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EVALUATION OF DIFFERENT SEED RATES EFFECTS ON AGRONOMICAL TRAITS AND SEED YIELD OF SOYBEAN VARIETIES IN MAZANDARAN

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ABSTRACT
In order to evaluate different seed rates on phenological and morphological traits, yield components, seed yield, and oil content in soybean cultivars, an experiment was laid out in split-plot based on randomized complete block design with four replications at Dashtenaz region of Mazandaran province in 2013. Main plot was seed rates including 55, 70 and 85 kg.ha^{-1} and sub plots were six soybean cultivars including Sari (JK), Telar(BP), Caspian(033), Nekador(032), Katul(DPX) and Sahar(Pershing). Results showed that seed rates have significant effects on all the traits except number of seeds per pod. Some of the traits including plant height, first pod height from earth, pods on main axis had increasing trend due to seed rate increasing, but the other traits including pods per plant and 1000-seed weight were decreased. Non-significant interaction effects of seed rates and cultivars for most of the traits except first pod height from earth and pods on main axis indicating that variations of the traits of each cultivar had similar trend in different seed rates. Average seed yield of the varieties for 55, 70 and 85 kg.ha^{-1} were 2999, 3246 and 2700 kg.ha^{-1}, respectively and they classified in two statistical groups. Among the cultivars, Nekador had the highest seed yield and its yield were 3766, 3643 and 3469 kg.ha-1 for 55, 70 and 85 kg.ha^{-1} seed rates, respectively and also its amount for 55 and70 kg.ha^{-1} were classified the same statistical group. The effect of soybean cultivars on oil content (%) was not significant. Sahar and Katulwere detected as the most early and late maturity cultivars with 135.3 and 156.9 days to maturity, respectively. Seed yield had positive and significant positive correlations with number of pods per plant and 1000-seed weight respectively, indicating that these traits had considerable effects on seed yield.

KEYWORDS: Oil content, seed yield and seed rates, soybean, yield components.

INTRODUCTION

Oil has an important role in human's nutrition so that today oilseed crops as a primary source of protein and energy that are considered as the second most important source of energy supply (Delka *et al*., 2005; Khalili, 2005; Sedaghati, 2003).Also vegetable oils have better quality in comparison with animal fats because of the low amount of saturated fatty acids (Beaverand Johnson, 1981).Oilseeds, are considered as the essential food for human that with different products not only provide a part of the human food needs, but also have industrial and pharmaceutical uses and that is why they are considered as important agricultural products (Bergland, 2002).Past researches indicate that only about 9% of the country's oil needs are domestically produced and the rest that is 91.7 percent should be imported from abroad, and to amend the severe shortage, the researchers found that a lot of work is needed to increase oil production in the country, which is possible to achieve both through an increase in area under cultivation and the increased yield per unit area, among which the second option seems more logical (Zaman and Malik, 2002).According to the World Food Organization (FAO) in 2000, the cultivation area of soybeans in the world was 74,367,965 hectares from which 161,290,488 tons of soybeans were harvested. The average soybean yield of 1128.6 kg/hectare (the minimum) in 1961 has reached 2436.9 kg/hectare (the maximum) in 2007, and this value is different from the yield in 2009 that was 2243 kg/hectare in the world (Deviation and Fao, 2011; Carpenter and Board, 1997). From the habit of growth, soybean is divided into three varieties of indeterminate growth, determinate growth, and semi-determinate growth.

Indeterminate varieties begin to flower when they have only half the main stem nodes, therefore, development of vegetative and reproductive organs of plants mostly starts with its life cycle .In this varieties, pod and seed formation starts from the lower part of plant, and simultaneously continues upward with the formation of new nodes. But these varieties as well as the other varieties of all beans grows at the same time. In the determinate growth, flowering starts to grow once in the end node of the main stem (Ablett *et al*., 1991). In these circumstances, the necessary measures should be taken to improve the environment for plant growth (Gupta *et al*., 1973).Soybean cultivation has some advantages

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including symbiotic nitrogen-fixing bacteria in the roots of soybean that fixes the nitrogen in the air, and as a result the plant will require less nitrogen during growth stages. Also some of the fixed nitrogen by symbiotic bacteria remains in the soil and the subsequent crops will require less nitrogen. Soybean cultivation has led to reduce incidence of pests and diseases and weeds in the field (Bharati *et al*., 1986).

