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EFFECT OF PLANT DENSITY ON AGRONOMIC TRAITS AND YIELD OF SOYBEAN CULTIVARS IN MASHHAD REGION

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Abstract

To study the effect of plant density on three soybean cultivars on 2008 at Mashhad region an experiment was conducted as factorial based on Randomized Complete Blocks Design with 4 replications. The experimental factors was included of three cultivars i.e. Hobit, Williams and LWK with three plant density that was 30, 45 and 60 plant/m^2. In each of three cultivars with increasing plant density, yield components decreased such as fertile node number, pod number on main stem, branch number, node number on branch and total pod in each plant. But plant height, lowest height of pod from the earth, node number on main stem, pod number on main stem node, seed number in each main stem pod, 100 seeds weight of main stem were not affected by plant density. Based on received results from the experiment, by increasing plant density, leaf area index, crop growth rate, biological and economical yield increased. Yield of cultivar Hobit with least plant height, the most short growth period duration, least biological yield and highest harvest index, was more than other cultivars and cultivar LWK showed minimum yield among three cultivars. Hobit and LWK at density 60 and 30 plant/m^2 with yield 5024 and 3378 kg/ha respectively, showed the most and least economical yield among the all of treatments.

Key words: *Soybean, Plant density, Cultivars, Yield, Yield components.*

INTRODUCTION

Plant density and planting pattern have a distinct effect on light interception and its efficiency to seed yield formation in most crops especially soybean (Wells et al., 1993). They concluded that with increasing plant density, number of branches and the total biomass is reduced. Cultivars response to population density and good impart from growing space need to genetic potential and its interaction with environment (Carpenter and Board, 1997). Cober et al., (2005) showed there was no significant difference for plant height between old and modern cultivars of soybean, but old ones simply flat down with increasing planting density. Boquet (1990) proposed the decreasing of growing season with early maturing cultivars for solving this problem. Some reports imply that with increasing plant density, plant height and yield components specially pod number, seeds per plant, and also seed weight are decreased, but the potential for branch formation is not affected (Boquet, 1990; and Purcell et al., 2002). Soybean seed yield is increased in narrower rows spacing because of increasing the crop growth rate (CGR) from emergence to R_5 stage (Flent et al., 1998). At seed filling period (R_5), Leaf area index (LAI) and total dry matter of crop have significant and positive effect on yield too (Mazaheri et al. 2005). LAI is increased with rising of plant density for better light interception and biomass and CGR production (Ball et al., 2000).

MATERIALS AND METHODS

This experiment was done on 2008 at Mashhad, Iran. The framework of experiment was factorial based on Randomized Complete Blocks Design with 4 replications. The experimental factors was included of three cultivars i.e. c_1: Hobit, c_2: LWK and c_3: Williams with three plant density that was d_1: 30, d_2: 45 and d_3: 60 plant/m^2. Traits under study were yield and yield components ie. fertile node number, pod number per plant, branch number, seed per pod and 100 seed weight. Plant height, CGR, LAI, biomass and harvest index were noticed too. ANOVA and Duncan multiple range test was used for interpretation of results.

RESULTS AND DISCUSSIONS

Mean comparison (P=0.01) for above mentioned agronomic traits has shown in Table 1. Hobit showed the least fertile nodes per plant amongst cultivars. With increasing plant density, number of nodes were decreased significantly. Total pods per plant decreased with increasing of plant density in all cultivars. Hobit and LWK showed the greatest and the least numbers of pods per plant, in 30 and 60 plant.m^{-2} respectively. The low plant density, the largest area for expansion of canopy and the more pods/plant.

