

PRODUCTIVITY AND PROFITABILITY OF GREEN GRAM, *VIGNA RADIATA* (L.) WILCZEK AS INFLUENCED BY FRONTLINE DEMONSTRATION UNDER ARID REGION OF RAJASTHAN

Subhash Chandra, M.L. Reager*, Naval Kishor, B.S. Kherawat and Richa Pant

Directorate of Extension Education

*Krishi Vigyan Kendra, Bikaner-II

Swami Keshwanand Rajasthan Agricultural University, Bikaner (Rajasthan)

Received-02.01.2022, Revised-19.01.2022, Accepted-28.01.2022

Abstract: Pulses are important food crops for human consumption and animal feed. The green gram production among pulses was 1299655 MT from the area of 2322998 hectares in Rajasthan in the year 2019-20. The major cultivation of green gram is based upon rainfed conditions. In Bikaner district, the green gram is grown in an area of 47420 hectares with an annual production of over 16857 MT (Agricultural Statistics at a Glance Year 2019-20, Govt. of Rajasthan). The study in total 125 frontline demonstrations were conducted on farmers' fields in four block of Bikaner district in Rajasthan during *Kharif* season 2018 and 2019 to demonstrate production potential and economic benefit of improved technologies for the green gram crop. The findings of the study revealed that demonstrations recorded a mean seed yield of 657 Kg ha⁻¹ which was 25.03 % higher than farmers' practice seed yield (525 Kg ha⁻¹). The average extension yield gap, technology yield gap and technology index were 132 Kg ha⁻¹, 444 Kg ha⁻¹ and 40.1 %, respectively. Higher mean net income of ₹ 24647/- ha⁻¹ with a Benefit: Cost ratio of 2.40 was obtained with improved technologies in comparison to farmers' practices (₹ 18013/- ha⁻¹ with a Benefit: Cost ratio of 2.2). The frontline demonstrations conducted on green gram at the farmers' field revealed that the adoption of improved technologies enhanced the seed yield as well as the net returns and income to the farmers under rainfed conditions.

Keywords: Adoption, Frontline demonstration, Profitability, Green gram, Livelihood and gap analysis

INTRODUCTION

Pulses are important food crops for human consumption and animal feed. Being leguminous in nature, they are considered to be important components of cropping systems because of their viability to fix atmospheric nitrogen, add substantial amounts of organic matter to the soil and produce reasonable yields with low inputs under harsh climatic and soil conditions. The green gram production among pulses was 1299655 MT from the area of 2322998 hectares in Rajasthan in the year 2019-20. The major cultivation of green gram is based upon rainfed conditions. In Bikaner district, the green gram is grown in an area of 47420 hectares with an annual production of over 16857 MT (Agricultural Statistics at a Glance Year 2019-20, Govt. of Rajasthan).

India is the world largest homeland of vegetarian population and world leader in pulse production and import to provide protein supplements (Singh *et al.* 2013). Rapid population growth and low production especially of pulses have enhanced the problem of food security. Indian pulse production has been stuck in between 14 and 15 Mt since mid-nineties, resulting in poor consumption (33 g/capita/ day) during 2010 (Ali and Gupta, 2012). Cultivated land area has become stagnated and there is lesser possibility to increase in the future (Singh *et al.* 2013). In India especially rice-wheat is the prevalent cropping system and the area and resultantly the production of pulses have become marginalized

(Singh *et al.* 2013). In the wake of these circumstances, it can be said that given due importance, green gram can play a major role in the national economy of India due to their wider adaptability, easy digestibility, better palatability and higher market price (Ramakrishna *et al.* 2000, Patil *et al.* 2013 and Reddy, 2009). Potential yield of green gram can be achieved through optimum use of inputs and agronomic practices. Besides other inputs like date of sowing and improved varieties are of primary importance (Ali and Gupta, 2012). Singh *et al.* (2010) suggested that date of sowing is the most important non-monetary input to obtain optimum yield from green gram. It has strong root system and capacity to fix the atmospheric nitrogen into the soil and improves soil health and contributes significantly to enhancing the yield of subsequent crops.