Deep planting of seed cultivars that genetically, have a shorter hypocotyl are also not recommended. Deep cultivation of soybean seeds in some cases even increased the risk of soil diseases is the greening seedlings (Jason and Emerson, 2005). Characteristics of soybean vegetative and reproductive growth stages has been investigated by (Fehr *et al*., 1977). Many factors, including weather conditions, planting design, seeding rate, management of farm operations and food can cause a variety of performance and other characteristics of soybean (Dekeeijer *et al*., 2003). (Akond and *et al*., 2013) in the study of the effect of row spacing on agronomic characteristics of soybean reported that yield is affected by changes in plant population and row spacing (Akond and *et al*., 2013). Parvez *et al*., (1989) through some studies showed that main stem height, number of pods per unit area and seed yield increased with increasing density, while the number of nodes on main stem and number of pods per plant decreased (Parvez *et al*., 1989). Carpenter and Board's (1997) study showed that when the density increase , the number of pods per unit area and seed yield of main stem increased, while seed yield decreased in secondary branches and harvest index Carpenter and Board's (1997. Boeurlein (1988) examined effect of removing the branches in soybean yield. The results showed that with increasing distance in normal plants, the average seed yield increases, while the wingless plants small distance was more desirable (Boeurlein (1988). Domingues and Hume (1973) after examining the three varieties of soybean growth (restricted and semi-restricted and unrestricted growth) reported that with increasing density, height of cultivars had indeterminate reduction Domingues and Hume (1973). With increasing density, light intensity on vegetation was reduced and it reduced the number of tributaries and biomass. His research showed that absorbing photo-synthetically active radiation to achieve maximum performance was influenced by morphological and physiological characteristics (Wells, 1993). Isik through applying different densities on bean reported that with increasing plant density the weight of each only bush decreases, but with increasing the number of bushes per unit area, biological yield increases (Jason and Emerson, 2005). Biological yield has been confirmed as one of the best indicators of selection in many studies (Blum, 2011).The researchers concluded that soy density per unit area can reduce the yield per unit area due to increased competition for water and nutrients (Boeurlein, 1988; Jason and Emerson, 2005). Optimum plant density of soybean cultivars changes according to varieties and geographic location (Goli and Olsen, 1983). Boeurlein (1988) concluded that increased density in late planting can reduce crop damage caused by delay. Quantities of low seed consumption may also lead to poor posture bushes at the farm level, as a result there can be non-uniformity in the green field, especially if there is a possibility of Crust forming on the soil surface (Beuerlein and Ryder, 1981).

