Productivity and economics of different maize (Zea mays)-based crop sequences under dryland conditions

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ABSTRACT

A field experiment was conducted during 1993-97 at Rakh Dhiansar, Bari-Brahamana, Jammu, to study the productivity and economics of different maize (Zea mays L.-based cropping systems. Among the cropping sequences tried, the productivity and net returns were the highest in maize-wheat (Triticum aestivum L. emend. Fiori & Paol.) sequence, followed by green fodder-toria [Brassica campestris L. ssp. oleifera (metzger) sinsk. var. toria]+gobhi sarson (B. napus L. ssp. oleifera DC. var annua L.). Maize–toria–wheat and greengram–(Phaseolus radiatus L.) toria–wheat achieved the highest land-utilization efficiency. However, the production efficiency was the highest in green fodder–toria+gobhi sarson sequence, followed by maize–wheat sequence.

Key words: Maize-based crop sequences, Equivalent yield, Economics, Net returns, Production efficiency

As the scope of increasing irrigation potential in the near future seems to be very limited in our country, the development of feasible cropping systems for the rainfed areas is the need of the hour. Maize, being a short-duration, moderately drought-tolerant and comparatively high yielding, is the major rainy (kharif)-season crop of the rainfed areas of Jammu region. Apart from the production potential and the land utilization, there is a need to evaluate crop sequences on the basis of their nutrient requirement and stability of production. The need for inclusion of oilseeds and pulses for sustainable crop production has also been recognized now. Therefore an investigation was carried out to study the production potential, land utilization and economics of maize-based crop sequences for 5 years.

MATERIALS AND METHODS

A field experiment was conducted from 1993-94 to 1997-98 at Dryland Agriculture Research Sub-Station, Rakh Dhiansar, Bari-Brahamana, Jammu, to study the feasibility of promising maize-based crop sequences. The treatments comprising 8 crop sequences, viz. maize–wheat (CS1), green manuring (GM)–toria–wheat (CS2),...
greengram–toria–wheat (CS₁), green-
manuring–wheat (CS₂), maize–toria–gram
(CS₃), maize–toria+gobhi sarson (CS₄)
maize–toria–wheat (CS₅) and green
fodder–toria+gobhi sarson (CS₆), laid out
in randomized block design with
replications in plots of 105 m². The soil
of the experimental site was sandy loam
in texture, having pH 6.8, organic carbon
0.32%, available nitrogen, phosphorus and
potash 165, 16 and 95 kg/ha respectively.
The recommended fertilizer doses were
applied in all the crops. The rainy-season
crops were sown with the onset of monsoon
and harvested at the physiological maturity
stage to conserve the residual soil moisture.
The harvesting of green fodder was done in
August and thereafter the soil moisture was
conserved by ploughing followed by
planking. Gobhi sarson and toria were
sown in late September and the sowing of
gram was done in the second week of
October every year. Plant-protection
measures were adopted as per the need of
the crops.

For comparison between crop
sequences, the yields of all the crops were
converted into maize equivalent on price
basis (Verma and Modgal, 1983). The land-
use efficiency was worked out by taking
total duration of crops in individual crop
sequence divided by 365 and production-
efficiency values were obtained by total
production in a sequence divided by total
duration of crops in that sequence (Tomar

RESULTS AND DISCUSSION

Maize-equivalent yield

Maize–wheat sequence was found most
productive crop sequence with respect to
maize-equivalent yield, followed by green
fodder–toria+gobhi sarson and maize–toria
wheat (Table 1).

However, these crop sequences were at
par with each other in this respect. Maize-
equivalent yield recorded from greengram–
toria–wheat sequence was significantly
higher than green manure–toria–wheat and
maize–toria+gram. It was significantly
lower than that recorded in maize–wheat
and green fodder–toria+gobhi sarson crop
sequences. This was due to low yield of
wheat after toria in case of green manure-
toria–wheat and toria and gram after maize
in maize–toria + gram crop sequence.
Maize–toria+gobhi sarson, green manure–
wheat, green manure–wheat and maize-
toria+gram crop sequences were
statistically at par with each other in this
respect.

