Intercropping Maize with Cowpeas and Mungbean under Rainfed Conditions

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Abstract: The research study was conducted at two locations i.e. Barani Agricultural Research Station (Kohat) and Barani Seed Farm (Hangul to ascertain the biological efficient and economic efficient intercropping system of maize with cowpeas and mungbean. The results regarding LER showed that maize + cowpeas intercrop average of two locations was 1.29 indicating 29 percent yield advantage which is also biological efficient system. The maize + mungbean indicating 4 percent yield advantage. However, the economic analysis gave a different results which showed that mungbean sole crop gain highest BCR value (return per rupee invested i.e. Rs. 4.82) followed by cowpeas sole crop (Rs. 4.13). It is concluded that apart from biological efficient different economic indices should be computed for comparison and final recommendation for wide spread adoption.

Key words: Intercropping, maize, cowpeas, mungbean, biological and economical efficient

Introduction
Intercropping (growing one or more crops simultaneously on the same field) is one of the way of ameliorating the productivity of land and other inputs (Andrews and Kassam, 1976). Intercropping is used by small farmers primarily to increase the diversity of their products and the stability of their annual output through effective use of land and other resources (Frankis and Sanders, 1978). Enyi (1973) reported that small farmers in many countries are seriously constrained by low productivity and limited land resources. Therefore, preliminary research has shown that possible means of increasing the productivity on these farms would be through intercropping. Willey and Osiru (1972) recommended that intercropping of maize with legumes appears to be more profitable. The economic returns can be greater if relatively higher value legumes suitable for intercropping are chosen. In many tropical countries the intercropping of cereal-legumes mixture is practiced to mae effective use of land and other resources. Since this subject has not been thoroughly studied in the drier/rainfed areas of Kohat division where rain fall is erratic and low, thus in the preset study an attempt was made in the direction to explore the biological efficient system of maize in the rainfed condition of Kohat.

Materials and Methods
A field experiment was conducted at two diverse agro-ecological zones of Kohat division during the year 1998 Kharif (monsoon season).

Detail of Locations
1. Barani Agril. Res. Station Jarma, Kohat where rainfall ranged from 10” to 20” annually. The crop at this location was irrigated once when there was a drought spell in first week of September.
2. Barani Extension seed Farm Hangul where rainfall ranged from 15” to 30” annually.

The experiments comprised with the following treatments:
1. Maize sole crop
2. Cowpeas sole crop
3. Mungbean sole crop
4. Maize + Cowpeas intercrop alternate row
5. Maize + Mungbean intercrop alternate row

The treatments were replicated four times in Randomized complete block design using a net plot sizes of 3.6 x 5 m with row to row distance of 60 cm. The crop was sown with single row cotton drill with manual labor. Recommended seed rate and fertilizer dose were used for all the treatments. The rest of the agronomic practices were also normal and uniform. All the three crops were harvested manually at their respective physiological maturities and the grain yield data were recorded from the four central rows and then converted into kg/ha. Land Equivalent Ratio was calculated for biological efficiency as follow:

LER is the land required for sole crops to produce the yield achieved in the intercropping mixture. This provides measure of the efficiency of particular crop association relative to the sole crop (Willey, 1979) and is the most important index of measuring biological advantage of intercropping as compared to corresponding monocropping system. The index is based on relating the yield of each crop in an intercrop mixture to the yield of that crop grown as a sole crop and then sum up the resulting ratios to give the combine index.

LER can be calculated as:

\[
LER = \frac{YI^1}{YS^1} + \frac{YI^2}{YS^2}
\]

Where
- \(YI^1\) = Yield of first crop (maize) in the intercropping system
- \(YS^1\) = Yield of first crop (maize) in sole cropping system
- \(YI^2\) = Yield of 2nd crop (cowpeas/mungbean) in the intercropping system
- \(YS^2\) = Yield of 2nd crop (cowpeas/mungbean) in the sole’ cropping system.

The interpretation embodies that a value of the intercropping system which is greater than one (1) is indicating an over all biological advantage of intercropping over the sole crops. Economic indices i.e. Gross income, cost of cultivation and Net income were calculated for computing BCR value (return per rupee invested as follow):

\[
\text{Return per rupee invested} = \frac{\text{Gross return}}{\text{Total (variable)}} - \text{cost of cultivation}
\]

