Impact of Technology Demonstration on Productivity of Greengram (Vigna radiata L.) in North Eastern Ghat Zone of Odisha

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Authors’ contributions

This work was carried out in collaboration among all authors. Author SKS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors PKP and DP collected the data through interview schedule. Author FHR managed the analyses of the study and edited first draft of the manuscript. Author SS managed the literature searches. All authors read and approved the final manuscript.

ABSTRACT

The study was conducted to recognize the technological impact of proper package of practice for the production and productivity of Greengram in comparison to the traditional practices followed by the farmers of Ganjam district of Odisha. To enable impact assessment 100 farmers of which 50 farmers followed technology demonstration and 50 followed traditional method of cultivation were selected for the study. The results of technology demonstrations showed that farmers got increased productivity of Greengram notably by switching over to improved variety and adoption of improved production technology. From the experiment it was observed that the improved Greengram variety IPM 02-14 recorded the 42.5% higher yield compared to the local variety PDM-139. Technology gap and the technology index values were 230 kg/ha and 23%, respectively. Farmers are experiencing yield loss due to the high incidence of yellow mosaic vein diseases of the crop. The increment in
productivity of the crop under technology demonstrations was not only due to adopting improved variety which is resistant to yellow mosaic vein diseases but also following other attributing factors like seed treatment with bio-fertilizers, proper seed rate, application of herbicide, judicious dose of fertilizers and plant protection measure.

Keywords: Technology demonstration; impact; Greengram; Ganjam.

1. INTRODUCTION

Pulse is the second most important food crop group after cereals, which play a key role in States Agriculture. Their ability to use atmospheric nitrogen through biological nitrogen fixation is economically more sound and environment friendly [1]. Pulses are a good and chief source of protein for a majority of the Indian population. Pulses contribute 11% of the total intake of proteins in India [2]. In India, frequency of pulses consumption is much higher than any other source of protein, which indicates the importance of pulses in their daily food habits. Pulses production in India has not kept up with growth in demand calling for import [3]. Even though pulses production increased significantly during the last decade but continuing the rapid growth is a challenge for researchers, extension agencies and policy makers to fulfill the domestic demand. The productivity of pulses in the state is quite low than most of the major pulse producing states in our country. In Odisha, Greengram is cultivated in both khari and rabi season with an area of 8.57 Lakh ha with production 4.07 Lakh MT and productivity 476 kg/ha [4].

Evaluation is an inevitable component for any programme, which would help the policy makers, administrators, project staff, sponsors and the beneficiaries to dig into details of the programme consequences and thereby devising appropriate strategies for up scaling, continuing or terminating a programme. Hence this study was undertaken to meet the purpose of evaluation between the demonstrated technologies vis-a-vis practices traditionally followed by farmers as a means to establish the success of interventions in farmers’ fields.

2. MATERIALS AND METHODS

The study was carried out in Chopra, Lepa, Nada, Chikili villages under Jagannathprasad block of Ganjam district which are the operational area of National Innovations on Climate Resilient Agriculture (NICRA) Project of Ganjam Krishi Vigyan Kendra where farmers followed the technology demonstration besides two other villages i.e. Jeerabadi and Gandadhara where farmers followed traditional methods as control. In Table 1 the details of average temperature and precipitation is provided. The experiment on demonstration was conducted on high yielding variety Greengram since last 4 years (2016-17 to 2019-20) in project villages under NICRA. The data on output of high yielding variety of Greengram and inputs used per hectare have been collected from the 50 farmers of demonstration trials by following purposive sampling. All the participating farmers were trained for proper package of practices for Greengram production technologies. Recommended agronomic practices and quality seeds of Greengram were used for the demonstrations in 0.4 ha area. In addition to this, data on traditional practices followed by farmers have also been collected from 50 farmers selected randomly from nearby villages in the same block. The primary data were collected from the selected farmers with the help of interview schedule and interpreted and presented in terms of percentage increased yield. Thus, a total sample size comprised of 100 respondents from 6 villages across Jagannathprasad block of Ganjam district. To estimate the technology gap, extension gap and technology index following formulae outlined by Samui et al. [5] have been used:

Technology gap = Pi (Potential yield) - Di (Demonstration yield)

Extension gap = Di (Demonstration Yield) - Fi (Farmers yield)

Technology index = \[
\frac{\text{Technology gap} \times 100}{\text{Potential yield}}
\]
Table 1. Year wise precipitation and temperature data of the selected villages*

<table>
<thead>
<tr>
<th>Month</th>
<th>2016-17</th>
<th>2017-18</th>
<th>2018-19</th>
<th>2019-20</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Precipitation (mm.)</td>
<td>Avg. min. temp. (°C)</td>
<td>Avg. max. temp. (°C)</td>
<td>Precipitation (mm.)</td>
</tr>
<tr>
<td>Dec.</td>
<td>0</td>
<td>14.2</td>
<td>30.6</td>
<td>0</td>
</tr>
<tr>
<td>Jan.</td>
<td>0</td>
<td>13.4</td>
<td>30.1</td>
<td>0</td>
</tr>
<tr>
<td>Feb.</td>
<td>35</td>
<td>17.2</td>
<td>33.2</td>
<td>0</td>
</tr>
</tbody>
</table>

* Automatic weather station is available at one project village and all the villages under the study are located within a radius of 5.0 km. from that project village.