In studying the physiological response of soybean varieties to plant densities it was found that in all studied varieties yield of product was higher in high density compared to low density. There is a relationship between the reduction in seed yield at low density and reduced number of pods or seed per unit area (Gan *et al*., 2002). (Suhre and Davis, 2008) stated that yield is the result of increase in the number of pods and seed. Although higher seed rate, provides more functionality, low seed rate causes increase in plant yield. This increase is due to new varieties and higher abilities of cultivars to head higher in low seeding situations, while heading is highly reduced in comparison to seeding rates. New cultivars can better compensate lower plant population through producing more seed on the branches than older cultivars (Suhre and Davis, 2008).Optimum density is important for ensuring maximum yield in soybean planting. Changing in the pattern of planting density is possible in two ways: changing the distance between rows or changing the distance on rows. The results of other investigations indicated that the higher yield is achieved by reducing the spacing between the rows. Generally, the maximum yield is achieved at high density and at check row planting mode (Parks and Manning,1980). De Bruin and Pederson have recommenced the soybean planting in 40cm rows and observed that significant yield increase in contrast to 75cm rows (Walker *et al*., 2009). Walker *et al*. (2009) have analyzed the effects of plant populations and row spacing on soybean maturity group III on the three varieties (Asgrow, Pionear, 93M90) and the distance between rows 38 and 76 cmdeclared. They have claimed that narrow rows can confirm greater or equal yield as compared to wider rows (Walker *et al*., 2009). Parks has reported that increase of soybean yield in narrow rows is because of increase in seed production in aerial part of plant (Parks and Manning,1980).Since analyzing the effect of distances of rows on yield and soybean's yield component, (Torrie and Brigges, 1995) have observed that constant light absorption takes place greatly in nearer rows (25 cm) than wider rows in the same leaf level. They have attributed the great light absorption due to steady distribution(Torrie and Brigges, 1995).In a research about the yield and yield components of Soybean, Goli and Olsen (1983) have shown that increase in density causes the decrease in the seed yield in minor branches, pod numbers, and seed yield in a plant (Goli and Olsen, 1983).In relation to the effect of density on yield and yield components of soybean, (Pandy and Torrie, 1993) have confirmed that number of minor branches, pod numbers, and node numbers are significantly under the influence of density. In lower densities, the above three parameters increase but yield in various densities remain constant (Pandy and Torrie, 1993) .(Basent *et al*., 1974) have surveyed the effect of 46 am and 92 cm row spacing and 3.8 cm and 6.4 cm inter-row spacing on the yield of soybean. The results have shown the greater yield of 46 cm rows than 96 cm rows. Increase in density has not a significant effect on yield by means of regulating distances and in some cases leads to decrease in yield. As reducing the density, the number of pods per minor and main branches and the number of seed per plant, seed weight are increased but the density has no any effect on 1000-seed weight (Basent *et al*., 1974). (Mayers *et al*., 1991) have claimed the existence of mutual significant interaction among planting date, varieties, and density. The average maximum yield in all dates and varieties are approximately above60plants per m (Ablett *et al*., 1991) in high densities. For above mentioned reason, the seed yield in delayed plants typically reaches maximum densities of 40 or 60 plants per m (Ablett *et al*., 1991), but in early varieties, the maximum yield is obtained at densities above 80plants per m (Ablett *et al*., 1991).Given that the effects of treatments are different and depend on crop planting dates of latitude and longitude, and altitude above sea level.

However, the numbers of seed and resulting density depend on the determined seed, the varieties genetics potential from the view of compressibility and freshness (Mayers *et al*., 1991).(Cober and Voldeng, 2000) have expressed that density increment can decrease the amount of oil and increase the seed's protean. In this connection, many researchers have reported existence of reverse relationship between protean amount and seed oil as the relation is negative among them (Cober and Voldeng, 2000). Boeurlein (1988) has accounted that dye-wee is one of the effects of high density. Genetic features and factors like wind, rain, irrigation, and blight attack effectively control the number of lodging7 .Cooper believes that severe decrease of yield in high densities may be due to early lodging. Plant height to stem's diameter is an index that defines response of a plant in the competition conditions (Cooper, 1971).Johnson and Harris have reported that lodging increases as density increases but harvesting soybean with combine harvester has not created much casualty in high densities (Johnson and Major, 1999). There is a claim that lodging grows due to its long height, decrease in stem's diameter, or the combination of these two (Fontes and Ohlrogge, 1972).Changes in node's numbers in main stem are different as a consequent of density increment proportional to growth mode. In Fykobi varieties (limited Growth), node's rate was not under the influence of density but in varieties 903-52 (semi-limited growth), node decreases as density increases. As density increase, the first pod's height increases from the earth surface consequently. In unlimited varieties, as height increases in high density, the main stem's diameter decreases and causes the increase in lodging. In limited growth, high density does not face lodging (Fontes and Ohlrogge, 1972).

Researchers have said that extra density increase causes decrease in yield; and factors such as varieties, lodging, prematurity, and bad environmental conditions have influence on yield (Wright *et al*., 1984). In this study, we investigated the effects of different cultivars on agronomic characteristics and yield of soybean cultivars and also by determining the appropriate values for the cultivars in Mazandaran climate, we determined the effect of seeding rate on phenological and morphological characteristics of yield components and specified the correlation rate of traits and the most effective rates on the yield of desired seed cultivars.

MATERIALS AND METHODS

EXPERIMENTAL SECTION

This scheme was done in the crop year of 2013 in a region with 36 degrees longitude, 42 minutes east and with 53 degrees latitude, 13 minutes North and a height of 16 meters above sea level, with warm summers and cold and humid winters and the annual rainfall of 560 mm.

