Effect of Planting Date and Bush Density on Yield and Yield Component of Soybean

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A R T I C L E   I N F O

A B S T R A C T

In order to determine planting date and plant density on yield and yield component (JK) an experiment was carried out at 2013 in research farm of Azad university of Chalous as split plot on the base of completely randomized design with three replications. Planting dates in three levels (20 June, 6 July and 21 July) was considered as the main factor and planting densityin four levels(20,30,40 and 50 plant per square meter) was considered as the subsidiary factor. Results indicated that increasing plant density from 20 to 50 plant led to increase yield as the amount of 1103.4 kilograms per hectare that is showing an increasing equal to 40% in relation to the density of 20 plants per square meter. Comparing the means of planting date and density effects on seed yield indicated that the highest yield of seed was observed in density of 50 plant and third planting date of 20 June and the minimum seed yield was observed in density of 20 plant and third planting date (21 July). Therefore, the best planting date is 20June and the most yields were observed with 50 plant density.

INTRODUCTION

Soybean (Glycine max L.), is a Dicotyledon plant, one year old plant and from the family of legominosea, is one of the most important seed oils which has high application in agriculture and industry and was account as one of the five holy seeds(wheat, barley, rice and soybean) [8]. Many factorssuch as weather conditions, planting date, planting pattern, plant population, growth habits, agronomy activities management and nutritious could be resulted in variation of yield. Planting date is an important factor which influences on time duration of vegetative and reproductive growth and equilibrium between them also the other factors of production, harvest quality, and ultimately, the yield[3]. Increasing the number of plant in area unit, causes decrease in useable light of each plant because of the more shadowing and therefore cause decreasing in the yield. But increasing of plant per area unit,(until favored limit) compensates theyield of single bush and increases the yield of area unit[8]. It has been revealed in soybean that increasingplant density to an specified level, increases seed yield and increasing the plant density more than this level not only dose not lead to increasing the seed yield but it results in decreasing of the yield[9]. Yield components of soybean are included pod number per bush, seed number per pod, and the 100 or 1000 seed- mean weight [7]. Hansen et al, 2005, expressed that planting of soybean in low densities can lead to increasing of subsidiary branch number and the portion of subsidiary branches in the yield, so that, in high densities, the portion of subsidiary branches is reached to 14 to 15 percent and in low densities, the potion of subsidiary branches reaches to 47 to 74 percent. Ball *et al*[1], reported that increasing the planting density, decreases the yield of single bush but increases the yield of area unit that the decreasing the yield resulting of low density is due to less number of seed per area unit . Decreasing the yield in low density is related with less number of pod and seed per area unit. It has been revealed in soybean that increasing the plant density to an specified level increases seed yield and increasing density more than this level not only had no effect on increasing the seed yield, but results in decreasing of the yield [10]. Banest *et al*, reported in their experiment that with increasing the plant density, plant height is increased and the number of subsidiary branches is decreased. Khademhamzeh *et al* [8], studied three dates of planting, 22May, 5June and 26June, and four density levels of 30,40, 50 and 60 plant per square meter yield component of Habit cultivar soybean seed in

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industry university of Isfahan and concluded that with delay in planting, plant height and first fertile node height from the ground decreased but with increasing the plant density, increasing of these two traits were observed. In this regard, specifying the most favored planting density and planting date of soybean, in order to reaching the maximum yield in climate condition of region.

MATERIAL AND METHOD

In order to study the effect of planting date and plant density on the yield and yield component of soybean, an experiment was performed in research farm of Azad university of Chalous(longitude of 53 degree and 69 eastern min and latitude of 40 degree and 58 northern min,and +3 meters height from the sea level). Total rainfall and evaporation during growth period was 252.3 and 625.1 millimeter respectively. The maximum rainfall was observed in Sep as 93.5 millimeters and the minimum rainfall was observed in June as 3.2 millimeters. Before starting experiment, mixed sampling was provided from 30 centimeters depth of the soil and soil physical and chemical specifications were determined (table1). Experimental soil had claytexture with electrical conductance of 0.94 milli-mouse per square meter and the PH= 7.31 the experiment was performed as split plot on the base of completely randomized block design with 3 replicates. Planting dates in three levels (20June, 6 July and21 July)were the main factor and plant density in 4 levels(20,30,40 and 50 plant per square meter were as subsidiary factor. Preparation operation of the farmincluding furrow, and twice perpendicular disk was performed and in order to weed management roundup weedicide was applied as 1 liter per hectare 30 days before planting. Weeding was performed by hand during the growth period. The first irrigation was performed after planting the seeds and next irrigations were performed at 40 percent discharge of the soil. Traits such as plant height, pod number, pod length, seed number per pod, 100-seed weight, node number of plant the first node height from the ground, subsidiary branches number, pod yield and grain yield was measured during the growth season. Data analyzing was performed by MSTATC software and mean comparison was performed with Dancan's multiple-side test at probability level of 5 percent and correlation of traits were also calculated with SPSS software.