**Greengram crop is sown in the month of December and harvested in February.
Table 2. Comparison of farmers’ practices and technological intervention for Greengram

<table>
<thead>
<tr>
<th>SN.</th>
<th>Particular</th>
<th>Farmers’ Practice</th>
<th>Demonstration Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Variety</td>
<td>PDM 139</td>
<td>IPM 02-14</td>
</tr>
<tr>
<td>2.</td>
<td>Seed Treatment</td>
<td>No seed treatment</td>
<td>Thiram @ 3g/kg seed + Rhizobium 20gm/kg seed before 1 hour of sowing.</td>
</tr>
<tr>
<td>3.</td>
<td>Time of sowing</td>
<td>First Week of December</td>
<td>Last week of December</td>
</tr>
<tr>
<td>4.</td>
<td>Fertilizer dose</td>
<td>Only providing Nitrogenous fertilizer</td>
<td>Application of Water soluble fertilizer (N:P:K - 19:19:19) @ 10 gm./ lt. 25 &amp; 40 DAS . Application of Boron @ 1 Kg./ ha. after 40 DAS.</td>
</tr>
<tr>
<td>5.</td>
<td>Weeding</td>
<td>Manual weeding</td>
<td>Application of post emergence herbicide – Imazethapyr @ 750 ml/ha at 25 DAS</td>
</tr>
<tr>
<td>6.</td>
<td>Plant protection measures</td>
<td>Farmers don’t use any plant protection chemicals</td>
<td>Spraying of Thiamethoxam @ 150 gm/ ha. for controlling Aphid and white fly.</td>
</tr>
</tbody>
</table>

2.1 Differentiation in Farmers’ Practices and Demonstration Package in Greengram Crop

The major differences were observed between demonstration package and farmer’s practices are regarding recommended varieties, seed treatment, time of sowing, fertilizer dose, application of herbicide and plant protection measures (Table 2). The data showed that under the demonstrated plot recommended varieties, water-soluble fertilizers, plant protection chemicals and herbicides were provided to the farmer and all package and practices were timely performed by the farmers under the supervision of scientists. Under farmers’ practice, the variety var. PDM 139 was used at higher seed rate without any treatment. This variety found to be quite susceptible to yellow vein mosaic disease [6,7]. As a result, the farmers selected under demonstration programme on Greengram were provided with the seed of YMV tolerant Greengram var. IPM 02-14 from the year 2016 onwards.

It is also observed that under farmer situation, normally sowing of Greengram is earlier to escape from water shortage for irrigation, thus leading to reduction in yield. Regarding the application of fertilizer, under demonstration is concerned water soluble fertilizer (N:P:K :: 19:19:19) was applied at the rate 10 gm. / lt. of water at 25 and 40 days after sowing (DAS), whereas, under farmers’ practice, broadcast method of fertilization was adopted. Similar findings have also been observed by Raj et al. [3], Chandra [8] and Subbaiah and Jyothi [9].

3. RESULTS AND DISCUSSION

3.1 The Performance of Technology Demonstration on Production of Greengram

A comparison of yield performance between demonstrated practices and local checks is shown in Table 2. It was observed that the improved YMV tolerant Greengram variety IPM 02-14 recorded the higher seed yield (770 kg/ha) when compared to farmers practices (540 kg/ha). The increase in the yield over local check was 42.59%. Similar yield enhancement in different crops in demonstration has been documented by Poonia and Pithia [10], Patel et al. [11]. It is evident from the results that the yield of improved YMV tolerant variety was found better than the local check under same environmental conditions. Farmers were motivated by results of demonstrated agro technologies applied in the demonstration and it is anticipated that they would adopt these technologies for Greengram production, which is also reported by Sidhu and Dhillon [12] and Sonawane et al. [13]. Yield of the demonstration and potential yield of the crop was compared to estimate the yield gap, which were further categorized into technology index. In Table 2, year wise demonstration yield is given with the benchmark yield of different adopted villages under NICRA. It is worth mentioning here that the average yield of Greengram in 2 check villages was also 540 kg ha⁻¹. It is observed that there is a significant mean difference of 230 ha⁻¹ between the benchmark and demonstration yield.

3.2 Technology Gap

The technology gap is the difference or gap between the demonstration yield and potential
yield (1000 kg ha$^{-1}$) and it was 230 kg ha$^{-1}$. This gap exists due to variation in the soil fertility and climatic conditions. Hence location specific recommendations are necessary to bridge the gap. These findings are similar to the findings of Patel et al. [11] and Mishra et al. [14].

3.3 Technology Index

Technology index shows the feasibility of the technology at the farmer’s field. The lower the value of technology index more is the feasibility. Result of present study depicted in Table 3, revealed that the technology index values was 23. The results of the present study are in recurrency with the findings of Pandiyan et al. [15].