2-1 Soil properties of the testing site

To determine the soil characteristics (texture and chemical characteristics of the soil) sampling was done prior to testing, for this project the site was sampled at several points at the depth of 0-30 cm. Table 1 shows the results of soil samples prior to the plant.

Table 1 - Physical and chemical properties of the soil of the testing place before planting

Varieties of the texture	Soil texture			Potassium of the soil (P.P.M)	Soil Phosphor (P.P.M)	Organic carbon (O.C) percentage	Organic material (O.M) percentage	Neutral materials %T.N.V	Electrical Conductivity $EC \times 10^3$	Saturat ion percent age (S.P)	Soil pH	The depth of the soil (Cm)
	clay	Silica	sand									
Loamy	20	30	50	180	13.6	1.2	2.2	30	0.68	50	7.6	0-30

Treatments of the test and the statistical characteristics of the design

The experiment was conducted in small plots (split plots) in a randomized complete block design with four replications which had 2 factors of density (the amount of the consumed seed), and cultivar. The amount of the seeds were 55, 70 and 85 kg/hectare were considered as the main factors and soybean cultivars including Sari (JK), Telar (BP), Caspian (033) , Nekador (032), Katul (D.P.X) and Sahar (Pershing) were considered as minor factors.

Characteristics of soybean cultivars

1 - Sari (JK): semi-limited growth mode (Semi-determinate), 2 - Telar (BP): Semi-limited growth mode (Semi-determinate), 3 - Caspian (033): semi-limited growth mode (Semi-determinate), 4- Nekador (032): semi-limited growth mode (Semi-determinate), 5 - Sahar(Pershing): semi-limited growth mode (Semi-determinate), 6 - Katul (DPX): semi-limited growth mode (Semi-determinate).

Research Stages

The field was planted for wheat in the last year. The used herbicide is Trifluralin before planting 2.5 liter per hectare. The disc is used to mix the poison to the soil. According to soil testing, fertilizers are 120 kg/ha phosphate triple, 150 kg/ha sulfate potassium, 50 kg/ha urea, 50 kg/ha manganese sulfate, and 20 kg/ha sulfate. The experiment map is implemented after fertilizing and mixing them with soil. When planting, *Rhizobium japonicum* (a bacterium) is used to inseminate the seed. The planting operations are according to treatments of consumed seed rates, with four replications in plots. Each replication contains 18 plots; each plot includes 6 rows with 5m longitude at a distance of 40cm. Distances of plants on row planting are different according to seed rates and 1000-seed weight, i.e. About 4cm to 8cm.

Sampling method for the studied traits

Days to flowering: The time after planting stage depends on day numbers after planting in each plot until first flowering.
Days to end of flowering: The time after planting stage until the finishing time of flowering is determined as day numbers.
Flowering period: Elapsed time from the beginning to the end off lowering stage determined as the duration of flowering for each plot.
Plant height in flowering stage: 10 shrubs randomly selected from each plot and then height is measured for each 10-shrub plot.
Day to maturity: the time after planting stage until physiological finishing time for each plot.
Pod's height from surface: the distance of first plot from earth surface for 10 randomly shrubs in each plot.
Pods numbers in main stem: In 10 randomly selected plants, number of pods of each main stem was counted and the average was calculated for each plant.
Pod's number in shrub: the number of 10-shrub pods is measured and its average is set for this trait.
Seeds per pod: in 10 randomly selected plants, the numbers of seeds per pod on main stem were counted and the average was calculated for each pod.
1000-seed weight: Five hundred seeds from each plot was weighed and then doubled, so the weight of 1000 seeds was measured in grams.
Seed yield: The marginal effect was calculated on a kg scale with respect to weighing the seed of each plot in 4.8 square meters after correction with 12% moisture per kg and then was extended to kilograms per hectare.

Harvest Index: The harvest index for each plot is obtained through obtaining economic yield and biological yield and through the following equation.

$$HI = \frac{Agricultural\ yield}{Plant\ total\ dry\ matter} \times 100$$

Oil Content: By soxhlet was measured by the oil content. In this context the mill to 5 grams of the samples, solvent extraction using petroleum ether with a boiling range of 40 to 60 ° C was performed. After extraction, solvent oil was isolated by vacuum evaporation. After measuring the sample weight and oil content was calculated.