Green gram (*Vigna radiata* (L.) Wilczek) is a popular and important grain legume in tropical and subtropical Asia. It is one of the most important pulse crops for protein supplement in subtropical zones of the world. It is widely grown in Indian subcontinent as a short duration catch crop between two principal crops. Being an excellent source of easily digestible protein (24%), carbohydrate (51%) mineral (4%), and vitamins (3%) utilized in the cereal-based diets (Khattak *et al.* 2003). It contains vitamin A (94 mg), iron (7.3 mg), zinc (3 mg), calcium (124 mg) and folate (549 mg) per 100 g dry seed. Usually it is used in split form (Dhal) and in other different food products (Rasul *et al.* 2012). Besides providing protein in the diet, it has the

*Corresponding Author

remarkable quality of helping the symbiotic root rhizobia to fix atmospheric nitrogen and hence to enrich soil fertility (Khan *et al.* 2008). It is also used as green manuring crop. Green gram can be used as a feed for cattle even husk of the seed can be soaked in water and used as cattle feed. They emphasized the value of grain legumes as a source of protein, which is deficient in maize and other cereals. The lysine content in many pulse crops is 6 percent, which is higher than in cereal grains. Legumes of grain and fodder types have been used in farming systems since older times. Their capacity to increase the soil fertility and to produce a harvestable crop with high protein content is well known. Inclusion of green gram in cereal cropping system can increase farm income, improve soil productivity, save irrigation water and can boost sustainability of agriculture (Hussain *et.al.* 2012). In India it is cultivated in three different seasons, viz., *kharif, rabi and summer.*

With the advent of short duration, MYMV (Green gram yellow mosaic virus) tolerant and synchronous maturing varieties of green gram (55-60 days), there is a big opportunity for successful cultivation of green gram in crop rotation without affecting this popular cropping pattern. However the production and productivity is very low in green gram mainly due to its cultivation in resource poor lands with minimum inputs, non-synchronous maturity and indeterminate growth habit. Green gram yield is also affected by insect-pests and diseases, especially by green gram yellow mosaic virus (MYMV) and *Cercospora* leaf spot (CLS). There is a strong need to develop the lines/varieties which give outstanding and consistent performance in *kharif* season over diverse environment. The Front Line Demonstration is an important method of transferring the latest technologies to farmers. By which, farmers learn latest technologies of pulses production under real farming situation at his own field, which may lead to higher adoption. Further, these demonstrations are designed carefully where provisions are made for speedy dissemination of latest technology among farming community through organization of other supportive extension activities, such as field days and farmers convention. The main objective of the Front Line Demonstration is to demonstrate newly released varieties, crop production and protection technologies at the farmers field under diverse farming situations. The Scientists also to know the factors contributing to higher crop production, field constraints of production and thereby generating production factor and feedback information. Keeping in view the present study was done to analyze the performance and to promote the green gram cultivation in the district.

MATERIALS AND METHODS

In total 125 frontline demonstrations were conducted on farmers' field in four blocks of Bikaner district

during *Kharif* seasons of 2018 and 2019. Each demonstration was conducted on an area of 0.4 ha, and 0.4 ha area adjacent to the demonstration plot was kept as (local check) farmers' practices. The package of improved technologies like improved newly released variety, proper seed rate, line sowing, balanced nutrition, seed treatment and full package were used in the demonstrations. The variety of Green gram IPM-02-03 and MH-421 were included in the present study. Particulars (Table.1) showing the details of green gram grown under FLD and farmers' practice. Improved practices under demonstrated were Line sowing, Spacing 30 cm between rows and 10 cm between plants. Seed treatment with Bavistin 2 g Kg⁻¹ seed, Weed management using Pendimethalin 30 EC @ 1litre a i ha⁻¹ in as pre-emergence for effective control of weeds. All the crop production management practices and plant protection measures were followed for crop production as per the recommendations for *kharif* green gram by SKRAU, Bikaner. Data with respect to grain yield from FLD plots and farmers practices adopted by the farmers of the area were collected and evaluated. Different parameters as suggested by Yadav *et al.*, (2007) was used for gap analysis, and calculating the economics. The results were economically analysis in terms of B: C ratio and net returns to re-establish the viability. The yield and economics of data was obtained from 75 respondents from four selected blocks for a period of two years. The yield data were collected from both the demonstration and farmers practice by random crop cutting methods and analyzed by using simple statistical tools. The Technology yield gap, extension yield gap and technology index (Samui *et al*, 2000) were calculated by using following formulae as given below:

% yield increase =

$$\frac{\text{Demonstration yield (Kg ha}^{-1}\text{)} - \text{farmers practice yield (Kg ha}^{-1}\text{)}}{\text{Farmers practice yield (Kg ha}^{-1}\text{)}} \times 100$$