Table 1: Soil physical and chemical characteristics before transplanting, in 0-30 centimeters depth.

Tested characteristics	value
Electrical conductance(ds/m)	0.94
Total saturated acidity	7.31
(%) Nutrealizing material percent	2.46
Soil texture	clay

Plant height:

Plant height was significant under effect of planting date at the probability level of 1 percent(table 2). Reciprocal effect mean comparison effect indicated that the maximum plant height was achieved in planting date of 20 June with plant density of 20 plant per square meter(68.61 centimeters) and minimum plant height was achieved in planting date of 21 July with plant density of 20 plant per square meter(27 centimeters) (figure 1). It seems that decreasing the plant height in the last planting date was due to short long days in addition to short growth duration that resulted in speeding in flowering and therefore stopping the main stem growth and decreasing the plant height[14]. Also, increasing the height in low density is because of increasing the node number and in high density is due to increasing the internode space [4].
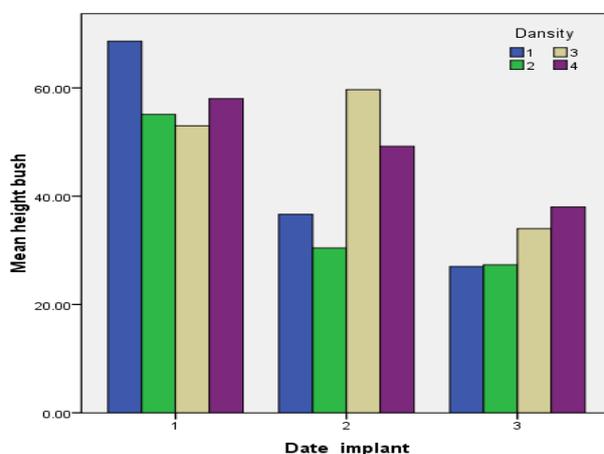

Fig. 1: The effect of planting date and plant density on plant height.

Pod number:

Effect of planting date on pod numberwas significant at the probability level of 1 percent(table 2). Mean comparison indicates that from planting date of 20 Jun to 21 Jul pod number per bush was decreased. Such that it was changed from 108.2 pod per square meter at the first planting date to 48.11 pod per bush at third planting date(figure 2). Hansen and Shibles[6], believed that yield component of the seed such as seed size, seed number in the pod and pod number in the plant is controlled by plant genetic and traits such as plant height, node number per bush and pod number per plant have positive correlation with yield. With delay in planting date and decreasing the growth duration of soybean cultivars, the number of produced pod in each plant was decreased[11].
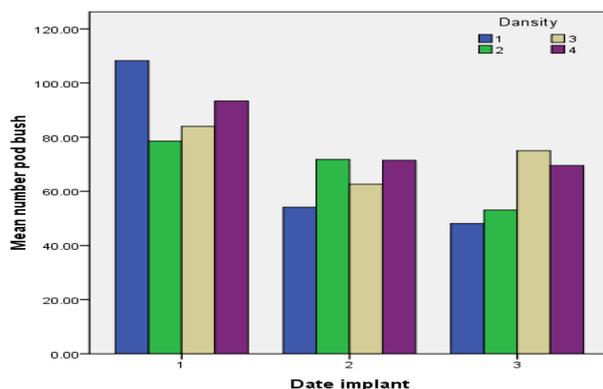

Fig. 2: The effect of planting date and plant density on pod number.