Oil Yield: Multiplying the oil content and seed yield for each treatment was calculated as kilograms per hectare.

Statistical analysis

Data obtained was analyzed by SAS and MSTAT-C statistical software and was compared through the comparisons of Duncan's multi-domain mean. In each group of comparing the mean, the means that have at least one letter in common are not statistically significant.

RESULTS AND DISCUSSION

The effects of different seed rates on morphological traits of soybean varieties

Mean squares of seed amount for the characteristics of plant height were significant at the five percent level, which indicates a significant difference of this characteristic in the amount of consumed seed (Table 4). Comparing the mean of this characteristic in Duncan's method is shown in Table 2. With increasing the amount of consumed seed, the height of the plant has increased, the degree of this characteristic in the consumed seed levels was variable from 75.5 to 82.8 cm respectively related to the amount of the consumed seed for 55 and 85 kg/ha (Table 2). Significance of the mean squares of this characteristic for the studied cultivars had a significant difference regarding the plant height (table 4). Also among the studied cultivars, the degree of this characteristic has been variable from 54.6 to 103.2 cm respectively in Telar and Katul cultivars. In this study, the long height cultivars often had high 1000-seed weight; so that the correlation of plant height and 1000-seed weight is shown to be significant and positive (Table 6). Significant mean squares of the seed amount for the characteristic of Pod's Height from surface at the probability level of one percent indicates significant difference of this characteristic is applicable in the levels of the seed amount (Table 4). With increasing the consumed seed rate, the height of the first pod from the surface increases (Table 2). The degree of this characteristic on seed levels of 55, 70 and 85 kg/ha have been respectively equal to 11.8, 17.3 and 21.1 cm, which have statistically been classified in three distinct classes. Significance of the mean squares of these characteristics for the studied species also indicates that the studied cultivars have had a significant difference regarding the height of the first pod from ground (Table 4). Also, among the amount of data the degree of this characteristic has been variable between 12.9 to 20.3 cm in Sahar and Nekador variables, respectively (Table 2). Considering that the high levels of this characteristic will lead to facilitation in harvest and less waste in the harvest time, therefore the Caspian and Nekador cultivars will have priority in having high levels of this characteristic. Negative and significant correlation of this characteristic with the number of pods per shrub indicates that cultivars with high levels of this characteristic have less number of pods per plant (Table 6). Average amount of the seeds used for the characteristic of Pod's Number in Shrub was significant at the one percent level, which indicates a significant difference of this characteristic in the levels of this level of the seeds (Table 4). With increasing the amount of the consumed seed, the number of pods per plant decreased. The amount of this characteristic in the levels of the consumed seed was variable from 50.5 to 64.2 numbers for 55 and 85 kg/ha consumed seed. Also, the degree of this characteristic for the seed amount of 70 and 85 kg per hectare are in a statistical group. The significance of mean squares of this characteristic for the studied cultivars indicates that the studied cultivars have had a significant difference regarding the pods per shrub (Table 4).

Among the varieties studied, the amount of this characteristic was variable from 46.8 to 63.7 in Telar and Sari cultivars, respectively (Table 2). Positive and significant correlation of this characteristic with the harvest index indicates that the increase in the grain yield have an effective role in increasing the harvesting index (Table 6).

