Analysis of yield gaps in black gram (*Vigna mungo*) in district Bilaspur of Himachal Pradesh

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**Abstract**

Black gram (*V. mungo*) is one of the important pulse crops in India which plays an important role in supplementing the income of small and marginal farmers. Non adoption of improved varieties and recommended practices is one of the reasons for low productivity in this crop. Improved technological package was compared with that of farmers’ practice in the Bilaspur district of Himachal Pradesh during *kharif* 2006 to 2009. The results revealed that the use of improved variety, line sowing and balanced application of fertilizers under the improved practice increased seed yield of mash by 34.1 to 81.6% over farmer practice. Improved technological package gave 33.7% higher gross return and 70.4% higher net return over the prevalent practice of the farmers. The average additional cost and additional net return of INR 3003 and INR 10715 were recorded from 2006 to 2009. Incremental benefit cost ratio (IBCR) ranged from 3.10 to 4.64 with an average value of 3.55. The water use efficiency has also been increased by using the improved agricultural technologies in the demonstrations.

**Key words:** Technology gap, extension gap, technology index, Black Gram.

Food legumes are the vital source of protein. These crops contain high amounts of protein, macro and micro-nutrients (Ca, P, K, Fe and Zn), vitamins, fibre and carbohydrates for balanced nutrition. They are rich in lysine and essential amino acids which are found only at low levels in cereal proteins (Mohmoud, 2009). Black gram (*V. mungo*) is an important food legume widely consumed in India. It also plays an important role in sustainable agriculture enriching the soil through biological nitrogen fixation. It is mostly grown in Madhya Pradesh, Maharashtra, Tamil Nadu, Uttar Pradesh, Rajasthan and Gujarat during rainy season, where as in Andhra Pradesh and West Bengal in winter (*rabi*) season (Ram et al., 2010). On account of its short duration, photosensitivity and dense crop canopy it assumes special significance in crop intensification, diversification and conservation of natural resources and sustainability of production system (Katiyar and Dixit, 2010). In the recent past CSKHPKV came up with worthwhile production technologies. However, such technological benefits are not yet harnessed by the state farmers.

Therefore, yield level at farmers field is quite low than that is achieved in experimental farms and demonstration plots. Therefore, the present investigation was carried out to estimate the yield gaps in black gram for having planning for better research and extension.

**Material and Methods**

Improved technology package (Table 1) was compared with farmers’ practice of growing mash in all the three blocks of Bilaspur district during *kharif* 2006-2009. In total, 120 trials were conducted on the farmer’s field. The gross plot size was 400 m². Yield data for the improved practice as well as from farmers’ practice were recorded at the time of threshing and analyzed to draw the inferences. The season-wise detail of sowing and harvesting has been given in Table 2.

The technology gap, extension gap and technology index were estimated using the following formulae (Kadian et al., 1997, Samui et al., 2000 and Dwivedi et al., 2014):

Technology gap = Potential yield (P) – Demonstration plot yield (D)
Extension gap = Demonstration plot yield – Farmer’s plot yield

Technology index (%) = \( \frac{(P - D)}{P_i} \times 100 \)

The potential yield refers to that maximum reported at the time of release of the variety. Cost of cultivation of black gram (V. mungo) includes cost of inputs like seed, fertilizers, pesticides etc. purchased by the farmers (in farmers practice) and supplied to him (in improved practice) as well as hired labour, sowing charges by bullocks/tractor and post harvest operation charges paid by the farmers. The farmers’ family labour was not taken into consideration in the present study. The gross and net returns were worked out accordingly by taking cost of cultivation and price of grain and byproduct. Additional costs include expenditure on improved technological inputs over farmers’ practice. Similarly, the incremental benefit-cost ratio (IBCR) was worked out as a ratio of additional net returns and corresponding additional cost of cultivation (Kumari et al., 2007).

The seasonal water use (Et) was computed from profile water contribution (CS), effective rainfall (ER) and irrigation water applied (I) using the equation: \( Et = CS + ER + I \). Since, the trials were conducted in wide area under varying agro-ecological conditions, the profile water contribution (CS) was not taken into consideration. Similarly, the crops were grown under rainfed farming conditions only.