Land use and production efficiency

Maize–toria–wheat and greengram–
toria–wheat crop sequences achieved the
highest land-use efficiency of 82% (Table
1), followed by maize–wheat, maize-
toria+gram, maize–toria+gobhi sarson and
green fodder–toria+gobhi sarson. The
lowest land-use efficiency was recorded in
green manuring–wheat sequences, as the
land was occupied by the crops for a short
period in this sequence in comparison with
other crop sequences studied. Production
efficiency was the highest in green fodder–
toria+gobhi sarson, followed by maize–
wheat, greengram–toria–wheat and maize-
toria–wheat. Green manuring–toria–wheat
and maize–toria+gobhi sarson accrued
more or less the similar production
## Table 1. Grain yield and economics of different maize-based crop sequences (pooled over 5 years)

<table>
<thead>
<tr>
<th>Crop sequence</th>
<th>Grain yield (kg/ha)</th>
<th>Land-use efficiency (%)</th>
<th>Production efficiency (kg/ha/day)</th>
<th>Gross returns (Rs/ha/year)</th>
<th>Net returns (Rs/ha/year)</th>
<th>Benefit cost ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>2,520</td>
<td>73.9</td>
<td>18.70</td>
<td>26,375</td>
<td>14,175</td>
<td>1.16</td>
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<tr>
<td>Wheat</td>
<td>2,700</td>
<td></td>
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<tr>
<td>Maize equivalent</td>
<td>5,051*(270)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Green manuring</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toria</td>
<td>624.5</td>
<td>60.3</td>
<td>12.35</td>
<td>12,534</td>
<td>3,234</td>
<td>0.34</td>
</tr>
<tr>
<td>Wheat</td>
<td>1,592.0</td>
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<tr>
<td>Maize equivalent</td>
<td>2,728.0 (220)</td>
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<tr>
<td>Green gram</td>
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<td></td>
</tr>
<tr>
<td>Toria</td>
<td>366.5</td>
<td>82.0</td>
<td>16.87</td>
<td>15,100</td>
<td>4,875</td>
<td>0.47</td>
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<td>Wheat</td>
<td>2,491.5</td>
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<td></td>
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<td>Maize equivalent</td>
<td>3,740.0 (300)</td>
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<tr>
<td>Green manuring</td>
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</tr>
<tr>
<td>Wheat</td>
<td>3,257</td>
<td>49.3</td>
<td>10.17</td>
<td>14,070</td>
<td>3,345</td>
<td>0.31</td>
</tr>
<tr>
<td>Maize equivalent</td>
<td>3,053.0 (180)</td>
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<tr>
<td>Maize</td>
<td>1,873.50</td>
<td>71.2</td>
<td>10.48</td>
<td>11,980</td>
<td>2,650</td>
<td>0.28</td>
</tr>
<tr>
<td>Toria</td>
<td>160.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Gram</td>
<td>214.0</td>
<td></td>
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<tr>
<td>Maize equivalent</td>
<td>2,726.0 (260)</td>
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</tr>
<tr>
<td>Maize</td>
<td>1,973.0</td>
<td>82.0</td>
<td>14.18</td>
<td>14,240</td>
<td>3,415</td>
<td>0.31</td>
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<tr>
<td>Toria</td>
<td>250.0</td>
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</tr>
<tr>
<td>Wheat</td>
<td>1,908.0</td>
<td></td>
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<tr>
<td>Maize equivalent</td>
<td>4,256.0 (300)</td>
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</tr>
<tr>
<td>Maize</td>
<td>1,833.50</td>
<td>71.0</td>
<td>12.66</td>
<td>16,352</td>
<td>3,227</td>
<td>0.28</td>
</tr>
<tr>
<td>Toria</td>
<td>155.0</td>
<td></td>
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<tr>
<td>Gobhi sarson</td>
<td>527.0</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Maize equivalent</td>
<td>2,393.0 (260)</td>
<td></td>
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</tr>
<tr>
<td>Green fodder</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Toria</td>
<td>29,410.0</td>
<td>65.7</td>
<td>20.39</td>
<td>17,908</td>
<td>12,058</td>
<td>2.06</td>
</tr>
<tr>
<td>Gobhi sarson</td>
<td>583.0</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Maize equivalent</td>
<td>4,894.0 (240)</td>
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<tr>
<td>CD (P=0.05 for</td>
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</tr>
<tr>
<td>Maize equivalent</td>
<td>888.0</td>
<td></td>
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</tr>
</tbody>
</table>

Figures in parentheses indicate duration of crops in that sequence.
efficiency. All other crop sequences had more or less the similar production efficiency. It was the lowest in green manuring–wheat and maize–toria+gram. This was due to less production in these crop sequences spread over a long duration compared with other cropping systems.

**Economics**

Maize–wheat crop sequence accrued the highest gross returns as well as the net returns followed by green fodder–toria+gobhi sarson. Green manuring–toria+wheat, maize–toria+wheat and maize–toria+gobhi sarson combined well with early-maturing toria which helped in the efficient use of above- and below-ground resources by the component crops and subsequently increased the productivity, monetary returns and benefit: cost ratio. These results corroborate the findings of Jadhav et al. (1991), Mulik et al. (1996) and Verma and Warsi (1999).

**REFERENCES**


