Productivity enhancement of lentil (*Lens culinaris* Medik) through integrated crop management technologies

A.K. Tripathi*

Jawaharlal Nehru Krishi Vishwa Vidyalaya, Krishi Vigyan Kendra, Sagar – 470 002, Madhya Pradesh, India.

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**ABSTRACT**

The frontline demonstrations were conducted on 45 farmer’s fields in the five adopted villages of Bundelkhand region of Madhya Pradesh during *rabi* seasons of 2010 to 2012 in rainfed condition on medium to heavy soil with medium fertility status under blackgram – lentil cropping system to study the productivity enhancement of lentil through improved production technologies. The results revealed that integrated crop management practices reduced the wilt disease incidence in lentil from 20.7 to 4.9 per cent (76.3 per cent), spray of systemic insecticide imidacloprid 17.8 SL reduced the aphid population from 17.0 to 7.6 per plant (55.2 per cent) in various years. The average 22-27 pods per plant were obtained under improved technology over to farmer’s practices (17-21). The seed yields of lentil under improved technology ranged between 5.02 to 10.5 q ha\(^{-1}\) with average yield of 8.63 q ha\(^{-1}\) which was 30.5 per cent higher over the farmer’s practice (6.61 q ha\(^{-1}\)). However, maximum average net returns (Rs.21666 ha\(^{-1}\)) as well as benefit cost ratio (3.47) were recorded under improved technologies as compared to farmer’s practice (Rs.15278 ha\(^{-1}\) and 2.96).

**Key words**: Demonstration, ICM, Lentil.

**INTRODUCTION**

*Lentil* (*Lens culinaris* Medik) is an important pulse crop in vegetarian diet being a rich source of protein and essential amino acid. It is the second most important *rabi* pulse crop in India, occupying an area of 1.51 million ha with annual production of 0.95 million tone (Maheshwari *et. al*. 2008). Lentil mainly used as Dal (whole or dehulled) as well as in various other culinary preparations. It contains about 25% protein, 0.7 % fat, 2.1% mineral, 0.7% fiber and 59% carbohydrates. It is also a rich source of phosphorous and carotene. In India, it is mainly cultivated in Madhya Pradesh, Uttar Pradesh, Bihar and West Bengal states as rainfed crop during *rabi* season. These states contribute 90% of the total lentil production of the country.

Lentil crop is prone to disease like wilt and root rot diseases and sucking insect like aphid. These biotic stresses have been reported to reduce the productivity of lentil by 20-25 per cent (Maheshwari *et. al*. 2008). Lentil wilt is one of the most widespread and destructive diseases caused by *Fusarium oxysporum* Scheчет. Emend. Snyder and Hansen f. sp. *lentis* Vasudeva and Srinivasan (Fol).The disease may cause complete crop failure under favorable conditions for disease development and can be the major limiting factor for lentil cultivation in certain areas (Chaudhary and Amarjit, 2002). In general, average productivity of lentil continues to be lower (3.45-4.75 q ha\(^{-1}\)) than expected 8.0-12.0 q ha\(^{-1}\) from agricultural technology for the last 20 years, mainly due to its cultivation on marginal lands with poor crop management. The major concern of increasing productivity of crop is inadequate supply of nutrients and poor production practices on poor soils (Singh and Khan, 2003). The continuous use of poor production technologies by farmers may not sustain soil fertility, productivity and profitability of lentil crop. In order to realize this opportunity, an analysis is needed of the major current constraints limiting lentil productivity in India. Use of improved production technologies of lentil offers a great scope for increasing productivity and profitability. The yield of lentil can be increased by 21-53% with adoption of improved technologies such as improved variety, recommended dose of fertilizer, weed management and plant protection. Keeping this in view, frontline demonstrations on lentil was undertaken to improve the productivity and profitability of lentil with proven improved production technologies on farmer’s fields.