Results and Discussion
Land equivalent ration (LER): Cowpeas and mungbean were tested for the suitability as intercrops in maize in the rainfed condition of Kohat. The important criterion was not to sacrifice the yield of maize but at the same time to get some additional yield from the intercrop. Among the intercrop tested at Barani Agril. Res. Station Kohat and Barani Seed Farm (Hangul), cowpeas was found to be the most suited intercrop in maize (Table 1).
Intercropping system which was probably attributed to better that the productive/biological efficiency of cowpea was higher in locations was 1.29 indicating 29 percent yield advantage from regarding LER of maize intercrop with cowpeas average of two compatible intercrop for maize in Kohat and Hangu areas. The data with Singh (1981). Calculation of LER showed that cowpea is being climbing type and crop mature earlier than maize and did not where the LER values are 1.28 and 1.30 respectively. Cowpeas

Maize price per kg = Rs.6/-, Cowpeas price per kg = Rs. 24/-, Mungbean price per kg = Rs. 18/-

Maize + mungbean 652+399=1051 11092 2970 8122 3.73
Maize + cowpea 823 + 337 =1160 13026 3320 9706 3.92
Cowpea sole 534 12816 3100 9716 4.13
Maize sole 1246 7476 2800 4676 2.67

system/ of locations income cultivation income per rupee invested (Rs.4.13). This is because both the crops i.e. mungbean and cowpea are leguminous crops and tolerant to drought as compared to maize sole and intercrop involved maize. These results are in close confirmation with the finding of Singh (1981). Calculation of LER showed that cowpea is being climbing type and crop mature earlier than maize and did not where the LER values are 1.28 and 1.30 respectively. Cowpeas

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Comparision of economic indices based on yield: Agro-economic feasibility of an intercropping system is ultimately determined by its not monetary gain. No single index is capable of giving a good comparison of intercropping system and so a number of indices are used together to assess the economic viability of the system. The agronomist decides on the biological efficient while the economist decides on the economic worthiness of the system using one or more of the economic indices. In general, a biologically efficient system is also economically superior but quite often it so happens that a biologically efficient system is not economically viable and cannot be recommended for wide scale adoption by farmers. An estimate of the economic aspect of the present studies were computed and the data regarding the monetary gain alongwith all relevant calculations and interpretation average of the two locations are presented in (Table 2). In a intercropping system experiment for rainfed area of Kohat and Hangu, it was observed that maize + cowpea and maize + mungbean are biologically efficient and were better than sole cropping having LER values of 1.29 and 1.04 (Table 1) respectively. But economic analysis (Table 2) gave a different result where sole crop of mungbean gave the highest gross returns (Rs. 13248), net returns (Rs. 10498) and return per rupee invested (Rs. 4.82). Next in order was cowpea sole crop which gave gross return (Rs. 12816), net returns (Rs. 9716) and return per rupee invested (Rs. 4.131. This is because both the crops i.e. mungbean and cowpea are leguminous crops and tolerant to drought as compared to maize sole and intercrop involved maize. These results are in close confirmation with the finding of Elangovan (1980), Singh (1995) and Enyi (1973). De et al. (1978) further indicated that the productive efficient of both the legumes crops sown alone were higher which was probably attributed to better utilization of growth factors as compared to intercropping with maize. Those findings are also in accordance with the present achievements. Maize price per kg = Rs. 61.94, Cowpeas price per kg = Rs. 24.6. Mungbean price per kg = Rs. 18.6.

Acknowledgement

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References


Table 1: Yield and LER values of maize and intercrops

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Yield kg/ha Barani Agric. Res. Station Kohat</th>
<th>Yield kg ha⁻¹ Barani Seed Farm Hangu</th>
<th>Average Yield kg ha⁻¹ of locations</th>
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<tbody>
<tr>
<td>Maize sole</td>
<td>1692</td>
<td>1</td>
<td>1246</td>
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<tr>
<td>Cowpeas sole</td>
<td>617</td>
<td>1</td>
<td>534</td>
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<tr>
<td>Mungbean sole</td>
<td>871</td>
<td>1</td>
<td>736</td>
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<tr>
<td>Maize + cowpeas</td>
<td>1140</td>
<td>373</td>
<td>823</td>
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<tr>
<td>Maize + mungbean</td>
<td>988</td>
<td>438</td>
<td>652</td>
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Table 2: Economic analysis of intercropping maize with cowpeas and mungbean average cross two locations

<table>
<thead>
<tr>
<th>Intercropping system of locations average of two locations</th>
<th>Average Yield of locations (kg/ha)</th>
<th>Gross Income (Rs./ha)</th>
<th>Cost of Cultivation (Rs./ha)</th>
<th>Net Income (Rs./ha)</th>
<th>Return per rupee (Rs.)</th>
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<tbody>
<tr>
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<td>7476</td>
<td>2800</td>
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<td>3100</td>
<td>9716</td>
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<tr>
<td>Mungbean sole</td>
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<td>2750</td>
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<td></td>
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