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# Front line demonstration technology for pulses production using *Rhizobium* sp., *Trichoderma* sp. and phosphate solublising bacteria: A comparative study

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**ABSTRACT**
*The experiment was conducted at agricultural farm of Krishi Vigyan Kendra, Azamgarh, Uttar Pradesh on for evaluating comparative production of pulses pigeon pea, chick pea, field pea and lentil seed plus phosphate solublizing bacteria (PSB), Rhizobium plus Trichoderma plus insecticide in combination, under field demonstration technology (FLD) and farmers trials. The trials were attempted in sandy, clay and loamy soils under rainfed condition. The highest pulse yield (16.6 q/ha) followed by lentil (13.0 q/ha), chick pea (12.1 q/ha), and pigeon pea (11.2 q/ha), respectively under standard situation. Maximum 49.3 per cent higher yield was reported over the farmers practice (7.50 q/ha) in case of pigeon pea production. Similarly, other pulses yields were also higher than farmers' trials. The increase of pulses yield was found due to variation in agro-climatic situation under rainfed condition along with addition of biofertilizer; phosphate solublizing bacteria, Trichoderma sp., Rhizobium sp., and insecticides. Increase yield of all pulses under FLD offer to demonstrate this technology under existing farming situations for better yield.*
***Keywords:*** *Agro-climatic factors; Biofertilizer, FLD; PSB; Pulses.*

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## INTRODUCTION

Pulses are the only cash vegetable leguminous crops of significance in the region and are cultivated in summers mainly. They are good source of protein, carbohydrate, fat, minerals (calcium, phosphorus, iron) and vitamins. They are excellent animal feed and also have good forage value. Whereas Chickpea is the premier pulse crop widely consumed in India and the cheapest source of protein and is the inseparable part of the daily diets of every Indians. It also plays an important role in sustainable agriculture enriching the soil through symbiotic biological nitrogen fixation (BNF) with *Rhizobium* spp. However, productivity is far below the potential yield. Abiotic factors are responsible for declining of yield potential (Singh et al. 2013). Plant growth promoting rhizobacteria (PGPR) reported to enhance plant growth by different mechanisms: atmospheric nitrogen fixation that is transferred to the plant, production of siderophores that chelate iron and make it available to the plant root, solublization of phosphorous and synthesis of phytohorones (Yadav et al. 2016). The front line demonstration is to demonstrate newly released crop production and protection technologies and its management practices in the farmers' field under different agro-climatic regions and farming situations. While demonstrating the technologies in the farmers' field, the scientists are required to study the factors contributing higher crop production. FLD are only newly released technologies or those likely to be released in the near future are selected. It is used as a source of generating data on factors contributing higher crop yields and constraints of production under various farming situations.

Traditional farmers sowing practices, improper crop geometry, avoid use of balanced major nutrient (N,P,K), Secondary nutrients and biofertilizers, biopesticide, and climatic variabilities are major cause for limited crop yield (Yadav et al. 2016). Abiotic stresses are responsible for declining of yield potential (Singh et al. 2013). However, technological developments have been made in the field of agriculture research, but benefits of these developments could not be realized by the farming community because of low knowledge of these technologies at the farmers' level. Front line demonstration (FLDs) was conducted by Krishi Vigya Kendra, Azamgarh (U.P.) with the aim of increased yield of pulses. Comparative FLD studies were implemented for different pulses production in year 2014-15. The present study were undertaken with an objective of FLD (using pulses seed + phosphate solublising bacteria (PSB), *Rhizobium* sp. + *Trichoderma* sp. + insecticide) for enhancing pulses yield over the traditional methods used by the Indian farmers.

## MATERIALS AND METHODS

The Front line demonstration technique was conducted by Krishi Vigyan Kendra, Azamgarh (U.P.) in four villages of district Azamgarh U.P. A total 16 farmers for each pulse were associated under FLD programme. The components of demonstration of front line technology for pulses yield were comprised of improved variety of seed, proper tillage, proper seed rate and line sowing method, balance dose of biofertilizer along with beneficial microorganisms such as *Rhizobium*, *Trichoderma*, phosphate solubilising bacteria (PSB), insecticide, proper irrigation, weed management, protection measures, etc. The technique was performed with above components for better yield of pulses.

In the demonstration, one control plot was also kept where farmers practices was carried out for each pulse. The yield data were collected from both the demonstration and farmers practice using random crop cutting method and analyzed. The formula given by Samui et al. (2000) was used for calculation of extension gap

The yield data were collected from the selected FLD farmers by random crop cutting method. Qualitative data were converted into quantitative form and expressed in terms of per cent increase in yield calculated using following formula:

$$\frac{\text{Grain yield under FLD} - \text{Grain yield under farmers practice}}{\text{Grain yield under farmers practice}} \times 100$$

Extension gap = Demonstrated yield - Yield under existing practice

## RESULTS AND DISCUSSION

Nowadays advance technology such as Front line demonstration (FLD) is used for increasing the yield of vegetable pulses. In this study, FLD was laid out on pulses to assess the yield and economics at farmers' field. The results indicate that use of improved variety of seed, proper tillage, proper seed rate and line sowing method, balance dose of biofertilizer, use of beneficial microorganisms such as *Rhizobium*, *Trichoderma*, phosphate solubilising bacteria (PSB), insecticide, proper irrigation, weed management, protection measures, and others agronomical management enhancing the yield of pulses over farmers' practices (Table 1 & 2). Different parameters such as percent potential yield and extension yield were analysed for evaluating yield of pulses.