**MATERIALS AND METHODS**

To assess the economic feasibility of technology transfer for pest management and better productivity of lentil, the front line demonstrations were conducted on 45 farmers field of adopted villages *viz.*, Doriya, Chokhda Sagoni Pachuwara of chhatarpur district in Bundelkhand region of
Madhya Pradesh during *rabi* seasons of 2010-11, 2011-12 and 2012-13 in rainfed condition on medium to heavy soil with medium fertility status under blackgram – lentil cropping system. Each demonstration was conducted on an area of 0.40 ha and the same area adjacent to the demonstration plot was kept as farmer’s practices. The package of improved production technologies included wilt resistant variety JL-3 in 2010-11 and 2011-12 and DPL 62 in 2012-13, fertilizer 20:50:20 NPK as basal application. Seeds were treated with Carboxin + Thiram (Vitavax power) @ 2 g kg\(^{-1}\) seed and inoculated with Rhizobium and PSB @ 10 g kg\(^{-1}\) seed. Seed sowing was done between October 08 to 20 in every year with a seed rate of 25 kg/ha in line sowing with row to row spacing of 30 cm and 10 cm between plants in the row. Recommended dose of fertilizer (20:50:20 NPK kg ha\(^{-1}\)) was applied through urea, single super phosphate and murate of potash as basal application. One hand weeding was done at 25 DAS for control of weeds. Foliar spray of Imidacloprid 17.6 SL was done at flower initiation stage for management of aphid. The crop was harvested during February 25 to March 15 after the leaves turn yellow and start dropping.

In the second plot, locally available mix seed of lentil treated with Carbendazim 50 W P @ 2 g kg\(^{-1}\) was sown with basal dose of DAP 50 kg ha\(^{-1}\) and maintained as farmers practice.

The data on incidence of wilt disease was recorded from flowering to crop maturity stages, whereas, aphid population was recorded from flowering to podding stages. The data on seed yield, cost of cultivation and gross and net monetary return were collected from technological demonstration plot. In addition to this, data on farmer practices were also collected from the equal area. The benefit cost (B:C) ratio was calculated based on gross return. The following formulæ were used to calculate the parameters as suggested by Das et al. (1998):

1. Increase in grain yield =
   \[
   \text{Grain yield from Demo plot} - \text{Grain yield from FP plot} / \text{Grain yield from Demo plot} \times 100
   \]

2. Net Return = Gross Return – Cost of cultivation
3. Benefit/ Cost Ratio = Gross Return / Cost of Cultivation \times 100

To assess the technology gap and extension, following formulæ given by Kadian et al. (1997) was used:

Technology gap = Potential yield – Demonstration yield
Extension gap = Demonstration yield - farmers yield

**RESULTS AND DISCUSSION**

The data on wilt disease incidence, aphid population, yield and yield attributing characters of lentil for 3 years presented in Table-1 revealed that occurrence of wilt disease in improved technology (use of wilt resistant variety and seed treatment by vitavax power) was 6.4, 4.8

<table>
<thead>
<tr>
<th>Year</th>
<th>Area of demonstration (ha)</th>
<th>No. of dem.</th>
<th>Area of FP</th>
<th>No. of FP</th>
<th>Area of Demo</th>
<th>No. of FP</th>
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<td>6.0</td>
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<td>3.7</td>
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<td>8</td>
<td>21.4</td>
<td>17.4</td>
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<td>2011-12</td>
<td>15</td>
<td>6.0</td>
<td>22.4</td>
<td>22.4</td>
<td>17</td>
<td>8</td>
<td>20.7</td>
<td>17.4</td>
<td>21</td>
<td>9.6</td>
<td>19</td>
<td>8.9</td>
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<tr>
<td>2012-13</td>
<td>15</td>
<td>6.0</td>
<td>24.6</td>
<td>24.6</td>
<td>18</td>
<td>8.6</td>
<td>25.2</td>
<td>17.4</td>
<td>22</td>
<td>8.4</td>
<td>21.4</td>
<td>17.4</td>
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<th>Year</th>
<th>Area of demonstration (ha)</th>
<th>No. of dem.</th>
<th>Area of FP</th>
<th>No. of FP</th>
<th>Area of Demo</th>
<th>No. of FP</th>
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<th>Area of Demo</th>
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<td>2012-13</td>
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<td>8.6</td>
<td>25.2</td>
<td>17.4</td>
<td>22</td>
<td>8.4</td>
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Table 1: Wilt disease incidence, insect population, seed yield of Lentil as affected by improved and local practices on farmer’s fields

Demo- Demonstration, FP- Farmer practice
Table 2: Economics of Lentil production as affected by improved and local practices

