Effect of planting pattern and on growth, yield and nutrient uptake by *kharif* integrated nutrient management Pulses under semi-arid region of Rajasthan

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Abstract

An investigation was carried out during *kharif*, 2015 under rainfed condition to study the feasibility and economic viability of *kharif* Pulses under different intercropping systems and integrated nutrient management at S.K.N. College of Agriculture, Jobner (Jaipur). Among different intercropping systems, sole crop of mungbean and mothbean recorded significantly more growth and yield attributes except plant height which recorded in mungbean + sesame (2:1) PR ratio and mothbean+sesame (2:1) PR ratio. Sole planting of *kharif* Pulses gave significantly maximum seed and straw yields, whereas, mungeban equivalent yield and net returns were observed under mungbean + sesame (2:1) PR ratio. The concentration of N, P and K and its total uptake and protein content were observed significantly under sole crop of mungbean and mothbean over rest of systems. Application of 50% RDF through fertilizer + 50% RDF through vermicompost recorded significantly higher growth and yield attributes and yield, mothbean equivalent yield and net returns and remained at par with application of 75% RDF through fertilizer + 25% RDF through vermicompost. A significant increase in N, P and K concentration and its total uptake observed Application of 50% RDF through fertilizer + 50% RDF through vermicompost.

Keywords: intercropping, mungbean, mothbean, nutrient uptake, planting pattern, integrated nutrient management

Introduction

Intercropping and mixed cropping is predominant in the arid and semi-arid tropics. Greengram [*Vigna radiata* (L.) Wilczek] and mothbean (*Vigna aconitifolia* (Jacq.) Marechal), a major rainfed crop in arid zone of Rajasthan, is mostly grown with clusterbean and sesame. Plant population and spatial arrangement in intercropping have important bearing on productivity of component crops. Mungbean and mothbean, being a short duration crop, fits well in sequential and intercropping systems for stepping up the production. Short supply of pulses and oilseeds has forced our country to import pulses and edible oil. Under these circumstances intercropping of pulses and oilseeds may be a feasible and viable option to augment per unit area productivity of these crops through spatial intensification which could be comparable with other higher productive crops (Meena *et al*. 2008) [4]. Among the various technologies developed for rainfed agriculture, intercropping is one of the most important techniques which embody growing of crop under different plant geometry. With the release of early maturing and diverse crop varieties it is proved beyond doubt that such a system, when based on sound production principles, will provide greater stability, productivity and profitability. The system of intercropping not only improves the yield and returns but also reduces the risk of complete crop failure as compare to the sole cropping system (Rao and Singh, 1990) [10]. In India fertilizer is one of the costliest inputs in crop production. Thus, with the rising cost of fertilizers, the potential of using legumes to increase soil nitrogen becomes increasingly attractive. Lipmann (1913) [3] was the first to suggest that soluble nitrogenize compounds were utilized by adjoining porous root walls of non-legume when grown in association with legumes. Legumes offer excellent compatible combination for mixing with oil seeds to minimize the competition and to confer a symbiotic association to achieve the prim aim of maximizing available resources. Hence, the practice of intercropping of sesame with *kharif*...
pulses of rainy season seems to be a good position to economize the applied nutrient. The integration of chemical fertilizers with organic manures have been found to be quite promising not only in maintaining higher productivity but also providing greater stability in crop production (Nambiar and Abrol, 1992) [6]. Vermicompost has been advocated as a good source of organic manure for use in integrated management practices for field crops. A judicious combination of organic and inorganic fertilizers can maintain long term fertility and sustain higher productivity of crops. Considering the low nutrient status of soil (particularly N and P as well as organic matter) there is need of integrated nutrient management (organic and inorganic fertilizer), in a balanced proportion than which either alone or in combination can increase and sustainable growth and yield of crops. Therefore, the present study aimed to determine the compatibility of sesame for intercropping with kharif pulses under varying level of fertilizer and vermicompost.

Materials and Methods
A field experiment was conducted during kharif, 2015 at S.K.N. College of Agriculture, Jobner (Jaipur). The soil was loamy sand in texture, alkaline in reaction (pH 8.2), low in organic carbon (0.14%), available nitrogen (130 kg/ha), available phosphorus (16.52 kg P2O5/ha) and medium in potassium (151.8 kg K2O/ha) content. The experiment consisted of four intercropping systems viz., [sole mungbean, sole mothbean, sole sesame, mungbean + sesame in 2:1 paired row ratio and mothbean + sesame in 2:1 paired row ratio] and four treatments of integrated nutrient management (100 % RDF through fertilizer, 75% RDF through fertilizer + 25% RDF through vermicompost, 50% RDF through fertilizer + 50% RDF through vermicompost and 100% RDF through vermicompost) was laid out in Randomized Block Design with three replications.