Thus, effective rainfall was considered as seasonal water use in the present study by taking into account the respective crop growth period of each demonstration and the water use efficiency was worked out accordingly (Table 2). The rainfall data were taken from ‘Agro-meteorological Observatory’ of Pulse Research Sub Station, Berthin Distt. Bilaspur (H.P.) which is situated in the centre of the district.

**Results and Discussion**

**Grain yield**

With the adoption of improved production technology on black gram (V. mungo), the grain yield was invariably higher (791 to 998 kg ha\(^{-1}\)) than the farmers’ plot (510 to 590 kg ha\(^{-1}\)) yields during all the years (Table 4) which may be attributed to the adoption of recommended agro-technologies during the study period. Sagar and Chandra (2004) and Choudhary et al. (2009) have also reported increase in yield by the use of recommended agro techniques.

Table 4 revealed that percent seed yield increase in black gram in improved package over farmers’ plots was highest (81.6%) during **kharif** 2006 and lowest (34.1%) during **kharif** 2009. This indicates that with the adoption of improved technology in pulses, the yield levels in pulses could be raised by 34.1 to 81.6% over the farmers’ practice. The yield advantage of 36.9 to 192.0% has also been reported in earlier studies (Kumari et al., 2007 and Choudhary et al., 2009).

**Table 1. Detail of improved package and farmers practice**

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Improved package</th>
<th>Farmers practices (Local check)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variety</td>
<td>UG-218</td>
<td>Local (Kathu)</td>
</tr>
<tr>
<td>Seed rate</td>
<td>18-20 kg/ha</td>
<td>30 kg/ha</td>
</tr>
<tr>
<td>Sowing method</td>
<td>Line sowing (30 cm x10 cm)</td>
<td>Broad casting</td>
</tr>
<tr>
<td>Situation</td>
<td>Rainfed</td>
<td>Rainfed</td>
</tr>
<tr>
<td>Fertilizer dose</td>
<td>20:40:20 (N:P:K kg/ha)</td>
<td>Nil</td>
</tr>
<tr>
<td>Plant protection</td>
<td>Need based insecticides &amp; fungicides spray</td>
<td>No spray and insecticides &amp; fungicides</td>
</tr>
</tbody>
</table>

**Table 2. Date of sowing and harvesting**

<table>
<thead>
<tr>
<th>Year</th>
<th>Dates of sowing</th>
<th>Dates of harvesting</th>
</tr>
</thead>
</table>
Technological gaps

The yield gaps in the present study were categorized into technological and extension gaps. The technology gap observed ranges from 202 to 409 kg ha\(^{-1}\) during the years of investigation. The highest technological gap was obtained during kharif 2009 (409 kg ha\(^{-1}\)) followed by 345 kg ha\(^{-1}\) during kharif 2008 while lowest gap was observed during kharif 2006 (202 kg ha\(^{-1}\)). This may be attributed to the lack of irrigation facilities, improper distribution of rainfall (Table 3), variation in soil fertility status, cultivation in the marginal lands, non congenial weather conditions and local specific crop management problems faced in order to obtain the yield potential of specific crop cultivars (Sagar and Chandra 2004; Choudhry 2013). The location specific crop management is required to bridge the gap in the potential and the demonstration yields (Kumari et al. 2007), besides strengthening of irrigation infrastructure in the region (Choudhry et al. 2009).

Extension gaps

The successful development, dissemination and adoption of improved technologies for small-holders depend on more than careful planning of research and the use of appropriate methodologies in extension. (Mishra et al. 2007; Choudhary 2013). The extension gap ranged from 201 to 448 kg ha\(^{-1}\) during the period of study. The higher extension gap in the present study (Table 4) indicates that there is a strong need to aware and motivate the farmers which is emphasizing on need to educate farmers through various means for adoption of improved agricultural production technologies over existing local practices to minimize the extension gap. Maximum extension gap of 448 kg/ha was observed during kharif 2006 and lowest during 2009. Extension yield gaps are the indicators of lack of awareness for the adoption of improved farm technologies by the farmers (Kadian et al. 1997; Kumari et al. 2007; Choudhary 2013). Thus this study infers that extension functionaries of Bilaspur district have to strictly focus on dissemination of proven farm technologies in pulse production systems enhancing thereby the pulse productivity over existing.