The effects of different seed rates on phonological traits of soybean varieties

The results of means comparison (Table 2) for days to maturity show that Sahar cultivars is the most early maturity and the Katul cultivars is the most late maturity cultivars among the studied cultivars and the amount of this characteristic in the used seeding levels is different from 144.8 to 148.4 days, respectively, related to used seeding levels of 85 and 55 kg per ha. In addition, the amount of this characteristic for 55 and 70 kg seed per ha statistically is placed in one group. Correlation of this characteristic with the positive seed yield was not significant (Table 6), which indicates that late maturity cultivars mainly have higher seed yield. Significant and positive correlation of this characteristic with 1000-seed weight also indicates the positive impact of this characteristic was mainly through increased 1000-seed weight. The comparison of average number of days to start of flowering in the used seed levels were different from of 56.4 to 60 days for used seed per ha were respectively 55 and 70 kg (Table 2). The correlation of this characteristic was not significant with seed yield (Table 6), which shows that changes of the characteristic did not have a significant impact on studied cultivars. Positive and significant correlation of this characteristic with days to maturity indicates that cultivars which have high number of days to end of flowering are almost late maturity. The comparison of average number of days to end of flowering in the used seed levels were different from of 94.2 to 99.9 days for used seed per ha respectively 85 and 55 kg (Table 2). Mean squares of seed amount for number of days to end of flowering at one percent probability level is significant, that is indicating the significant difference of this characteristic in different amount of used seed (Table 4). Among the studied cultivars, days to end of flowering characteristic have been different from 88.9 to 106.3 days respectively for Sahar and Katul cultivars. (Table 2). Significant difference of the mean squares of this characteristic for the studied cultivars also indicates that the studied cultivars had significant differences from the view of number of days to end of flowering. (Table4). The correlation of days to end of flowering characteristic was significant with 1000-seed Weight (Table 6). It indicates that changes in this characteristic in the studies cultivars had significant impact of 1000-seed weight on seed level. In addition, the significant and positive correlation of this characteristic with days to maturity suggests that cultivars that have higher number of days to the end of flowering are mainly late maturity.

The effects of different seed rates on yield components and seed and oil yields of soybean varieties

mean comparison of number of seeds per pod characteristic shows that (Table 3) with increasing the used seed amount number of seeds per pod does not follow a specific process and amount of this for all 3 levels of seed in places in one statistical group, and indicates that number of seeds per pod was influenced by genetic factors and environmental factors do not have a significant impact on it. The correlation of this characteristic is positive with seed yield (Table 6), thus increasing this characteristic as one of the important components of seed can also lead to seed yield. Table 3 indicates that with increasing the used seeding rate, 1000-seed weight decreased, which indicates increasing plant density and increasing competition between plants, eventually lead to the reduction of grain weight. Among the studied cultivars the amount of this adjective was different from 159.2 to 202 g for Sahar and Katul cultivars, respectively, which shows that 1000-seed weight is a genetic characteristic but also is affected by environmental situation. The correlation of this characteristic with phonological characteristics such as the number of days to start of flowering, days to end of flowering and days to maturity indicates that late maturity cultivars often have higher 1000-seed weight (Table 6).

The results of mean comparison shows that (Table 3), with increasing the amount of used seed, the seed yield has increased and then decreased that obtained yield for 55 and 70 kg seed per hectare is placed in one statistical group. The significant mean squares of this characteristic for the studied cultivars in one percent probability level is indicating the genetic differences between cultivars under study from the yield seed view (Table 4). The significant and positive correlation indicates of this characteristic with harvest index indicates that increasing seed yield has an effective role in increasing the harvest index (Table 6) Also positive and significant correlation with 1000-seed weight suggests that in studied cultivars, these characteristics have more effective role in increasing the seed yield. Significant mean squares of seed amount for oil content characteristic, indicates the significant effect of used seed level on this characteristic (Table 3). It seems that with increasing plant density and lower light penetration into the canopy of vegetation leads to lower oil content and amount of this characteristic in studied cultivars has not been significant which shows that there is not a significant difference between the studied cultivars from the view of oil content. The correlation of this characteristic with 1000-seed weight and seed yield is positive (Table 6), therefore, the cultivars with potential yield and high yield components have higher oil yield in this study. Oil yield was significantly affected by the amount of the consumed seed which is resulted from the genetic difference of the seed yield of the consumed cultivars (Table 3).The significant and positive correlation of this characteristic with the seed yield and oil yield indicates that this characteristic is significantly influenced by both of the main components (Table 6).

Table 2- Mean comparison of the effect of seed rates, soybean cultivars and their interaction effects on Morphological andPhenological Characteristics.

