Influence of Tillage and Plant Density on Mungbean

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Abstract

Response of mungbean (Vigna radiate L.) to two tillage systems viz. conventional planting and No-till system on in-rows wheat stuble, and five plant densities viz. 10, 15, 20, 25, and 30 plant m\(^{-2}\) was studied in south west Iran during 2008. All measured traits include grain and protein yield were higher in conventional planting than in no-till system due to well prepared seed bed in conventional planting, but no-till system is a sustainable agricultural systems helping farmers to produce economically mungbean during summer season. Result also showed that the number of pods per plant and grain protein content decreased by increasing in plant density, but 25 plant m\(^{-2}\) produced maximum grain and protein yield of 1973.0 and 311.5 kg ha\(^{-1}\), respectively, due to the most optimum plant density in the existing ecological condition.

Key words: Mungbean, Tillage, Plant density, Grain yield, Protein content.

Introduction

Tropical legumes produce higher biomass content in temperate climates Mansoer et al., (1997). Yadvinder et al. (1992) showed that tropical legumes could produce their biomass in a shorter time period compared with winter legumes. Reddy et al. (1986) showed mean biomass yield of 10 mg ha\(^{-1}\) for several tropical legumes across a 3-yr full summer production period with mean N yields of 200 kg ha\(^{-1}\).

Mungbean (Vigna radiata L.) is a pulse crop with high content of protein and has potential in short hot summer season due to nitrogen fixation, maximizing the amount of N that is available for a subsequent crop, early maturity and ability to fit well into a crop rotation program as a second crop after harvesting fall crops, such as wheat and barley. It can be also used as food in similar manner as faba and lentil. Moreover, mungbean can be used as a crop with export potential.

Some of the major causes of low crop yields are declining soil fertility and insufficient use of fertilizers resulting in severe nutrient depletion of soils. Use of legumes in combination with inorganic fertilizers is a less expensive way of increasing soil fertility and consequently crop yield compared with the use inorganic fertilizers alone Palm et al., (1997).

Conservation tillage is a system of managing crop residue on the soil surface with minimum or no tillage Unger and McCalla, (1980). This system has increased in some crop production gradually due to increased availability of subsoil water Weatherly and Dane, (1979) and reduced water runoff, soil erosion, and energy requirements Tyler and Overton, (1982). Problem associated with conservation tillage systems are cold and wet soil conditions in the spring Karlen and Sojka, (1985), higher soil bulk density Douglas et al., (1980), and lower soil \(O_{2}\) levels Edwards et al., (1988).

According to Ahmad et al. (2004) among mungbean management practices, plant densities greatly affect crop growth and then finally grain yield and is a key factor in the flexibility and yielding ability of cultivars. They observed that maximum pods per plant and minimum grain yield were produced in the lowest plant population. Panwar and Sirohi (1987) reported increase in grain yield with increasing in plant density from 15 to 30 plants m\(^{-2}\), but number of pods per plant and yield per plant decreased in all the four cultivars tested.

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The purpose of this study was to compare (i) two different tillage systems and (ii) different plant densities, in the west Iran.

**Material and methods**

The experiment was carried out at Kamalvand Farm Station, Islamic Azad University of Khorramabad, Iran, under temperate condition of the year 2008. The experimental field was silty clay loam textured soil having a PH value of 7.5 and 0.8% organic carbon. The experiment was laid out in RCBD with strip plot arrangement with four replications. Conventional planting and No-till system were in main plot as strip and five plant densities incloud 10, 15, 20, 25 and 30 plant m\(^{-2}\) were randomized in subplots. In this case the distance between plants on row were 25, 16.7, 12.5, 8.33 cm, respectively. In conventional planting system the crop was sown manually on a well prepared seed bed in 40 cm spaced rows. In No-till system the mungbean seed was sown after wheat harvesting manually in 40 cm spaced rows each other wheat stubles in-rows.

The cultivar used was Paro variety. The seeds were sown on Joully 1, 2008. Three seed were sown in each hole. Thining was done at 12 days after sowing (DAS) and one safe and strong plant was remaind in each hole. The crop field was weed twice, first at 16 DAS and second at 33 DAS. All other agronomic practices like irrigation were kept normal and uniform in treatments.

Observations like leaf area index, pods per plant, grains per pod, 1000-grain weight, grain yield, harvest index, grain protein content, and protein yield were recorded. Data so collected were analyzed statistically using fisher’s analysis variance techniques and DMRT at 5% probability level was employed to test the significance among treatments means Steel and Torroe, (1980).

**Results and discussion**

**Planting Systems**

Data in Table 1 revealed that among two different planting systems, the conventional system produced significantly more leaf area index (4.3), plant height (53.6 cm), pods per plant (54.7), grain per pod (9.8), 1000-grain weight (67.8 g), grain yield (2133.2 kg ha\(^{-1}\)), harvest index (36.5%), grain protein content (16.6%), and protein yield (352.7 kg ha\(^{-1}\)) than No-till system, due to well prepared seed bed and enough irrigation water supply in conventional system. These results are in line with those reported by Karlen and Sojka, (1985), Douglas et al. (1980), and Edwards et al. (1988), but they are in contrast with Tyler and Overton, (1982), and Weatherly and Danc, (1979) because of enough soil water supply, no water runoff and no soil erosion in conventional system.