Pod length:

Analyzing of variation indicates that reciprocal effect of planting date in plant density on pod length was significant at the probability level of1 percent(table 2). Such that the maximum value of pod length with 5.50 centimeters in planting date of 20 Junand plant density of 20 plant per square meter was achieved in relation to other planting dates with different densities(figure 3).
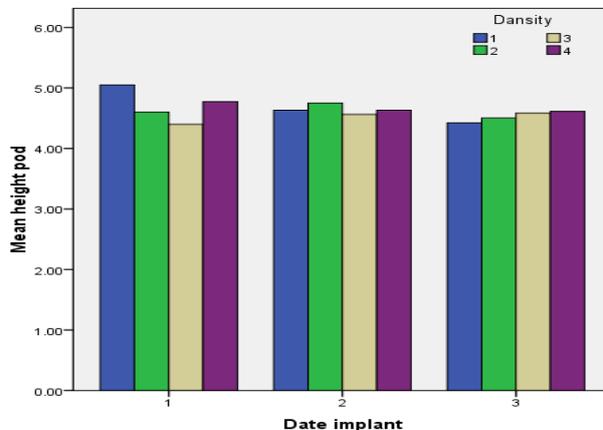

Fig. 3: Effect of planting date and plant density on pod length.

100-seed weight:

Planting date, plant density and reciprocal effect of planting date and plant density, resulted in significant difference at probability level of 1 percent on 100 seed weight(table 2). 100-seed weight was influenced significantly by planting date such that with delay in planting, descending trend was observed in that. Results show that the maximum value of 100-seed weight is related to the20 Junplanting date(37.89 grams)in planting date of 20 plant per square meter and minimum value of this trait is related to the third planting date (21 Jul) with 22.67 grams in density of 30 plant per square meter(figure 4). It seemsthat decreasing the 100 seed weight in the last planting date is due to contacting flowering stage with high temperature. With increasing density, 100-seed weight was decreased and this trend was continuing to 30 plant per square meter density. Insufficient photosynthesis material in grain filling period in high densities may be a reason of decreasing 100-seed weight with increasing density. Maximum value of 100-seed weight was achieved in 20 plant density and first planting date that indicates 15.22 grams increase in relation to its minimum value in 30 plant density in the last planting

date., Beatty *et al*[2], reported that seed weight is influenced by planting date, year and reciprocal effect of planting date and year and seed weight is decreased significantly with delayin planting in all cultivars.
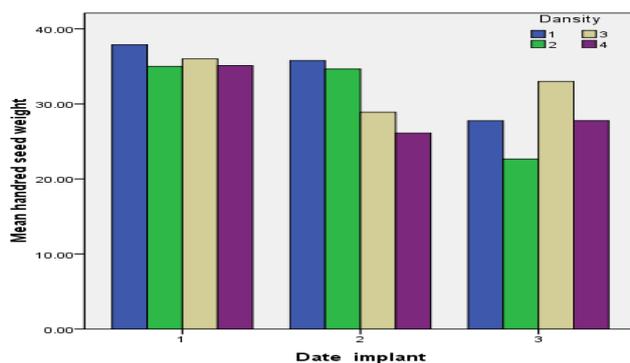

Fig. 4: Effect of planting date and plant density on 100-seed weight.

Plant node number:

Results shows that planting date at probability level of 1 percent results in significant effect on node number in plant but also plant density andreciprocal effects of planting date and plant density had no significant effect on this factor(table 2). Such that under effect of reciprocal effect of planting date and plant density, the first planting date(25.89) and plant density of 20 had the maximum and third planting date (12.87) and plant density of 30 had the least value(figure 5). Decreasing the node number in the main branch can be resulted in short growth duration and also acceleration in flowering under short days in third planting date that leads to rapid finish of plant vegetative period and short plants. Increasing thenode number of plant in two planting dates of the first and second, can be considered as abenefit for these treatment to higher yield. Not influencing of plant density on node number in the plant has been reported by others too[13].
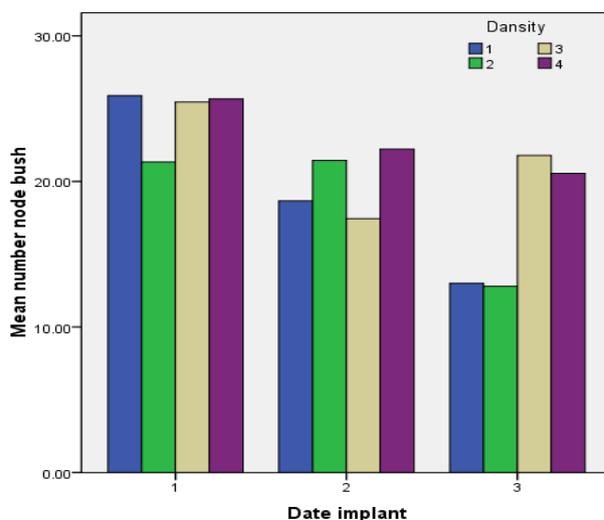

Fig. 5: The effect of planting date and plant density on the plant node number.