Technology index

Black gram is the major component of existing pulse production systems in the Bilaspur district in terms acreage and production (Anonymous 2009) and is under cultivation with the farmers as pure or mixed crop since many years. Technology index indicates the feasibility of the evolved technology in the farmers’ fields under existing agro climatic variations (Kumari et al. 2007; Choudhary et al. 2013). Lower the value of technology index, higher is

<table>
<thead>
<tr>
<th>Month</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>289.0</td>
<td>387.4</td>
<td>246.2</td>
<td>399.4</td>
</tr>
<tr>
<td>August</td>
<td>280.0</td>
<td>380.0</td>
<td>375.6</td>
<td>340.6</td>
</tr>
<tr>
<td>September</td>
<td>198.8</td>
<td>172.6</td>
<td>64.6</td>
<td>172.6</td>
</tr>
<tr>
<td>October</td>
<td>27.6</td>
<td>22.6</td>
<td>4.0</td>
<td>796.8</td>
</tr>
<tr>
<td>Total</td>
<td>895.4</td>
<td>796.8</td>
<td>709</td>
<td>916.6</td>
</tr>
</tbody>
</table>

Table 3. Rainfall (mm) during the cropping season
the feasibility of the improved technology. Technology index varied from 16.8 to 34.1% in different years of study. The lowest technology index 16.8% was recorded during kharif 2006 followed in increasing order by 25.8% during 2008, 30.4% during 2007 and 34.1% during kharif 2009, respectively. This indicate that a strong gap exist between the generated technology at the research institution and disseminated at the farmer’s field (Kadian et al. 1997, Vaghasia et al. 2005 and Kumari et al. 2007). But the introduction of HYV’s and demonstration of improved technology followed by intensive awareness campaign will eventually lead to adaption of generated technology among farmers of the district to accelerate the crop diversification, crop intensification and productivity enhancement in the black gram (V. mungo).

**Economic analysis**

The gross and net returns in improved practice were highest during kharif 2006 with an average value of INR 39920 and INR 31670/ha, respectively. While, in farmer practice highest gross and net returns recorded were INR 29500/- and INR 18000/-, respectively. The IBCR ranges from 3.10 to 4.64 (Table 5). Enhanced monetary returns as well as IBCR through improved farm technology have also been reported by various workers (Kumari et al., 2007; Choudhy et al. 2009; Choudhary et al. 2013). Overall economic analysis highlights that use of improved technology and its adoption in black gram (V. mungo) had substantially enhanced the farm gains over farmer’s practice which indicated that use of farm technology can greatly improve the livelihood and profitability of the farming community of Bilaspur district.

**Water use and water use efficiency**

The total seasonal water use during the crop growth period in black gram (V. mungo) varied from 709.0 to 916.6 mm (Table 4). Water use efficiency (WUE) varied from 0.86 to 1.21 kg ha-mm⁻¹ in the improved practice and 0.61 to 0.77 kg ha⁻¹ mm in farmers plots. From the data, it was evident that use of improved technology has greatly enhanced the water use efficiency of black gram (V. mungo) as compared to farmers’ field plots, though the crop water use was same under both the conditions (Table 3). This can be attributed to improved crop yields of black gram (V. mungo) in the improved practice because of better crop management and plant nutrition (Choudhary et al. 2006; 2009), resulting in higher water use efficiency with the same amount of seasonal water use. Overall, water use efficiency in improved plot was higher than that of farmer’s plots.
It can be concluded from the study that the wide gap between potential and demonstration yield in black gram (V. mungo) was mainly due to technological and extension gaps. The productivity and profitability of the agricultural farm can be improved greatly under rainfed situations by adopting the improved agricultural technologies in the Bilaspur district. It was also observed that there was need to educate and motivate the farmers for adoption of improved technologies, so that marginal farmer with limited resources could improve their livelihood and diversify their farming situation.

References