSB, black gram, yield, HI, FLD, benefit cost ratio

Introduction

The sustainability of agriculture in Western Uttar Pradesh can improve by Crop diversification. In particular, pulses are crops that can help both sustainable agriculture and the soil health security as they improve soil health, physical structure and ultimately crop productivity and help in reducing chemical fertilizer consumption. Today, however, the area of these crops in Western Uttar Pradesh has been reduced due to development of irrigation facilities since major crops have been co-developed to a greater extent in farming and food systems. Although pulses are more important from the nutritional point of view, there has not any significant increase in area during the year 1950-51 (19.09 million ha) to 2017-18 (29.81 million ha), however, significant growth in production and productivity has been recorded during this period. The total production of pulses was recorded 8.41 m tonne in 1950-51 and it increased to 25.445 m tonne in the year 2017-18. The productivity of pulses has increased about 476% at 25.42 q/ha during 2017-18 from the level of only 4.41 q/ha in 1950-51 (Anonymous 2019) [2]. As a result of Green Revolution, production of rice and wheat went up by over 448% and 1445% respectively in 2017– 2018, compared to 1950–1951, but it also have created externalities affecting the ecosystem and human health. These externalities have been caused by intensive food grains cropping systems and by the lack of crop diversity. However, over the same period, production of pulses in India increased only by about 202% (Anonymous 2019) [2]. The major pulse producing states are Madhya Pradesh 7.81 m tonne (33.38%) Rajsthan 3.68 m tonne (15.71%) and Uttar Pradesh 2.40 (10.24%) accounted which together for about 60 percent of the total production (Anonymous 2019) [2]. In western Uttar Pradesh pulses are grown only in areas left after satisfying the demand for cereals/cash crops, as pulses do not require intensive irrigation facility. Pulses, are rich in protein, also provide green pods for vegetable and nutritious fodder for cattle as well. Black gram is a highly priced pulse very rich in phosphoric acid, contains 26.2 percent crude protein 1.2 percent Fat and 56.6 percent carbohydrate. India is the largest producer and consumer of Black gram in the world and contributes more than 70% to the global production. In India during *Kharif* 2020-21, black gram area increased by 1.5% at 38.62 lakh ha as against 38.03 lakh ha last year. The major *Kharif* growing states are Madhya Pradesh 16.01 lakh ha, Uttar Pradesh 6.92 lakh ha, Maharastra 3.88 lakh ha, Rajasthan 3.76 lakh ha (Anonymous 2020 I) [3]. The per capita availability of pulse was 22.1 kg/capita/annum during 1951 but the production of pulses, in general and black gram in particular, has not been able to keep pace with the rapid increase in demand by ever increasing population. This has resulted in decreasing trends of their per capita availability (18.7 kg/capita/annum during 2018) (Anonymous 2020 I) [3]. In 2019, about 48 grams of pulses (against WHO recommendation of 80 gram per day) was available per capita daily in India. This was a decrease compared to the previous year (54.7 grams/day/capita). Rice and wheat had a higher per capita daily availability and had a higher consumption rate among food grains during the measured time period. Oct 16, 2020 (Anonymous 2020 II) [4].

The Hathras district of Aligarh division falls under Indo-Gangetic Plain (IGP) having alluvial soils varies in texture from sandy, sandy loam to clay loam. Rice (26090 ha), pearl millet (42953 ha) and pigeonpea (5838 ha) are main crops of *Kharif* season. A very little area of about 400 ha only is used to grow black gram and green gram. The continuous repetition of heavy nutrient feeder rice-wheat, pearl millet-wheat, and pearl millet-potato crop rotations since last 15-20 years are resulting in soil degradation and losing their fertility day by day.