Traits / Factor	Plant Height	Pod's Height from surface	Pod's Number in Shrub	Day to flowering	Day to end of Flowering	Day to maturity
55 kg.ha	75.5b	11.8c	64.2a	60.0a	99.9a	148.4a
70 kg.ha	77.8ab	17.3b	53.6b	56.4b	97.3b	147.6a
85 kg.ha	82.8a	21.1a	50.5b	56.3b	94.2c	144.8b
Sari(JK)	75.0c	15.9bc	63.7a	62a	104.2b	153.2b
Telar(BP)	54.6e	17.4bc	46.8d	53.1e	90.0e	140.7e
Caspian(033)	96.9b	18.3ab	58.5ab	58.7bc	98.8c	145.7d
Nekador(032)	75.4c	20.3a	60.3ab	56.7	94.7d	149.8c
Katul(DPX)	103.2a	15.5c	55.5bc	60.3	106.3a	156.9a
Sahar(Pershing)	67.1d	12.9d	51.6cd	54.6	88.9f	135.3f

In each group of average comparison, those averages that have at least one trait in common do not have significant difference.

Table 3- Mean comparison of the effect of seed rates, soybean cultivars and their interaction effects on Yield Components and Seed and Oil Yields.

Traits / Factor	Seeds per pod	1000-seed Weight (gr)	Seed Yield(Kg.ha)	HI (%)	Oil content (%)	Oil Yield (Kg.ha)
55 kg.ha	2.22a	196.1a	2999ab	43.4a	23.08	694.7a
70 kg.ha	2.27a	187.2b	3246a	36.9b	21.5b	698.2a
85 kg.ha	2.19a	177.0c	2700b	32.2c	19.36c	532.4b
Sari(JK)	1.62d	185.8bc	3024bc	40.4b	21.52b	658.9b
Telar(BP)	2.86a	178.3c	2855bcd	43.4a	21.79b	621.2bc
Caspian(033)	2.41b	196.0ab	3141b	36.7c	20.63b	648.7b
Nekador(032)	2.42b	199.3a	3626a	39.0bc	22.68a	822.6a
Katul(DPX)	2.13c	202.0a	2690cd	31.7d	20.79b	564.9bc
Sahar(Pershing)	1.93c	159.2d	2536d	33.8d	20.03b	534.5c

In each group of average comparison, those averages that have at least one trait in common do not have significant difference.

The results of the analysis based on the split-plot design indicated that the effect of the seed rates was significant in all characteristics. The cultivars have had significant difference regarding all the studied characteristics except for the oil content which indicates genetic differences in all the studied cultivars (Table 3). Insignificance of the interaction between the seed rates and cultivar for the studied characteristics indicated that changes in the characteristics in the studied cultivars at all seed levels have a similar trend.

Table 4- Analysis of variance for Phonological and Morphological Characteristics in soybean cultivar

Source of Vraiance	df	Mean of Squares(MS)					
		Days to Flowering	Days to end of Flowering	Days to maturity	Plant Height	Pod's Height from surface	**Pod's Number in Shrub**
Replications	3	103.4 **	5.3	4.3	145.9*	18.7*	**533.3***
Seed Rates(a)	2	104.1 **	198.5 **	86.5 **	333.7*	511.7**	**1234.3****
Error	6	2.7	1.9	1.8	31.1	3.5	**47.9**
Cultivar (b)	5	139.9 **	653.8**	773.7 **	4011.6**	75.7**	**442.3****
a×b	10	1.5	11.1	2.1	16.6	14.9**	**53.4**
Error	45	1.4	2.2	4.9	27.7	4.3	**35.6**
C.V (%)	-	3.5	1.5	1.5	6.7	12.4	**10.6**

, * Significant at p=0.05 and 0.01, respectively

Table 5-Analysis of variance for Yield components, Oil Content, Seed and oil Yield in Soybean Cultivars.

Source of Vraiance	df	Mean of Squares(MS)					
		Seeds per pod	1000-Seed weight	Seed Yield	HI(%)	Oil Content (%)	**Oil Yield**
Replications	3	0.06	31.5	537071*	9.5	0.9	**1845**
Seed Rates(a)	2	o.o4	2183.9**	1795455**	764.6**	71.7**	**215416****
Error	6	0.04	23.5	103865	6.5	1.7	**6605**
Cultivar (b)	5	2.28**	3142.5**	1786088**	221.4**	6.7	**122092****
a×b	10	0.03	31.8	114311	5.7	0.1	**4827**
Error	45	0.06	107.4	108370	4.6	4.2	**9201**
C.V (%)	**-**	11.2	5.5	11.1	5.7	9.5	**14.9**

, * Significant at p=0.05 and 0.01, respectively

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Table 6- Correlation coefficient of the traits in soybean cultivars in different planting densities.