**Table 1: Effect of planting system and density on the plant characteristics and yields of mungbean.**

<table>
<thead>
<tr>
<th>Planting System</th>
<th>Leaf area index</th>
<th>Plant height (cm)</th>
<th>Pods plant(^{-1})</th>
<th>Grains pod(^{-1})</th>
<th>1000-grain weight (g)</th>
<th>Grain yield (kg/ha(^{-1}))</th>
<th>Harvest index (%)</th>
<th>Grain protein content (%)</th>
<th>Protein yield (kg/ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>4.3a</td>
<td>53.6a</td>
<td>54.7a</td>
<td>9.8</td>
<td>67.8</td>
<td>2133.2a</td>
<td>36.5a</td>
<td>16.6a</td>
<td>352.7a</td>
</tr>
<tr>
<td>No-till</td>
<td>3.4b</td>
<td>50.2b</td>
<td>54.7b</td>
<td>9.4</td>
<td>65.1</td>
<td>1546.6b</td>
<td>33.0b</td>
<td>15.8b</td>
<td>243.5b</td>
</tr>
<tr>
<td>B. Planting density</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 plant m(^{-2})</td>
<td>3.4b</td>
<td>49.5c</td>
<td>53.4a</td>
<td>9.9</td>
<td>65.3</td>
<td>1666.5c</td>
<td>35.9a</td>
<td>17.6a</td>
<td>279.3b</td>
</tr>
<tr>
<td>15 plant m(^{-2})</td>
<td>3.5b</td>
<td>51.3b</td>
<td>50.5b</td>
<td>9.8</td>
<td>66.3</td>
<td>1736.3b</td>
<td>35.1b</td>
<td>16.5a</td>
<td>288.5b</td>
</tr>
<tr>
<td>20 plant m(^{-2})</td>
<td>3.8ab</td>
<td>52.2ab</td>
<td>49.8bc</td>
<td>9.5</td>
<td>66.6</td>
<td>1874.0ab</td>
<td>34.9ab</td>
<td>16.1bc</td>
<td>303.6ab</td>
</tr>
<tr>
<td>25 plant m(^{-2})</td>
<td>4.2ab</td>
<td>52.5ab</td>
<td>48.4bc</td>
<td>9.5 ms</td>
<td>66.8 ms</td>
<td>1973.5a</td>
<td>34.2ab</td>
<td>15.8b</td>
<td>311.5ab</td>
</tr>
<tr>
<td>30 plant m(^{-2})</td>
<td>4.4a</td>
<td>54.1a</td>
<td>46.1c</td>
<td>9-4</td>
<td>67.4</td>
<td>1950.0a</td>
<td>33.8b</td>
<td>15.8b</td>
<td>307.5a</td>
</tr>
</tbody>
</table>

Any two means not sharing a letter differ significantly at 5% probability level (DUNCAN test).

**Plant Density**

Leaf area index increased significantly from 3.4 to 4.4 by increasing plant density from 10 to 30 plant m\(^{-2}\), respectively. The maximum plant height of 54.1 cm was recorded when highest plant density of 30 plant m\(^{-2}\) was used, and minimum one of 49.5 cm was observed in the lowest plant density of 10 plant m\(^{-2}\), because of increasing light competition with increasing in plant population. These results are agreement with those of Shakarami and Rafiee, (2009) and Ahmad et al. (2004).

Increase in plant population had significant effect on pods per plant. The number of pods per plant decreased by increasing plant density, probably due to vigorous plant growth. These results are in line with those reported by Ahmad et al. (2004), and Panwar and Sirohi, (1987).

The number of grains per pod did not differ significantly among various plant populations, however, these traits decreased with increasing in plant density. Similar results were also reported by Ahmad et al. (2004). Non-significant differences were determined in 1000-grain weight in different plant populations; however, it was increased by increasing in plant density. The highest 1000-grain weight of 67.4 g was observed in 30 plant
m² and the lowest of 65.3g was determined in 10 plant m², due to the reason of negative correlation of 1000-grain weight with number of grains per pod and number of pods per plant Ahmad et al. (2004).

Significantly the highest grain yield per hectare of 1973.0 kg ha⁻¹ was produced in 25 plant m² and followed by 30 plant m² (1950 kg ha⁻¹) due to optimum plant population, and the lowest of 1666.5 kg ha⁻¹ was observed in 10 plant m². These results are agreement with those of Ahmad et al. (2004) and Singh et al. (1988) in mungbean and Shakarami and Rafiee (2009) in corn, who reported significant variations for grain yield among various plant populations.

Harvest index was significantly decreased by increasing in plant population. The highest harvest index of 35.9% and the lowest of 33.8% was observed in 10 and 30 plant m², respectively. This is due to the fact that in case of low seeding density grain yield to biological yield ratio was more. These results are in line with Jan et al. (2000).

Grain protein contents were not significantly decreased by increasing in plant population from 16.7% to 15.8% in 10 and 30 plant m², respectively. Less plant population availed more available sunlight and aeration Shakarami and Rafiee, (2009) as well as more space and nutrients in the root zone Ahmad et al. (2004) resulted in nitrogen fixation and hence more protein contents in grains (Dwangan et al., 1992; Reddy et al., 1986; Taleci et al., 1999).

Protein yield (= Grain yield × Grain protein contents) was significantly affected by plant density similar to grain yield variations. The highest protein yield of 311.5 kg ha⁻¹ was observed in 25 plant m² and followed by 30 plant m² (307.5 kg ha⁻¹). These results showed that protein yield was more dependent upon grain yield than grain protein contents. These results are in line with our results in sugar beet that sugar yield was more dependent upon root yield than sugar contents Rafiee, (2009).

**Conclusion**

Using No-till system due to not prepared seed bed and soil compaction, plant growth and final yield reduced and practically needs special seed planter to work in-row stuble. However, No-till system and planting mungbean into in-row residue mulch reduced seed bed preparing cost and duration and energy requirements, and is one of the sustainable agricultural system, which helps farmers to produce economically enough mungbean grain yield during summer season. Also planting density of 25 plant m² was the best plant population for mungbean cultivar Parto under Khorramabad ecological conditions.

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