The lower yield of pulses than cereals resulted in assumption of that pulses may have a lower genetic potential for yield than cereals. However, available research evidence shows that grain legumes have as high or even higher genetic potential for yield as the cereal crops (DAC & FW, 2015-16). The low productivity of black gram is attributed to several constraints like old varieties, high rate of flower and fruit drop, non-synchronous maturity, susceptibility to deceases and pests, lack of good quality seeds and crop management, etc. along with extremely limited use of rhizobial cultures, phosphatic fertilizers. In spite of agricultural modernization in pulse crops, farmers are still facing diverse technological gap in cultivation. Rai *et al*. 2019 [10] have reported 9% to 75% technological gap in different interventions of pulse production and concluded that to improve this technological gap in adoption of pulse production technologies, large scale demonstration of newer technologies at farmers field are needed. Considering the deteriorating soil health, drastically depleting ground water level the black gram could be adapted and grown well in Hathras as it is being grown in Hasayan, Sikandrarao, Sahapao and Mursan Blocks replacing paddy in *Kharif*. As Blackgram is drought tolerant, it has an ample potential and scope for cultivation in Hathras.

Taking into account the above considerations, frontline demonstrations (FLDs) were carried out in a systematic manner on farmer's field to show the worth of Integrated nutrient management technique in Black gram and convincing farmers to adopt improved nutrient management technique for enhancing productivity and sustainable higher crop productivity with improved soil health.

Materials and Methods

All standard packages of practices were applied in demonstration plots (Table no. 1). The farmers were provided with Azad Urd-2 black gram seed @ 16 kg / ha. The input for famers practice was arranged by farmers themselves during both the years. The seed of new variety was purchased from C. S. A. University of Agriculture and Technology, Kanpur and made available to farmers. The soil of each demonstration plot was tested for pH, EC, O. C., N, P and K. The Recommended dose of fertilizer (100 kg DAP/ ha) in every demonstration was applied on soil test basis. The soil of all demonstration plots was sandy loam and it was low in nitrogen and phosphorus and medium in potash. The pH was reported in the range of 7.2 to 8.5.

Table 1: Details of Demonstrated package of practices and existing farmer's Practice of Black gram production in Hathras District.

Sr. No.	Intervention	Demonstrated package	Farmers' practice
1.	Farming situation	Limited Irrigation facilities	Limited Irrigation facilities
2.	Variety	Azad Urd-2	Local (Unidentified)
3.	Seed treatment	Thirum (2 gm) + Carbendazim (1gm)/kg seed, Culture: *Rhizobium* + PSB, one packet each for 10 kg seed.	Nil
4.	Time of Sowing	07 July to17 July 2012 10 July to 20 July 2015	
5.	Sowing Method	Line sowing at 30 cm L to L	Broadcasting
6.	Irrigation	Pre flowering stage	Nil
7.	Seed rate	16 kg / ha	15 kg/ha
8.	Fertilizer dose	DAP @100 kg/ha+ Culture for seed treatment: Rhizobium + PSB, @ one packet each of 200 gm for 10 kg seed.	Nil
9.	Plant protection	Seed treatment	Nil
10.	Weed management	One hand weeding at 30 DAS	One hand weeding at 35-40 DAS
11.	Harvesting time	10 to 18 Oct. 2012 15 to 20 Oct. 2015	10 to 18 Oct. 2012 15 to 20 Oct. 2015

The whole amount of Di Ammonium Phosphate (100kg/ha) was applied at sowing time as basal application. Sowing was done on 07 July to17 July during 2012 and 10 July to 20 July during 2015-16. The 16 kg/ha treated with *Rhizobium* + PSB @ one packet each of 200 gm for 10 kg seed, was used and sowing was done with seed drill keeping 30 cm row spacing. Farmers do the sowing of untreated seed with broadcasting method. The rainfall received during the crop growth period was only 271 mm and 340 mm during 2012-13 and 2015-16 respectively. However, one irrigation at pre-flowering stage was applied to demonstrations plots. Farmers usually do not go for any irrigation in kharif black gram crop. No disease and insect incidence occurred in crop. The crop was harvested manually at physiological maturity on 10 to 18 Oct. during 2012-1 and 15 to 20 Oct. during 2015-16. However, the plots of farmers practice were matured and harvested about one week later than demonstrations during both the years.