First node height from the ground:

Results indicate that planting date has significant effect on the first node height from the ground in this plant at probability level of 1 percent(table 2). Such that the maximum distance from the ground was achieved in planting date ofand plant density of 50 plant per square meter(8.33 centimeters) in relation to planting date of 21 Juland plant density of 30 plant per square meter(2.887 centimeters)(figure6).

Pod yield without seed:

Study of the effect of planting date and plant density and reciprocal effects of planting date in plant density was significant on the pod yield of soybean at the level of 1 percent(table 2). Such that the maximum yield of pod was in plant density of 50 plant and the first planting date(20 Jun) as 364.7 and the least yield of the pod was in the first density(30 plant) and planting date of 21 Jul with the value of 126.7 kilograms(figure 7).With regard to the figure 2,in planting date of 5 Jun, the yield in increasing with increasing the plant density that this

increasing in the pod yield is observed in the next planting dates also but it was less than first planting date that shows that with delay in planting the pod yield is decreased.
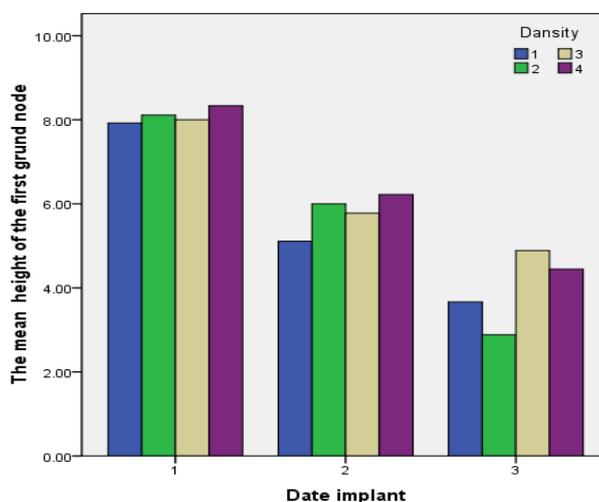

Fig. 6: Effect of planting date and plant density on the first node height from the ground.
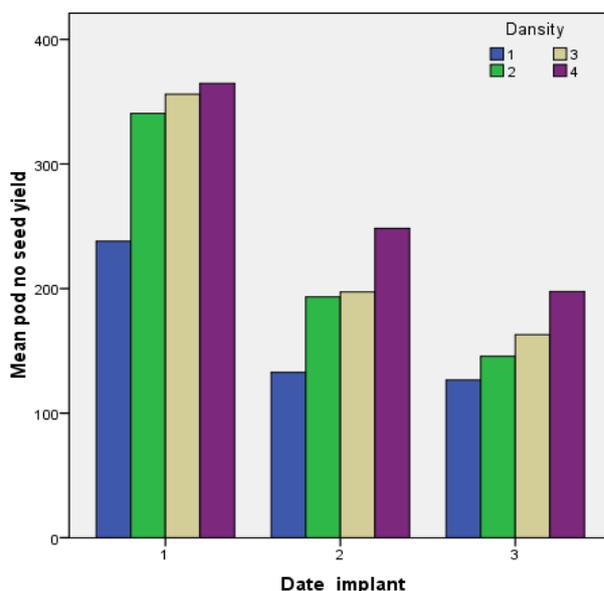

Fig. 7: Effect of planting date and plant density on pod yield of soybean without seed.

Seed yield:

Study of plant density and planting date and reciprocal effect of planting date in plant density on yield of soybean indicates that seed yield was significant at the level of 1 percent(table 2). As it can be seen in figure(8), with increasing plant density from 20 to 50 plant, the yield values were 254.3 and 738.7 respectively, such increasing is observed in the next planting date too and is indicating the positive effect of plant density on increasing the seed yield, but with delay in planting ,yield value is decreased such that planting date of21 Julwith 352.3 and planting date of 5 Jun with 738.7 had the minimum and maximum yield respectively. It seems that decreasing the seed weight and yield in the last planting date(21 Jul), is due to contact of this treatment flowering duration with high temperatures. With regard to that current condition of plant development in relation to water and weather has important role in variation of soybean seed size, if the condition became undesirable, less seeds is formed and seeds remain small because of insufficient feeding and the yield is decreased(Ranjbar and Karimi, 1988).Beaty et al(1982), reported that seed weight is influenced by planting date and year and reciprocal effects of planting date and year and 1000-seed weight is decreased significantly in all cultivars with delay in planting and therefore, the yield is decreased.
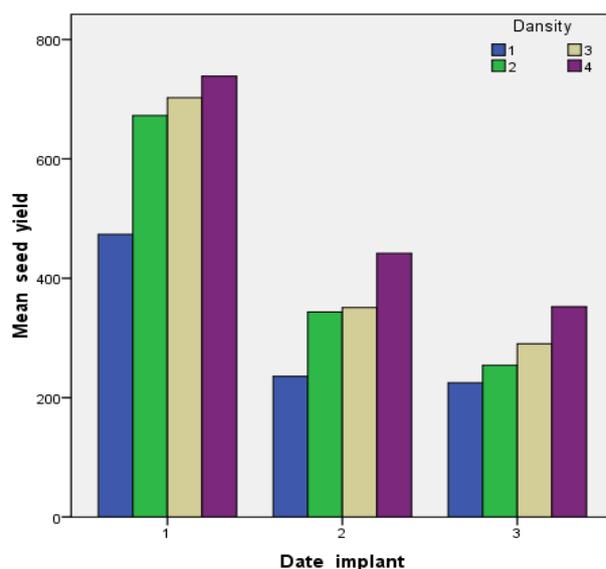
Fig. 8: Effect of planting date and plant density on seed yield.

Table 2: Mixed analyzing of variation for agronomical traits, yield and yield component.

Source of var5iation	df	Mean square(MS)							
		Seed yield	pod yield without seed	100-seed number	pod length	plant pod number	first node height from ground	plant node number	plant height
Repeat	2	19429.3	4527.25	163.107	0.016	1.783	11.701	3.529	96.855
Error	18	45430.852	1279.093	330.192	0.019	2.115	14.718	2.146	96.432
Planting date	2	460922.583**	92707.583**	3128.064**	0.095	202.69	174.442**	51.225**	2227.966**
Plant density	3	62364.176**	17232.37**	182.052	0.061	30.942**	36.374	1.347	109.046
6 (plant density)(planting date)		5072.398**	1284.62**	514645	0.103**	45.961**	31.210	0.887	2.141
%CV		15.9	15.87	25.06	0.94	4.58	18.7	24.63	21.46

Table 3: Mean comparison of planting date and plant density reciprocal effects on soybean traits.

Plant height	first node height	plant node number	100-seed weight	pod length	plant pod number	pod yield without seed	seed yield	treatment
68.61a	7.923a	25.89a	37.89a	5.05	108.2b	238b	473.7 b	(20 density)(3.30)
55.11abc	8.113a	21.34ab	35bc	4.6bc	78.56abc	340.7 a	672.7a	(30 density)(3.30)
53.01abcd	8.003a	25.45a	36ab	4.4c	60.33bc	356 a	702.3 a	(40 density)(3.30)
58abc	8.333a	25.67a	35.11bc	4.773b	93.33ab	364.7 a	738.7 a	(50 density)(3.30)
37.67def	5.123bc	18.67abc	35.78ab	4.633bc	54.22c	132.7 cd	235.7 d	(20 density)(4.15)
42.78cdef	6ab	21.44ab	34.67bc	4.75b	71.78bc	193.3bcd	343.3cd	(30 density)(4.15)
59.67ab	5.777ab	17.44bc	28.89d	4.563bc	62.67bc	197.3bc	351 cd	(40 density)(4.15)
49.22bcde	6.223ab	22.22ab	26.11e	4.633bc	71.44bc	248.3b	441.7bc	(50 density)(4.15)
27f	3.667bc	13c	27.78de	4.423c	48.11c	126.7d	225d	(20 density)(4.30)
27.33f	2.887c	12.87c	27.67f	4.503bc	53.11c	145.7cd	254.3d	(30 density)(4.30)
34ef	4.887bc	21.78ab	33c	4.583bc	75abc	163cd	290.3d	(40 density)(4.30)
38def	4.447b	20.55ab	27.78de	4.613bc	69.55bc	197bc	352.3cd	(50 density)(4.30)

Conclusion:

Results of this experiment indicated that, with increasing plant density per square meter, seed yield increased, such that in plant density of 20 plant per square meter minimum seed yield and in 50 plant per square meter maximum seed yield achieved. Also, it has been indicated that among different planting date of experiment, first planting date (20 Jun) with more seed yield, indicated its preference in relation to other two planting dates (6 Jul and 21 Jul)

ACKNOWLEDGMENT

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