Table 1. Mean comparison of yield and yield components of soybean cultivars× density interaction effects

Treatments	No.fertile nodes	Pod per plant	Branch number	Seed per pod	100 seeds weight (g)	Seed yield (Kg/ha)
$C_1 D_1$	10.2 cd	49.0 a	5.0 a	2.4 d	12.9 abc	4129 abc
$C_1 D_2$	8.70 d	31.0 c	3.3 b	2.4 d	12.8 abc	4067 abc
$C_1 D_3$	8.70 d	27.1cd	2.2 c	2.4 d	13.2 ab	5024 a
$C_2 D_1$	13.4 b	29.6 c	0.7 d	2.8 b	12.3 cde	3378 d
$C_2 D_2$	12.2 bc	26.5 c	0.2 d	2.9 a	11.7 de	3453 cd
$C_2 D_3$	10.9 c	20.4 d	0.1 d	3.0 a	11.4 e	4251 abc
$C_3 D_1$	15.4 a	41.9 b	1.8 c	2.7 b	12.6 bcd	3884 bc
$C_3 D_2$	13.1 b	30.2 c	0.9 d	2.6 bc	13.6 a	4266 abc
$C_3 D_3$	10.8 c	21.6 d	0.25 d	2.5 cd	12.9 abc	4473 ab

The low plant density, the largest area for expansion of canopy and the more pods/plant.
Branch number per plant showed the same trend and variations as pods/plant. Hobit had higher branches at all densities than the others. LWK had the more seeds per pod in different densities, because this cultivar has the least branches per plant, that creates more pods per main stem for compensation of seed yield.
Increasing plant density, decreased the 100seeds weight in all combinations of treatments. Williams and Hobit obtained the greatest 100 seeds weight. Hobit and LWK at density 60 and 30 plant/m^2 with the yield of 5024 and 3378 kg/ha respectively, showed the most and least economical yield among the all of treatments. Some of researchers have reported,the higher yield is achieved in narrower and slightly higher plant population densities (Egli, 1988: Flent et al., 1998).
Table 2 shows the interaction effects (P = 0.05) of cultivars×density on physiological parameters. LWK and Hobit showed the higher and non significant plant heights.The greatest LAI's belonged to Williams in higher densities. Hobit obtained a high LAI and CGR in 60 plant.m^{-2} too, both were prerequisite for its higher yield. The greater plant densities lead to the higher physiological growth indices and biomass too.
Harvest index (HI), was in the highest values for Hobit at all plant densities. This means, Hobit has a capable and efficient assimilate transport system for yield formation. The more partitioning carbohydrates to seeds, the most seed yield (Koocheki et al.,1991).

Table 2. Mean comparison of the interaction effects of cultivars× density on physiological parameters

Treatments	Height (Cm)	LAI	CGR (g.m^{-2}.days^{-1})	Biomass (Kg/ha)	HI (%)
$C_1 D_1$	50.0 b	3.0 d	15.78 c	9114 ab	44.25 a
$C_1 D_2$	51.40 b	3.97 cd	22.35 abc	9280 ab	43.5 ab
$C_1 D_3$	58.10 b	4.82 abc	24.11 a	11090 ab	43.25 ab
$C_2 D_1$	119.6 a	2.85 d	15.57 c	8479 b	35.75 abc
$C_2 D_2$	123.6 a	3.95 cd	20.14 abc	12050 ab	3.25 c
$C_2 D_3$	124.1 a	4.37 bc	24.15 a	12590 a	32.25 c
$C_3 D_1$	116.0 a	3.87 cd	16.52 bc	11240 ab	34.75 bc
$C_3 D_2$	114.6 a	5.27 ab	23.84 a	12500 a	34.75 bc
$C_3 D_3$	114.0 a	5.72 a	23.35 ab	12710 a	35.5 abc

Letters show significant differences based on Duncan's Test

CONCLUSIONS

Hobit produced the most seed yield between cultivars in 60 plant.m^{-2}.

The main reasons for Hobit higher yield were: increased LAI, CGR, Biomass and HI of this cultivar compared the others.

Hobit also has a good potential for branching. This traits help the plant to adjust and produce proper yield components.

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