The cost of cultivation was calculated on the basis of local rate of inputs and other operation prevailing at that time, similarly the local sale price of black gram was considered for calculation of gross and net return. The total values of produce i.e. grain yield was estimated treatment wise as per prevailing market rate and treated as gross return. From this gross return, ha^{-1} was calculated. Net returns were calculated by subtracting cost of cultivation from gross returns treatment wise. The benefit cost ratio is the ratio of gross returns to the cost of cultivation. It can also be expressed as returns per rupee invested. This was calculated with the following formula.

$$\text{Benefit cost ratio} = \frac{\text{Gross monetary return}}{\text{Cost of cultivation}}$$

Grain and biological yields data were recorded by crop cutting method of yield estimation from three randomly selected demonstrations plots from each cluster/ village. After three days sun-drying in the field, the total biomass (grain + straw) was weighed and threshed. Grain yield was reported at 14% moisture content. The total biomass on a dry weight basis was considered as biological yield. Frequent visit of all clusters was made by scientists of Krishi Vigyan Kendra, Hathras. Field day was also conducted at demonstration plot at harvesting stage of the crop.

Results and Discussion

Grain Yield

The data pertaining to performance of Black gram in demonstrations and farmers practice plots are given in Table : 2 and Figure**: 1**. It is evident from the table that grain yield, biological yield and harvest index of Black gram in demonstration plots was higher than the farmers practice of Hathras district during both the years. The maximum grain yield (11.0 q/ha) was obtained from demonstration plot during the year 2015-16 which was 25.27% higher than the yield of farmers practice. However, the yield increment due to application of fertilizer and seed treatment with *Rhizobium* + PSB was recorded more (26.19%) during the year 2012-13.

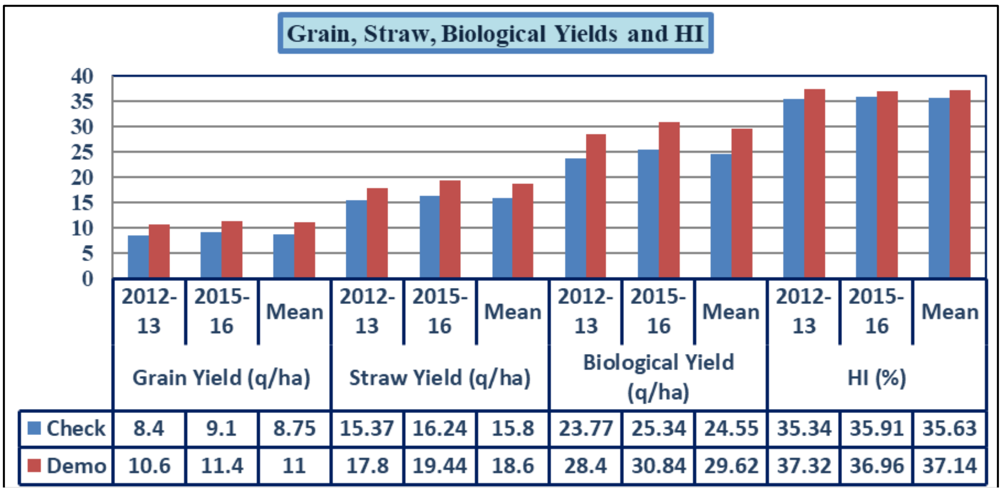

Fig 1: Grain, Straw, Biological yields and Harvest Index of Black gram

These results are in conformity with those of Rathi *et al*. (2009) [11] who reported yield increment due to *Rhizobium* inoculation and suggested that due to *Rhizobium* plants synthesize more photosynthates and resulted in developed storage organ (seed). Reddy *et al*., (2011) [12] reported that the application of organic and inorganic fertilizers along with bio-fertilizers enhance the microbial activity in the rhizosphere which enables the roots for the better uptake of nutrients. Similarly, Singh *et al*., (2011) [15] also suggested that the application of organic and in-organic fertilizers increases the overall growth attributes of the crop due to their synergistic effect. The findings confirm the results of Singh *et al*., (2016) [14] who reported higher grain yield of black gram due to combined inoculation of *Rhizobium* + PSB and suggested that the inoculation increased the nitrogen through symbiotic fixation of atmospheric nitrogen and growth regulators produced by *Rhizobium*. The combined inoculation of *Rhizobium* + PSB produces various organic acids like lactic acid and acetic acid and these acids solubilised the insoluble phosphates.