3.4 Economics of Technology Demonstrations

The economics of Greengram production under the package demonstrations have been presented in Table 3. The results of economic analysis of Greengram production revealed that the gross expenditure in recommended practices was higher than the farmer’s practices by about 18.88%. But the package demonstrations recorded higher gross returns (Rs. 38,500/ha) and net return (Rs. 21,500/ha). The benefit cost ratio of demonstration plot (2.26) was also more than the farmer’s practice. Further, additional cost of Rs. 2,700 per hectare in demonstration has increased additional net returns Rs.11,500 per hectare with incremental benefit cost ratio of 4.25 suggesting its higher profitability and economic viability of the demonstration. Similar results were also reported by Raj et al. [3].

3.5 Exploitable Yield Reservoir in Greengram

The results obtained from demonstrations during the four years (2016 to 2020) have conclusively proved the beneficial impact of the production technology over the farmers’ practices. The existing average productivity of Greengram in Odisha is 476 kg ha$^{-1}$ however the total annual production is 4.07 Lakh MT [4]. The estimates derived from the demonstration showed that there exists a commercially exploitable yield reservoir, which can be achieved through adoption of advocated improved crop production technology for Greengram. Thus, it is clear that with full adoption of the presently available production technologies, 6.59 Lakh MT of Greengram production could be achieved, which is almost adequate to meet the requirement of Greengram in the state.

<table>
<thead>
<tr>
<th>Sl. no.</th>
<th>Name of the village</th>
<th>Benchmark yield/ Farmers yield*</th>
<th>2016-17</th>
<th>2017-18</th>
<th>2018-19</th>
<th>2019-20</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chopara</td>
<td>5.6</td>
<td>7.6</td>
<td>7.9</td>
<td>7.9</td>
<td>8.1</td>
<td>7.88</td>
</tr>
<tr>
<td>2</td>
<td>Chikili</td>
<td>5.4</td>
<td>7.5</td>
<td>7.6</td>
<td>7.7</td>
<td>8</td>
<td>7.7</td>
</tr>
<tr>
<td>3</td>
<td>Nada</td>
<td>5.2</td>
<td>7.7</td>
<td>7.5</td>
<td>7.1</td>
<td>8.3</td>
<td>7.65</td>
</tr>
<tr>
<td>4</td>
<td>Lepa</td>
<td>5.4</td>
<td>8.4</td>
<td>7.4</td>
<td>7.3</td>
<td>7.2</td>
<td>7.58</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td>5.4</td>
<td>7.8</td>
<td>7.6</td>
<td>7.5</td>
<td>7.9</td>
<td>7.7</td>
</tr>
</tbody>
</table>

*Average yield of farmers for the year 2015-16 is provided in benchmark yield. (It was taken before starting technology demonstration)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Yield (kg/ha)</th>
<th>% increase over local check</th>
<th>Technology Gap (kg/ha)</th>
<th>Technology index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers’ Practices Demonstration (IPM 02-14)</td>
<td>540</td>
<td>-</td>
<td>230</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>770</td>
<td>42.59</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 5. Economics of technology demonstration for greengram production**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cost of cultivation (Rs/ha)</th>
<th>Gross return (Rs/ha)</th>
<th>Net return (Rs/ha)</th>
<th>Benefit: Cost ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmer’s Practices (Local check)</td>
<td>14300</td>
<td>27000</td>
<td>12700</td>
<td>1.88</td>
</tr>
<tr>
<td>Demonstration</td>
<td>17000</td>
<td>38500</td>
<td>21500</td>
<td>2.26</td>
</tr>
<tr>
<td>Additional in demonstration</td>
<td>2700</td>
<td>11500</td>
<td>8800</td>
<td>4.25*</td>
</tr>
</tbody>
</table>

* Incremental benefit cost ratio
3.6 Role of Technology Demonstration in Augmenting Greengram Production in the District

There is sizeable area (0.159 million ha) under Greengram cultivation in Ganjam district [4]. The decline in overall yield under cultivation of Greengram in district was reported due to high incidence of YMV disease. Farmers started keeping the land fallow after harvesting Rice. The technology demonstration programme under NICRA Project on IPM 02-14 variety with subsequent extension programme leads to revival of Greengram cultivation in the district.

4. CONCLUSION

The findings of the study revealed that wide gap exist in demonstration yield and farmer’s practices in Greengram varieties due to technology and extension gap in Ganjam District of Odisha. The percent increment in yield of Greengram to the extent of 42.59% in Demonstrations over the farmers practice created greater awareness and motivated the other farmers to adopt the improved package of practices of the important pulse crop. These demonstrations also enhanced the relationship and confidence built up between farmers and KVK scientists. The recipient farmers of NICRA project also play an important role as source of information and quality seeds for wider dissemination of the improved varieties of Greengram for other nearby farmers. It is concluded that the technology demonstration programme conducted under NICRA project is a successful tool in enhancing the production and productivity of Greengram crop through changing the knowledge, attitude and skill of farmers of the Ganjam district of Odisha.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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