The experimental crops were sown in lines 30 cm apart for sole crops. Under intercropping after pairing two rows of mothbean at 20 cm leaving the space of 40 cm in between pairs, one row of sesame was sown in 2:1 paired row intercropping system. The intra row spacing of 10 cm for both crops was maintained after the thinning. The mungbean variety ‘RMG-492’, mothbean ‘RMO-257’ and sesame ‘RT-46’ were used. A common recommended dose of fertilizers (20 kg N and 40 kg P2O5/ha) was uniformly applied to all the plots through urea, DAP and vermicompost, respectively before sowing in respective plots as per treatments. The crop was sown on 5th July 2015 and harvested on the 20 September 2015. Cost of cultivation was calculated by taking current market prices of inputs, while gross returns were obtained by multiplying seed and straw yields with market prices. Net returns were calculated by deducting cost of cultivation from gross returns. The N, P and K uptake and their available status in soil were estimated by using standard procedures. The yields further used for computation of LER as suggested by Willey (1979) [12]. Data was statistically analysed by the procedure described by Panse and Sukhatme (1985) [7].

Obseration on yield of mungbean and mothbean was recorded from area of net plots harvested. The mungbean equivalent yield was calculated by converting the seed yield of mothbean and sesame into mungbean yield on the basis of existing market prices of the crops.

Results and Discussion

Growth parameters
In the present investigation, plant height of mungbean and mothbean significantly increased when grown with sesame and maximum plant height recorded in 2:1 PR ratio over sole crop at 40 DAS and at harvest, while maximum dry matter accumulation observed under sole crop. The increase in plant height due to increased competition between plants for sunlight in paired row planting of mothbean. Application of 50 % RDF through fertilizer + 50% RDF through vermicompost significantly improved plant height and dry matter accumulation at different growth stages and remained at par with application of 75% RDF through fertilizer + 25% RDF through vermicompost.

Yield
The yield attributes (number of pods/plant and number of seeds/pod) and yields (seed and straw) of mungbean and mothbean were significantly higher in sole crop as compared to intercropping systems. Among the row ratios mungbean + sesame and mothbean + sesame grown in 2:1 paired row ratio recorded significantly maximum seed and straw yields, while maximum mungbean equivalent yield observed in mungbean + sesame and maximum LER observed in 2:1 paired row ratio. The reduction in yield in all row ratios over sole crop was primarily due to low plant population of mungbean and mothbean in intercropping systems. Reduction in yield of kharif pulses might also be due to competition between the component crops for sharing of nutrients, light and water by intercrop. These results are in close conformity with those of Prajapat et al. (2011) [8]. Application of 50 % RDF through fertilizer + 50% RDF through vermicompost significantly improved number of seeds/pod and seed and straw yields, mungbean equivalent yield and remained at par with application of 75% RDF through fertilizer + 25% RDF through vermicompost. The efficacy of inorganic fertilizer is much pronounced when it is combined with organic manure. The increased vegetative growth and the balanced C:N ratio might have increased the synthesis of carbohydrates, which ultimately promoted yield. The probable reason could be efficient and greater partitioning of metabolites and adequate transformation of nutrients to developing plant structures. As a result, almost all yield attributes of crops resulted into significant improvement due to organic manures and fertilizer in combination. The present trend of increase in yield is in close conformity with the findings of Jaishankar and Wahab (2005) [2], and Choudhary et al. (2011) [1] and Shivran et al. (2015) [11].

Nutrient uptake and quality parameters
Intercropping systems differed in concentration, uptake by seed and straw and total uptake of N, P and K and protein content in seed of mungbean and mothbean. Sole crop of pulses recorded significantly higher concentration, uptake by seed and straw and total uptake of N, P and K and protein content in seed of mungbean and mothbean as compared to 2:1 PR ratios. The higher total N, P and K uptake under sole crop as compared to intercropping systems was primarily due to increased seed yield under sole crop. Meena et al. (2008) [4] also reported significantly higher uptake of total N by sole clusterbean and sesame. Application of 50% RDF through fertilizer + 50% RDF through vermicompost significantly increased the nitrogen and potassium concentration in seed and in straw of both the crops (mungbean and mothbean), total uptake of N, P and K and protein content in seed of mungbean and mothbean and P concentration in seed and straw of mungbean and seed of mothbean. However, it remained at par with application of 75% RDF through fertilizer + 25% RDF through vermicompost. This might also be due to
improved nutritional environment in the rhizosphere as well as its utilization in the plant system leading to enhanced translocation of N, P and K to reproductive structures viz., pods, seeds and other plant parts. The increase in these parameters due to N, P and K fertilization led to an increased uptake of nutrients in the present study (Rana et al. (2014) [9].