Biological Yield

It is evident from the data that when seeds were treated with *Rhizobium* and+ PSB culture and 100 kg/ha DAP was applied as starter dose Black gram produced higher biological yield compared to farmers practice during both the years. However, the highest Biological yield of 30.84q/ha was obtained during the year 2015-16 from the same treatment. The mean biological yield of two years of Black gram was recorded to be 29.62 q/ha which was 20.6% higher than farmers practice. The higher biological yield due to application of 100 kg/ha DAP with *Rhizobium* and PSB culture as seed treatment could be ascribed to their direct influence on dry matter production in leaf and stem at successive stages by virtue of increased photosynthetic efficiency. The higher biological yield seems to be on account of higher vegetative (Straw) and reproductive growth (seed) as affected by nutrients applied (Shekhawat *et al*., 2018). Similarly, Fashina *et al*., (2002) [6] explained and Beniwal and Tomar (2019) [5] agreed with the opinion that sufficient amount of nutrients from the applied inorganic fertilizers and some from the organic fertilizers improves the cell activities, cell multiplication and luxuriant growth of the plant which could explained the increased in plant height and ultimately biological yield of the crop. Increased plant height, number of branches plant^{-1} dry matter of green gram due to dual inoculation of *Rhizobium* + PSB have also been reported earlier by Ghosh and Joseph (2006) [7]. The result of experiment carried out at Allahabad by Khatkar *et al*. (2007) [8] revealed that combined inoculation of *Rhizobium* and PSB significantly increased plant height, a higher number of nodules plant^{-1} and plant dry weight of black gram over control.

Straw Yield

A perusal of data on Straw Yield as presented in Table: 2 and Figure: 1. The data revealed that the application of 100 kg/ha DAP with *Rhizobium* and PSB culture as seed treatment gave better response on straw yield over farmers practice. The maximum straw yield (19.44 q/ha) of Black gram was recorded with the demonstration plots during the year 2015-16. The higher straw yield may be attributed to higher biological yield which directly affected by nutrients applied in demonstration plots. The combined use of bio fertilizers and DAP helps in improvement of favourable nutritional status of the soil which resulted into increased biomass production of the crop. Moreover the *Rhizobium* and DAP enhance the microbial activities and root proliferation in soil as a result of which native phosphorus and other nutrients got solubilized. The results of the present study that combined use of biofertilizer and chemical fertilizer has been found to be providing higher straw yield with those reported by Shekhawat *et al*., (2018) [13] and Mohammad *et al*, (2017) [9].

Harvest Index

The application of 100 kg/ha DAP with *Rhizobium* and PSB culture as seed treatment gave the higher harvest index during both the years. These values were37.32% and 36.96% during the year 2012-13 and 2015-16 respectively (Table : 2 and Figure: 1). The results are in line of findings of Singh *et al*. (2016) [14] who reported comparatively higher harvest index values of black gram in seed inoculation treatment than no seed inoculation treatment.

Economics

Economics *viz.*, cost of cultivation, gross return, net return and benefit cost ratio of Black gram under farmers practice and demonstrated technology have been tabulated in table 4. Returns were calculated from the market price of Black gram Rs. 4000/q during 2012-13 and Rs. 5500/q during 2015-16 (Table : 4 and Figure**: 2**). The gross return, net return and benefit cost ratio of Black gram recorded higher under demonstrated technology compared to farmers practice during both the years.