Technology yield gap (Kg ha⁻¹) =

$$\text{Potential yield (Kg ha}^{-1}\text{)} - \text{Demonstration yield (Kg ha}^{-1}\text{)}$$

Extension yield gap (Kg ha⁻¹) =

$$\text{Demonstration yield (Kg ha}^{-1}\text{)} - \text{Farmers practice yield (Kg ha}^{-1}\text{)}$$

Technology Index =

$$\frac{\text{Potential yield (Kg ha}^{-1}\text{)} - \text{Demonstration yield (Kg ha}^{-1}\text{)}}{\text{Potential yield (Kg ha}^{-1}\text{)}} \times 100$$

RESULTS AND DISCUSSION

Seed yield

The results revealed that seed yield ranges under demonstration were 623 to 690 Kg ha⁻¹ with mean yield of 657 Kg ha⁻¹ as against local check (farmers' practices) 500 to 550 Kg ha⁻¹ with mean seed yield of

525 Kg ha⁻¹ during the year 2018 and 2019 (Table 2). There was an increase to the tune of 24.60 to 25.45 % in seed yield under demonstration over farmers' practice. The average increase in the seed yield of green gram under demonstration was 25.02 per cent (Table.2). The increased grain yield with improved technologies was mainly because of use of improved varieties, line sowing at proper time, proper weed management with herbicides, balanced use of nutrients. The present study confirm with the findings of Poonia and Pithia (2011), Meena *et.al.* (2012) and Rajni *et al.* (2014).

Extension yield gap

Gap analysis Evaluation of findings of the study (Table 2) stated that an extension yield gap of 123 to 140 Kg ha⁻¹ was found between demonstrated technology and farmers' practice and on average basis the extension yield gap was 132 Kg ha⁻¹. The extension yield gap was highest (140 Kg ha⁻¹) during *Kharif* 2019 and lowest (123 Kg ha⁻¹) during *Kharif* season of 2018. Such gap might be attributed to adoption of improved technology especially high yielding varieties, line sowing with the help of seed cum fertilizers drill with balanced nutrition, weed management and appropriate plant protection measures in demonstrations which resulted in higher grain yield than the farmers' practices.

Technology yield gap

The study further exhibited a wide technology gap during different years. It was lowest (377 Kg ha⁻¹) during 2018 and highest (510 Kg ha⁻¹) during 2019. The average technology gap of all the two years was 444 Kg ha⁻¹. The difference in technology gap in different years is due to better performance of recommended varieties with different interventions and more feasibility of recommended technologies during the course of study.

Technology Index

Similarly, the technology index for all demonstrations in the study were in accordance with technology gap. Higher technology index reflected the inadequate transfer of proven technology to growers and insufficient extension services for transfer of technology. On the basis of two years study, overall 40.1 % technical index was recorded. Hence, it can be inferred that the awareness and adoption of improved varieties with recommended scientific package of practices have increased during the advancement of study period. These findings are in the conformity of the results of study carried out by Chandra (2010), Dayanand *et al.* (2012), Rajni *et al.* (2014). Meena and Singh (2016) and Meena and Singh (2017).

Economics

Different variables like seed, fertilizers, bio fertilizers and pesticides were considered as cash input for the demonstrations as well as farmers practice. Economic returns as a function of seed yield

