Effect of planting density on morphological characteristics and yield components of soybean (Glycine maxL) cultivars

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Abstract. For the purpose of studying the effect of different densities on yield attributes and morphological characteristics in three cultivars of soybean (Glycin max L.), an experiment on research field; Islamic Azad University, kermanshah was performed in 2007-2008. This factorial experiment of research was carried out 3 replication and in the form of the randomize complete blocks design. Cultivars factor were placed in the blocks at 3 levels including M7, M9, and Gorgan3 and density factors at 3 levels including plant were placed on 3, 5, 7 (cm) intra rows spacing in the blocks. The results showed that with increasing density, number of node per plant, number of pod per plant, number of grain per plant and numbers of branches were decreased. The most number of pod per plant and 100 grain weight was observed at the M7 cultiva.The highest number of branches relate to7cm intra rows spacing and the M7 cultivar had highest yield on 3 cm intra row spacing.

Key words: soybean, planting density, grain yield, yield components, Iran

Introduction

Soybean is one of the important oilseed crops and major source of high quality protein for human daily diet and livestock feed in the world (Lei et al. 2006). Soybean is grown on an area of 84,084 ha with an annual production of 207,476 tones given an average yield of 2467 kg/ ha in Iran (FAO, 2009).Among various agronomic factors limiting yield, planting pattern is considered of great importance. Ahmad et al. (2009) stated that. The optimum plant density with proper geometry of planting is dependent on variety, its growth habit and agro-climatic conditions. Ismail & Hall, (2002) stated a decrease in grain yield of cowpea with increased spacing. Bing et al. (2010) reported grain yield and numbers pod per plant were declined with increasing density. Liu et al. (2008) stated that adjusting the planting density is an important tool to optimize crop growth and the time required for canopy closure, and to achieve maximum biomass and grain yield. Ball et al, (2000) reported that increasing plants population reduced yield of individual plants but increased yield per unit of area. The objective of this study was to determine planting density effects on soybean yield and yield components.

Materials and Methods

This research was carried out as factorial based on randomized complete block design with three replications during growing season of 2007-2008 at Islamic Azad University, Kermanshah branch, Agricultural Research Station in west of Iran. The soil texture of the study area was silty-clay with a pH of 7.5., total organic matter 2.2%, electrical conductivity (ECe) 0.63dsm-1, total nitrogen 0.17%, available phosphorus 9.7 ppm, available potassium 561ppm. Soybean cultivars M7, M9, and Gorgan3 were sown manually in 23(*3cm intra rows spacing)*, 32 (*5cm intra rows spacing)* and 53(*7cm intra rows spacing)* plants/m^2 at the beginning of the third week of May.At the end of growth season, 10 plants were selected from each plot randomly and measured yield attributes and morphological characteristics. To calculate yield, 2 middle rows of each plot were harvested the beginning of the second week of October. After deducting 13% moisture, grains dry weight was calculated and considered as economic yield. Also, to determine biological yield, whole plant dry weight was considered as biological yield. Data normalizing test was done before statistical analysis and MSTAT-C used for ANOVA. Duncan multi range comparison used for comparing means ($p<5\%$).

Results and Discussion

The effects of density and cultivar on plants height was highly significant ($P < 0.01$). The most elevated height of plant was allotted to cultivar Gorgan3 and density of 23 plant.m^{-2}. Density of 23 plant.m^{-2}caused the highest plant height and density of 53plant.m^{-2}caused

the lowest. Parvez et al. (1989) reported that in soybean the plant height increased slightly with increase in planting density also, Boquet1990 () report is in agreement with findings of this research .

The effect of cultivar on number of branches per plant was significant and M9 had the highest number followed by M7 and Gorgan3.Since reduced branching at high plant populations has been reported (Weber et al., 1966;Blumenthal et al., 2005). Number of pod per plant was highly significantly influenced by density and cultivar. The highest and lowest pod per plant pertained to the density of 23 and 53 plant.m^{-2}, respectively. Number of pods per plant was significantly higher for M9 and Gorgan3 than that of cultivar M7. Boquet, (1990) and Bing et al. (2010) reported grain yield and numbers pod per plant were declined with increasing density.

The results this experiment are in line with those of Abbas et al. (1994) who had also recorded more number of pods per plant at lower density. Effects of density and cultivar on the number of grain per plant were highly significant.The highest number of which pertained to M9. These results correspond to those of Boquet,*(*1990). The weight of 100 grains of soybean was highly/ significantly affected by cultivar.the maximum weight of 100 grains pertained to the Gorgan3 and there was no significant difference between M7 and M9 in this regard.Taha (1988) reported that 100 grain weight was not affected by plant spacing. Effects of density and cultivar on grain yield were highly significant.The highest and lowest grain yield pertained to the density of 23 and 53 plant.m^{-2}, respectively.

There was no significant difference between 32 and 23 plant.m^{-2}, in this regard. Also, the highest and lowest grain yield pertained to the cultivars of M9 and Gorgan3, respectively. Boquet *(*1990) reported that grain and pod number per plant are typically reduced by increasing plant population, but this reduction is more than offset by the greater number of plants per square meter up to some optimum plant population.Ball et al. (2000) observed similar results and concluded that increasing plants population reduced yield of individual plants but increased yield per unit of area. Similar findings have also been reported in other research (Asanome & Ikeda*,* 1998; Bowers et al., 2000; Acikgoz et al*.,* 2009). The density had a highly significant effect on biological yield. The density 23 plant.m^{-2} had the highest biological yield and 53 plant.m^{-2} had the lowest.

The effect of cultivar on biological yield was highly significant. M9 had the highest biological yield and Gorgan3 had lowest. Harvest index was significantly affected by cultivar .The maximum and minimum harvest indexes pertained to the Gorgan3 and M7, respectively. There was no significant difference between M9 and M7, in this regard.Weber et al. (1966) found that very high populations in some crops, including soybean, may decrease HI because of lodging or barren plants. Non-significant effect of spacing on harvest index of legumes has also been reported by Sharar et al. (2001).

Conclusions

Results of this experiment showed that, the most of pod per plant and 100 grain weight was observed at the M7 cultivar also, the highest numbers of branch relate to7cm intra rows spacing (23 plant.m^{-2}) and the M7 cultivar had highest yield on 3 cm intra row spacing (53 plant.m^{-2}).

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