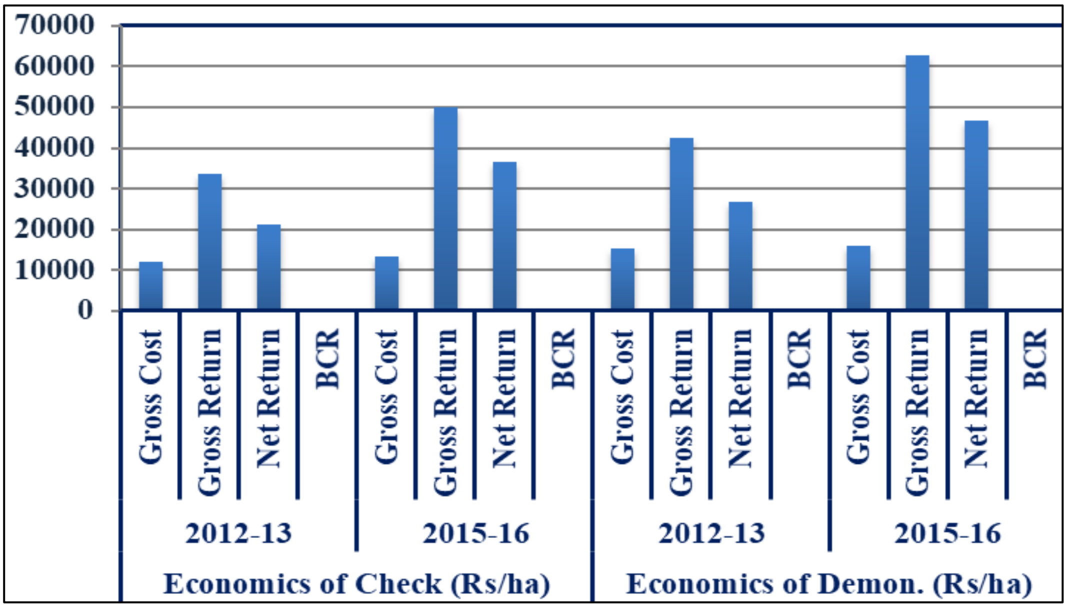

Fig 2: Economics of Demonstration and Farmers Practice

Among the farmers practice and demonstrated technology (application of 100 kg/ha DAP with *Rhizobium* and PSB culture as seed treatment) higher total cost of cultivation (Rs. 15420/ha and Rs. 16100/ha during 2012-13 and 2015-16 respectively) were recorded in demonstration. Gross return was also highest (Rs. 62700 ha-1) with application of 100 kg/ha DAP with *Rhizobium* and PSB culture as seed treatment during the year 2015-16. Similarly, maximum net return (Rs. 46600/ha during 2015-16) and highest B: C ratio (3.89 during 2015-16) was also recorded with the same treatment i.e application of 100 kg/ha DAP with *Rhizobium* and PSB culture as seed treatment. Ghosh and Joseph (2006) [7] reported that dual inoculation with *Rhizobium* + PSB increased net return and benefit: cost ratio over uninoculated in green gram. Moreover, Kumar and Elamathi (2007) also reported the higher total return, net return, and B: C ratio with application of nitrogen 20 kg ha-1 + *Rhizobium* than nitrogen 10 kg ha-1 + uninoculated in black gram.

Table 2: Grain Yield, Straw Yield, Biological Yield and Harvest Index of Black Gram obtained under demonstration and farmer's practice.

Treatments	Grain Yield (q/ha)			Straw Yield (q/ha)			Biological Yield (q/ha)			HI (%)		
	2012-13	2015-16	Mean	2012-13	2015-16	Mean	2012-13	2015-16	Mean	2012-13	2015-16	Mean
Check	8.4	9.1	8.75	15.37	16.24	15.8	23.77	25.34	24.55	35.34	35.91	35.63
Demo	10.6	11.4	11	17.80	19.44	18.6	28.40	30.84	29.62	37.32	36.96	37.14

Table 3: Yield increment of Black Gram in demonstration.

Treatments	2012-13		2015-16		Mean of Two years	
	Grain Yield (q/ha)	Yield Increase (%)	Grain Yield (q/ha)	Yield Increase (%)	Grain Yield (q/ha)	Yield Increase (%)
Check	8.4	-	9.1	-	8.75	-
Demo	10.6	26.19	11.4	25.27	11.00	25.71

Table 4: Economics of Black Gram under demonstration and farmer's practice.

Economics of check (Rs/ha)								Economics of demonstration (Rs/ha)							
2012-13				2015-16				2012-13				2015-16			
Gross Cost	Gross Return	Net Return	BCR	Gross Cost	Gross Return	Net Return	BCR	Gross Cost	Gross Return	Net Return	BCR	Gross Cost	Gross Return	Net Return	BCR
12200	33600	21400	2.75	13400	50050	36650	3.73	15420	42400	26950	2.75	16100	62700	46600	3.89

Conclusion

The demonstrated technology gave higher grain yield (11.00q/ha) and net return of Rs. 36,775/ha with benefit cost ratio 3.32 as compared to grain yield 8.75q/ha and net return of Rs. 29,025/-ha with benefit cost ratio 3.24 from farmers practice. On the basis of the experimental findings, it was concluded that the application of 100 kg/ha Di Ammonium Phosphate with *Rhizobium* and PSB culture as seed treatment, enhanced the grain, straw, and biological yield of black gram than the farmers practice and also increased the gross return, net return and B: C ratio. Thus the result of the experiment focussed the need of the use of DAP with *Rhizobium* and PSB culture as seed treatment to ensure the higher productivity at farmer's field with low cost input.