and MPS price varied during different years. The economics of the improved technology over farmers practice were calculated depending on the prevailing market prices of the inputs and outputs for the particular year (Table 3 and Fig.2). It was observed that the average cost of cultivation of green gram of ₹ 17120/- ha⁻¹ under demonstration as against in farmers practices ₹ 15375/- ha⁻¹. Demonstration gave higher gross returns, ranges from ₹ 34888/- ha⁻¹ to ₹ 48645/- ha⁻¹ with the mean of two years was ₹ 41767/- ha⁻¹ as compared to farmers practices which recorded gross returns of ₹ 28000/- ha⁻¹ to ₹ 38775/- ha⁻¹. On an average gross returns in farmers practice was recorded ₹ 33388/- ha⁻¹. Demonstration also gave higher net returns, ranges from ₹ 17848/- ha⁻¹ to ₹ 31445/- ha⁻¹ with the mean of two years was ₹ 24647/- ha⁻¹ as compared to farmers practices which recorded net returns of ₹ 12750/- ha⁻¹ to ₹ 32275/- ha⁻¹. On an average net returns in farmers practice was recorded ₹ 18013/- ha⁻¹. The maximum net returns (₹ 31445/- ha⁻¹) during the year 2019 followed by (₹ 17848/- ha⁻¹) during the year 2018 were obtained due to high seed yield. The higher additional returns and effective gain obtained under demonstrations could be due to improved technology, non-monetary factors, timely operations of crop cultivation and scientific monitoring. The lowest and highest benefit cost ratio (BCR) under demonstration were 2.04 and 2.82 in 2018 and 2019, respectively (Table 3) depends on produced grain yield and MPS sale rates. Overall average BCR was found 2.40. On an average benefit: cost ratio under demonstration and farmers practice was recorded 2.40 and 2.20 respectively. The results confirm with the findings of front line demonstrations on pulses by Chaudhary (2011), Dayanand *et.al.* (2012), Meena and Singh (2016), Dash and Rautaray (2017) and Dash *et.al.* (2018). The higher benefit cost ratio in improved technology was due to the higher yield obtained under demonstration as compared to farmers practice. Hence higher benefit cost ratio proved the economic viability of the technology interventions and convinced the farmers on the utility of improved technologies. Similar findings were reported by Gorfed, *et.al.* (2016), Vijaya Laxshmi *et.al.* (2017) and Veni *et.al.* (2018). It may be concluded that the frontline demonstrations conducted on green gram at the farmers' field revealed that the adoption of improved technologies enhanced the seed yield as well as net returns and income to the farmers. So, there is a need to disseminate the improved technologies among the farmers with effective extension methods like training and demonstrations. The farmers' should be encouraged to adopt the recommended package of practices for realizing higher returns.

Table 1. Difference between technological interventions and farmers practice under front line demonstration on Green gram

S.No.	Component	Technological intervention	Farmer practice	Gap
1.	Field preparation	Three ploughing	Three ploughing	10 %
2.	Variety	IPM-02-03 and MH-421	Old mix seed	70 %
3.	Seed rate	15 Kg ha ⁻¹	30 Kg ha ⁻¹	50 %
4.	Seed treatment	Carbendazim @2g/kg of seed	No Seed treatment	80 %
5.	Seed inoculation	Rhizobium and PSB culture@10g/Kg of seed	No seed inoculation	85 %
6.	Sowing method	Line sowing	Broadcasting	60 %
7.	Spacing	30 cm x 10 cm	No proper spacing	30 %
8.	Fertilizer dose	N:P: K:S 20-40-0-30 Kg ha ⁻¹	No use	35 %
9.	Weed management	Pre emergence application of Pendimethalin 30 EC @ 1.0 Kg a.i. ha ⁻¹ and one hand weeding	No weeding	70 %
10.	Irrigation	Rainfed	Rainfed	20 %
11.	Plant protection measures	Need based insecticide spray with proper dose and time	Use of insecticide without knowledge and with over /under dose of insecticide	25 %

Table 2. Performance of front line demonstration on green gram in Bikaner District of Rajasthan

Year	Variety	No.	Area (ha)	Average Seed Yield (Kg ha ⁻¹)		% Increase over FP	Potential yield (Kg ha ⁻¹)	Technology Yield Gap (Kg ha ⁻¹)	Extension Yield Gap (Kg ha ⁻¹)	Technology Index (%)
				Farmers Practice	Demonstration					
2018	IPM-02-03	75	30	500	623	24.60	1000	377	123	37.7
2019	MH-421	50	20	550	690	25.45	1200	510	140	42.5
Average		125	50	525	657	25		444	132	40.1

Table 3. Profitability and economics of green gram demonstration in Bikaner District of Rajasthan

Year	Demonstration				Farmers Practice			
	Gross Cost (₹ ha ⁻¹)	Gross Return (₹ ha ⁻¹)	Net Return (₹ ha ⁻¹)	B : C ratio	Gross Cost (₹ ha ⁻¹)	Gross Return (₹ ha ⁻¹)	Net Return (₹ ha ⁻¹)	B : C ratio
2018	17040	34888	17848	2.04	15250	28000	12750	1.83
2019	17200	48645	31445	2.82	15500	38775	23275	2.50
Average	17120	41767	24647	2.4	15375	33388	18013	2.2