FLD results obtained are presented in Table 3. The results obtained in FLD showed that pulses yield was better in all sets compared to farmers' practices. The highest pulse yield (16.6 q/ha) followed by lentil (13.0 q/ha), chick pea (12.1 q/ha), and pigeon pea (11.2 q/ha), respectively under standard situation. Maximum 49.3 per cent higher yield was reported over the farmers practice (7.50 q/ha) in case of pigeon pea production. Similarly, other pulses yields were also higher yield than farmers' practices. Increase yield of all pulses under FLD offer to demonstrate this technology under existing farming situations for better yield. This results clearly indicated that the higher average pulse yield in demonstration plots compare to local farmer practices might be due to these practices viz., timely sowing, seed treatment with microbes such as *Rhizobium*, *Trichoderma*, use of balanced dose of fertilizer (nitrogen and phosphorus), weed management and plant protection practices. The proper plant protection measures effectively increased the pulses yield compared to the yield observed under farmers' practices.

The lesser yield of pulses at farmer's practices over FLD may be due to the use local or old-age varieties instead of the recommended high yielding resistant varieties, unavailability of seed in time and lack of awareness (Yadav et al. 2016). Farmers followed broadcast method of sowing against the recommended line sowing and because of this, they applied higher seed rate than the recommended limit (Singh et al. 2014). Herbicides are one of the major groups of pesticides which also contribute to the increased and economic production of crops. Combined uses of organic and inorganic fertilizers along with bio based fertilizers have been reported not only to meet the nutrients need of the crop but also found to maintain large-scale productivity goals (Yadav et al. 2016).

The extension gap was calculated, and the values were 3.7, 3.0, 4.8, 3.8 for pigeon pea, chick pea, field pea, and lentil respectively which emphasizes that there is need to educate the farmers by many ways for adoption of improved production techniques. The frontline demonstration on pulses was helpful for farmers to adopt the new technologies to increase in pulses production. Therefore, for enhancing the production of pulses, strategy should be made for getting the more recommended technologies adopted by the farmers for increasing the yield of vegetable crops (Raj et al. 2013 and Sharma et al. 2011). The findings of this study indicate that FLDs programmes were effective in pulses production . Demonstration at field level with *Rhizobium*, PSB, and *Trichoderma* treated improved variety of pulse seeds provides an opportunity to display the productivity potential and profitability of this technology under the natural farming situations.

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**Table 1.** Comparison between technological intervention and farmers practices (under FLD on pulses)

| Parameter | Technological intervention | Farmers' practice |
|---|---|---|
| Variety | Improved pulse seed | Local (non-descriptive) |
| Weed management | Weedicide 3.5 liter $ha^{-1}$ | Occasional manual weeding for fodder |
| Fertilizer dose | 22 kg N and 60 kg P2O5 $ha^{-1}$ | No use of phosphatic fertilizer |
| Plant protection measures | Indoxacarb/Mancozeb @ 1.5 liter $ha^{-1}$ at 50% poding stage | No control measure |
| Seed treatment | *Rhizobium* @ 25 g $kg^{-1}$ of seed,<br>PSB @ 25 g $kg^{-1}$ of seed<br>*Trichoderma* powder @ 5 g $kg^{-1}$ of seed | No seed treatment |

**Table 2.** Technological demonstration and conditions for different pulses for farmers.

| Sl. No. | Crop | Technology Demonstrated | Area (ha) | | No. of farmers/ demonstration |
|---|---|---|---|---|---|
| | | | Proposed | Actual | |
| Pulses | | | | | |
| 2. | Pigeon pea | Seed+*Rhizobium*+ PSB+*Trichoderma*+ Raised bed planting+Indoxocarb | **5.0** | **2.5** | **16** |
| 3. | Chick pea | Seed+*Rhizobium*+ PSB+*Trichoderma*+ Indoxocarb | **5.0** | **2.5** | **16** |
| 4. | Field pea | Seed+*Rhizobium*+ PSB+*Trichoderma*+Mancozeb | **5.0** | **2.5** | **16** |
| 5. | Lentil | Seed+*Rhizobium*+ PSB+*Trichoderma* | **5.0** | **2.5** | **16** |

 

**Table 3.** Comparative average yield of pulses under FLD and farmers practices.

| Crop | Technology Demonstrated | Variety | No. of Farmers | Demo. Yield Qtl/ha | | | Yield of Check Q/ha | % Increase in yield |
|---|---|---|---|---|---|---|---|---|
| | | | | Highest | Lowest | Average | | |
| Pigeon pea | Seed+*Rhizobium*+ PSB+*Trichoderma*+ RB+Indoxacarb | NA-2 | **16** | **14.4** | **8.00** | **11.2** | **7.50** | **49.3** |
| Chickpea | Seed+*Rhizobium*+ PSB+*Trichoderma*+ Indoxacarb | Pusa-362 | **16** | **13.7** | **10.5** | **12.1** | **`9.10** | **33.0** |
| Field pea | Seed+*Rhizobium*+ PSB+*Trichoderma* | KPMR-400 | **16** | **18.3** | **14.9** | **16.6** | **11.8** | **40.7** |
| Lentil | Seed+*Rhizobium*+PSB | DPL-62 | **16** | **15.6** | **10.4** | **13.0** | **9.20** | **41.3** |

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