<table>
<thead>
<tr>
<th>Year</th>
<th>Cost of cultivation (Rs.)</th>
<th>Additional cost of cultivation (Rs.)</th>
<th>Net returns (Rs.)</th>
<th>Additional Net Return (Rs.)</th>
<th>B:C ratio</th>
<th>Technology gap</th>
<th>Extension gap</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Demo</td>
<td>FP</td>
<td>IT</td>
<td>FP</td>
<td></td>
<td></td>
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<tr>
<td>2010-11</td>
<td>8550</td>
<td>7650</td>
<td>900</td>
<td>9660</td>
<td>6250</td>
<td>3410</td>
<td>2.78, 2.25</td>
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<tr>
<td>2011-12</td>
<td>8900</td>
<td>7800</td>
<td>1100</td>
<td>26650</td>
<td>20430</td>
<td>6220</td>
<td>4.09, 3.20</td>
</tr>
<tr>
<td>2012-13</td>
<td>9650</td>
<td>8350</td>
<td>1300</td>
<td>28690</td>
<td>19155</td>
<td>9535</td>
<td>3.56, 3.44</td>
</tr>
<tr>
<td>Average</td>
<td>9033</td>
<td>7933</td>
<td>1100</td>
<td>21666</td>
<td>15278</td>
<td>6388</td>
<td>3.47, 2.96</td>
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and 3.6 per cent as against farmers practice having 21.4, 22.4 and 18.4 per cent during the years 2010-11, 2011-12 and 2012-13, respectively. Average reduction in wilt incidence 20.7 to 4.9 per cent (76.3 per cent). Which may due to protection from Fusarium oxysporum f.sp. lentis in seed as well as in soil. Earlier Maheshwari et al. (2008) also found reduction in wilt incidence with the seed treatment of systemic fungicide significantly. Balance fertilizer application showed better number of pods per plant. Numbers of pods per plant under improved production technology were 22, 26 and 27 as in farmer’s practice were 17, 21 and 21 per plant during the years. Precautionary spray of systemic insecticide Imidacloprid 17.8 SL reduced the aphid population from 17.0 to 7.6 per plant (55.2 per cent) in various years. The productivity of lentil in Bundelkhand region of Madhya Pradesh under improved production technology ranged between 6.61 q ha⁻¹ to 8.63 q ha⁻¹ with increase in seed yields by 30.5 per cent. The average seed yield under improved technology were 5.02 q ha⁻¹, 10.4 q ha⁻¹ and 10.5 q ha⁻¹ during 2010-11, 2011-12, and 2012-13, respectively as against farmers practice where seed yield was 3.75 q ha⁻¹, 8.4 q ha⁻¹ and 7.7 q ha⁻¹. Application of biofertilizer with phosphorus (50 kg ha⁻¹) and potassium (20 kg ha⁻¹) increased the seed yield of lentil as reported by Sahu et al. (2002).

The economic viability of improved technologies over traditional farmer’s practices was calculated depending on prevailing prices of inputs and output costs (Table 2). It was found that cost of production of lentil under improved technologies varied from Rs. 8550 to 9650 ha⁻¹ in various years, whereas in farmers practice it varied from Rs. 7650 to 8350 ha⁻¹. On an average an additional cost Rs. 1100 ha⁻¹ was required to raise the crop with improved package. Cultivation of lentil under improved technologies gave higher net return of Rs 9660 to 28690 ha⁻¹ in different years with an average of Rs.21, 666 ha⁻¹ as against in farmer practices Rs. 6250 to 20430 ha⁻¹ with an average of Rs. 15278 ha⁻¹. The improved technologies also resulted in better benefit cost ratio of 2.78, 4.09 and 3.56 as compared to 2.25, 3.2 and 3.44 under farmer practice in the corresponding years. Singh (2002) also suggested that the full planning and adoption of improved package of practices given significant increase in yield of various crops. The results from the current study clearly brought out the potential of improved production technologies for lentil cultivation in rainfed condition of Madhya Pradesh in India. Further analyzing the data it has been found that technology gap among farmers were 5.05 q ha⁻¹ and extension gaps 3.26 q ha⁻¹ with existed practices in comparison to improved technology. Ray et al. (2010) and Singh Barman (2011) also reported a gap in technology adoption in pulse crops both in rainfed and irrigated cropping system due to lack of awareness and timely availability of quality input at proper time. The study showed that there are a vast difference in technology gap of farmers and demonstrations by researchers. There is urgent need to demonstrate various technology of lentil production (viz., improved variety, IPNM and IPM) with farmer’s trainings/field visits at various stage of crop growth for higher productivity.

REFERENCES