SUMMARY

Front line demonstration is an effective tool for increasing area, production and productivity of green gram and changing the knowledge, attitude and skill of the farmers on the adoption of improved technologies. Front line demonstration of green gram enhance in average yield by 25.02 per cent over farmers practice. These demonstrations created greater awareness and motivated the other nearby farmers of the zone to adopt the improved technologies of green gram production. The results of frontline demonstrations clearly showed the growing of improved green gram varieties under improved technologies including seed of suitable HYV, recommended plant geometry, balance dose of fertilizer, weed management at proper time,

integrated pest management proved more productive and remunerative as compare to farmer's practices. The beneficiary farmers of the front line demonstration also played an important role as source of information on the quality seed of newly released varieties seed for wider dissemination of high yielding varieties of moongbeen to nearby farmers of the zone. Average higher Gross returns (₹ 41767/-ha⁻¹), net return (₹ 24647/- ha⁻¹) and benefit cost ratio (2.40) recorded under demonstration over farmers practice. Hence the farmers of the area are advised to adopt newly released high yielding varieties and improved agro-technology for higher return and more profit from chickpea, which also boost up the productivity of green gram under rainfed conditions of hyper arid partial irrigated zone of Rajasthan.

REFERENCES

- Anonymous** (2019-20). Agricultural Statistics at a glance. Government of Rajasthan, Pant Krishi Bhawan, Jaipur.
- Ali, M. and S. Gupta** (2012). Carrying capacity of Indian agriculture: Pulse crops. *Cur. Sci.*, 102, 874-881.
[Google Scholar](#)
- Chandra, G.** (2010). Evaluation of frontline demonstrations of green gram in Sundarbans, West Bengal. *Journal of Indian Society of Coastal Agricultural Research* **28** (1): 12-15.
[Google Scholar](#)
- Chaudhary, S.** (2011). Impact of front line demonstration on adoption of improved green gram production technology in Nagaur district of Rajasthan. M.Sc. Thesis, SKRAU, Bikaner.
[Google Scholar](#)
- Dash, S.R. and Rautaray, B.K.** (2017). Growth parameter and yield of green gram varieties (*Vigna radiata L.*) in East and South East Coastal Plain of Odisha, India. *Int. J. Curr. Microbiol. App. Sci.* **6** (1):1517-1523.
[Google Scholar](#)
- Dash, S.R., B.K. Rautaray and Dhal, A.** (2018). Perception and Constraints faced by Pulse Growers and yield gap analysis of Green Gram (*Vigna radiata L.*) in East and South East Coastal Plain of Odisha, India. *Int. J. Curr. Microbiol. App. Sci.* **7** (1): 338-346.
[Google Scholar](#)
- Dayanand, Verma, R.K. and Mahta, S.M.** (2012). Boosting the mustard production through front line demonstrations. *Indian Research Journal of Extension Education* **12**(3):121-123.
[Google Scholar](#)
- Gorfed, P.S., Baraiya, K.P and Prakashia, A. M.** (2016). Impact of front line demonstration of pulse crops in improved technology transfer. *International Journal of Agriculture Science.* **8** (13): 1228-1229.
[Google Scholar](#)
- Hussain, A., Ali, A. and Noorka, I. R.** (2012). Effect of phosphorus with and without rhizobium inoculation on nitrogen and phosphorus concentration and uptake by Green gram (*vigna radiata L.*). *J. Agric. Res.* 50:49-52.
[Google Scholar](#)
- Khan, A., Khalil, S.K., Khan, A. Z., Marwat, B.K. and Afzal** (2008). A The Role Of Seed Priming In Semi-Arid Area For Green gram Phenology And Yield, *Pak. J. Bot.*, **40** (6): 2471-2480.
[Google Scholar](#)
- Khattak, G.S.S., Zamir, R., Muhammad, T. and Shah, S.A.** (2003). Breeding Green gram (*Vigna radiata (L.) Wilczek*) genotypes for the agro climatic conditions of NWFP. *Pak. J. Bot.* 35: 763-770.
[Google Scholar](#)
- Meena M.L. and Singh D.** (2017). Technological and extension yield gaps in greengram in Pali district of Rajasthan, India. *Legume Research* **40** (1):187-191.
[Google Scholar](#)
- Meena, M.L. and Singh, D.** (2016). Productivity enhancement and gap analysis of moth bean (*Vigna acontifolia (Jacq.)*) through improved production technologies of farmers' participatory mode. *Indian Journal of Dry land Agricultural Research and Development*, **31** (1):68-71.
[Google Scholar](#)
- Meena, M.L. and Singh, D.** (2017). Impact assessment of frontline demonstrations on greengram: Experience from rainfed condition of Rajasthan. *Journal of Applied and Natural Science.* **9** (4): 2456 – 2460.
[Google Scholar](#)
- Meena, O.P., Sharma K.C., Meena, R.H. and Mitharwal, B.S.** (2012). Technology transfer through FLDs on mung bean in semi-arid region of Rajasthan. *Rajasthan Journal of extension Education* **20**:182- 186.
[Google Scholar](#)
- Patil, B.L., Hegde, V.S. and Saliath, P.M.** (2013). Studies on genetic divergence over stress and non-stress environment in Green grama. *Indian J. Gent. Plant Breed.* 63, 77-76.
[Google Scholar](#)
- Poonia, T.C. and Pithia, M.S.** (2011). Impact of front line demonstrations on chickpea in Gujarat. *Legume Research* **34** (4):304- 307.
[Google Scholar](#)
- Rajni, Singh, N.P. and Singh, P.** (2014). Evaluation of frontline Demonstrations on yield and economic analysis of summer moong in Amritsar district of Punjab. *Indian Journal of Extension Education.* **50** (1&2):87-89.
[Google Scholar](#)
- Ramakrishna, A., Gowda, C.L.L. and Johansen, C.** (2000). Management factors affecting legumes production in the Indo-Gangetic Plain. In: Legumes in rice and wheat cropping systems of the Indo-Gangetic Plain-constraints and opportunities (Eds.: C. Johansen, J.M. Duxbury, S.M. Virmani and C.L.L. Gowda). ICRISAT, Patancheru, Andhra Pradesh, pp. 156-165.
[Google Scholar](#)
- Rasul, F., Cheema, M.A., Sattar, A. Saleem, M.F. and Wahid, M.A.** (2012). Evaluating the performance of three Green gram varieties grown under varying inter-row spacing. *J. Anim. Plant Sci.* **22**:1030-1035.
[Google Scholar](#)
- Reddy, A.A.** (2009). Pulses production technology: Status and way forward. *Eco. Polt. Weekly*, 44, 73-80.
[Google Scholar](#)
- Samui, S. K., Maitra, S. Roy, D. K. Mondal, A. K. and Saha, D.** (2000). Evaluation on front line demonstration on groundnut (*Arachis hyposia L.*)