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References

1. Anonymous. Vital statistics. Department of agriculture, cooperation & farmers' welfare ministry of agriculture & farmers' welfare, GOI, New Delhi (INDIA) 2015-16.
2. Anonymous. Pocket Book of Agricultural Statistics. Government of India Ministry of Agriculture & Farmers Welfare, Department of Agriculture, Cooperation & Farmers Welfare, Directorate of Economics & Statistics, New Delhi 2019.
3. Anonymous. I. https://www.pjtsau.edu.in/agri-marketing-intelligence.html. Black gram Outlook, December 2020. Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, India 2020.
4. Anonymous. II. Daily availability of pulses per capita in India 2011-2019. Published by Statista Research Department, Oct 16 2020. https://www.statista.com/statistics/980339/india-daily-availability-of-pulses-percapita.
5. Beniwa lV, Tomer A. Effect of Integrated Nutrient Management on Growth Parameters of Black Gram (*Vigna mungo* L.) Int. J Curr Microbiol App Sci 2019;8(6):2045-2053.
6. Fashina AS, Olatunji KA, Alasiri KO. Effect of different plant populations and poultry manure on the yield of Ugu (*Telfairia occidentalis*) in Lagos State, Nigeria. In Proceedings of the Annual Conference of Horticultural Society of Nigeria (HORTSON) 2002, 14-17.
7. Ghosh MK, Joseph SA. Productivity and economics of summer greengram (*Vigna adiate*) as influenced by biofertilizers, phosphorus and sulphur application. Agronomy Digest 2006-07;6-7:19-20.
8. Khatkar R, Abraham T, Joseph SA. Effect of biofertilizers and sulpher levels on growth and yield of blackgram. Legume Res 2007;30(3):233-234.
9. Mohammad I, Yadav BL, Ahmad A. Effect of phosphorus and bio-organics on yield and soil fertility status of Mungbean (*Vigna radiata* L. Wilczek) under semi-arid condition of Rajasthan, India. International Journal of Current Microbiology and Applied Sciences 2017;6(3):1545-1553.
10. Rai D, Singh V, Singh VN, Ramkewal. Technological Gap in Adoption of Pulse. Technological Gap in Adoption of Pulse Production Technologies in Central Plain Zone of Uttar Pradesh. J Krishi Vigyan 2019;7(2):248-250.
11. Rathi BK, Jain AK, Kumar S, Panwar JDS. Response of *Rhizobium* inoculation with sulphur and micronutrients on yield and yield attributes of Blackgram [*Vigna mungo* (L.) Hepper]. Legume Res 2009;32(1):62-64.
12. Reddy A, Babu JS, Reddy M, Khan M, Rao MM. Integrated nutrient management in pigeonpea (*Cajanus cajana*). International Journal of Applied Biology and Pharmaceutical Technology 2011;2(2):467-470.
13. Shekhawat AS, Purohit HS, Jain HK, Meena RH, Meena R. Effect of phosphorus & bio-organics on quality and symbiotic efficiency of black gram (*Vigna mungo* L.). Journal of Pharmacognosy and Phytochemistry 2018;7(2):3419-3422.
14. Singh G, Choudhary P, Meena BL, Rawat RS, Jat BL. Integrated nutrient management in blackgram under rainfed condition. International Journal of Recent Scientific Research 2016;7(10):13875-13894.
15. Singh G, Ram H, Sekhon HS, Aggarwal N, Kumar M, Kaur P *et al*. Effect of nitrogen and phosphorus application on productivity of summer mungbean sown after wheat. Journal of Food Legumes 2011;24(4):327-329.