Economics
Comparison made amongst varying intercropping systems revealed numerically higher net returns were obtained with The mungbean + sesame 2:1 PR ratio gave significantly higher net returns (78656/ha) followed by sole mungbean (68300/ha), as compared to sole mothbean, sole sesame and mothbean + sesame 2:1 PR ratio. Application of 50% RDF through fertilizer + 50% RDF through vermicompost fetched significantly maximum net returns (55803/ha) and it remained at par with application of 75% RDF through fertilizer + 25% RDF through vermicompost. This might be due to higher seed and straw yields and proportionately higher additional income compared to cost involved which led to significantly more net returns than other treatments. These findings are in accordance with the results reported by Kumar et al. (2013) [9] and Shivran et al. (2015) [11] who reported that maximum net returns were obtained under application of inorganic and organic manures in combination.

**Table 1:** Effect of planting pattern and integrated nutrient management on growth and yield of Kharif pulses

<table>
<thead>
<tr>
<th>Treatment</th>
<th>MUNGBEAN</th>
<th></th>
<th></th>
<th>MOTHBEAN</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plant height (cm)</td>
<td>Dry matter accumulation (g/meter row)</td>
<td>Yield (Kg/ha)</td>
<td>Plant height (cm)</td>
<td>Dry matter accumulation (g/meter row)</td>
<td>Yield (Kg/ha)</td>
</tr>
<tr>
<td></td>
<td>40 DAS</td>
<td>At harvest</td>
<td>40 DAS</td>
<td>At harvest</td>
<td>Seed</td>
<td>Straw</td>
</tr>
<tr>
<td>A. Intercropping</td>
<td>24.30</td>
<td>51.80</td>
<td>37.20</td>
<td>116.33</td>
<td>1161</td>
<td>2403</td>
</tr>
<tr>
<td>MT sole</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MG + S (2:1) PR</td>
<td>27.20</td>
<td>54.50</td>
<td>33.15</td>
<td>105.96</td>
<td>965</td>
<td>1919</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>1.88</td>
<td>NS</td>
<td>2.30</td>
<td>6.58</td>
<td>56</td>
<td>90</td>
</tr>
<tr>
<td>100% RDF (fertilizer)</td>
<td>23.50</td>
<td>50.00</td>
<td>32.11</td>
<td>103.69</td>
<td>991</td>
<td>2003</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>2.66</td>
<td>4.60</td>
<td>3.25</td>
<td>9.30</td>
<td>80</td>
<td>128</td>
</tr>
</tbody>
</table>

**Table 2:** Effect of planting pattern and integrated nutrient management on nutrient concentration and uptake of Kharif pulses

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mungbean</th>
<th></th>
<th></th>
<th>Mothbean</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N concentration (%)</td>
<td>Total N uptake (kg/ha)</td>
<td>Protein content (%)</td>
<td>P concentration (%)</td>
<td>Total K uptake (kg/ha)</td>
<td>N concentration (%)</td>
</tr>
<tr>
<td>Seed Straw</td>
<td>Seed Straw</td>
<td>Seed Straw</td>
<td>Seed Straw</td>
<td>Seed Straw</td>
<td>Seed Straw</td>
<td>Seed Straw</td>
</tr>
<tr>
<td>A. Intercropping</td>
<td>3.941</td>
<td>1.261</td>
<td>76.44</td>
<td>24.63</td>
<td>0.543</td>
<td>0.260</td>
</tr>
<tr>
<td>MT sole</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MG + S (2:1) PR</td>
<td>3.564</td>
<td>1.214</td>
<td>57.96</td>
<td>22.28</td>
<td>0.398</td>
<td>0.180</td>
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<tr>
<td>CD (P=0.05)</td>
<td>0.056</td>
<td>0.024</td>
<td>2.04</td>
<td>0.35</td>
<td>0.016</td>
<td>0.014</td>
</tr>
<tr>
<td>B. Integrated nutrient</td>
<td>0.171</td>
<td>NS</td>
<td>6.17</td>
<td>1.07</td>
<td>0.049</td>
<td>0.043</td>
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Glycine max under mid hill conditions of
International Journal of Chemical Studies
11. 10. 9. 5. 4. 2. (P=0.05) + 25%
SEm (VC)
RDF
RDF
RDF
RDF
RDF
RDF
75%
influenced growth, yield and economics of fennel
1990
management on seed yield, quality and nutrient uptake of
24
mungbean as influenced by intercropping systems and
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