Journal of Indian Society of Coastal Agriculture Research, **18**: 180-183.

[Google Scholar](#)

Singh, A. K., Chandra, N., Bharati, R.C. and Dimree, S. K. (2010). Effect of seed size and seeding depth on Faba bean (*Vicia faba* L.) productivity. *Envi. Ecol.*, **28**, 1722-1727(2010).

[Google Scholar](#)

Singh, A.K., Manibhushan, Bhatt, B.P., Singh, K.M. and Upadhyaya, A. (2013). An analysis of oilseeds and pulses scenario in Eastern India during 2050-51. *J. Agric. Sci.*, **5**, 241-249.

[Google Scholar](#)

Singh, Guriqbal, Sekhan, H.S., Hari Ram, Gill, K.K. and Sharma, P. (2010). Effect of date of sowing on nodulation, growth, thermal requirement and grain yield of kharif Green gram genotypes. *J. Food Legumes*, **23**, 132-134.

[Google Scholar](#)

Veni, C.P., Rajkumar Vekata, B, Lakshmi, V., Swetha, and M, Bhavya Manjari (2018). Impact of Cluster Front Line Demonstration on yield enhancement of green gram and Bengal gram. *International Journal of Chemical Studies* **6** (5): 2294-2296.

[Google Scholar](#)

Vijaya Lakshmi, D., Vijay Kumar, P. and Padma Veni, C. (2017). Impact of cluster front line demonstratiions to transfer of technologies in pulse production under NFSM. *Bulletin of Environment, Pharmacology and Life Sciences*. **6** (1): 418-421.

[Google Scholar](#)

Yadav, V. P. S., Kumar, R., Deshwal, A. K., Raman, R. S., Sharma, B. K. and Bhela, S. L. (2007). Boosting pulse production through front line demonstration. *Indian Research Journal of Extension Education*, **7** (2&3):12- 14.

[Google Scholar](#)