Traits	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1-Days to flowering	1													
2- Days to end of Flowering	0.89**	1												
3- Flowering Period	0.67**	0.93**	1											
4- Days to maturity	0.77**	0.89**	0.86**	1										
5- Plant Height	0.53*	0.64**	0.63**	0.57*	1									
6- Pod's Height from surface	-0.36	-0.21	-0.07	-0.01	0.19	1								
7- Pod's Number in Main Stem	0.03	0.16	0.23	0.23	0.37	0.52*	1							
8- Pod's Number in Shrub	0.78**	0.59**	0.34	0.53*	0.18	-0.49*	-0.35	1						
9- seeds perpod	-0.57*	-0.43	-0.24	-0.29	-0.24	0.26	-0.06	-0.08	1					
10- 1000-seed Weight	0.63**	0.70**	0.66**	0.81**	0.51*	-0.09	-0.04	0.27	0.23	1				
11- Seed Yield	0.13	0.15	0.14	0.33	-0.02	0.16	-0.24	0.40	0.21	0.56*	1			
12- HI	0.17	0.05	-0.05	0.04	-0.56*	-0.45	-0.45	0.65**	0.26	0.31	0.50**	1		
13- Oil Percentage	0.26	0.16	0.05	0.20	-0.40	0.59**	-0.67**	0.47*	0.14	0.46*	0.54*	0.84*	1	
14- Oil Yield	0.21	0.17	0.13	0.34	-0.16	-0.09	-0.42	0.54*	0.20	0.61**	0.94**	0.60**	0.76**	1

*, ** Significant at p=0.05 and 0.01, respectively

CONCLUSION:

Generally, this study contains the following conclusions:

Significance of the mean squares of seed rates shows that morphological characteristic, yield components, and seed and oil yield except seed's number in pod are under the influence of significance of seed rates.

Significance of the mean squares of seed rates shows that phonological characteristic, yield components, and seed and oil yield except seeds per pod are under the influence of significance of seed rates.

In this regard, characteristics follow an increment progress such as shrub's height, distance of Pod's Height from surface and pod's number in main stem as the seed rate increases. Therefore, pod's number in shrub and 1000-seed weight fall in reduction.

The mean squares are significant for all traits except oil content which in turn shows the difference of genetic varieties except oil percentage.

The maximum seed yield is obtained from seed rate in 70 kg/ha field. Among investigated varieties, the Nekador varieties represent the high seed yield because of its seed yield components. In investigating mutual interaction, Nekador varieties high yield is registered in 50 kg/ha seed rate.

Correlation is positive between seed yield with traits of pod's number in shrub and 1000-seed weight which shows that these two yield components have an important role in seed yield.
The interaction effect of seed rate and varieties is not significant for all traits (characteristics) except for 1st pod's height from surface and pod's number in main stem. Therefore, this shows that changes in most traits follow a similar progress except traits at seed levels.

REFERENCES

Ablett G. R., Beversdorf W.D. and Dirks V.A. (1991). Row width and seeding rate performance of indeterminate, semi-determinate, and determinate soybean. *J. Prod*. Agric. 4:391–395.

Akond A., Ragin B. A., Willshenua l. and Stella K. (2013). Row spaces can effect Agronomic traits in Soybean(Glycine max L.). *J. Crop Management.* 55(1):28-32.

Basent, B., Mader E. L. and Nickell C. D. (1974). Influence of between and within- row spacing on agronomic characteristics of irrigated soybeans. *Agron. J.* 66: 657-659.

Beaver J. S. and Johnson R. R. (1981). Response of determinate and indeterminate soybeans to varying cultural practices in the northern U.S.A. Agron. J. 73:833-838.

Bergland D. R. (2002). Soybean production field guide for North Dakota and Northwestern Minnesota.Published in cooperative and with support from the North Dakota soybean council. 136Pp.

Beuerlein J. and Ryder G. (1981). Planter beats drill for narrow-row soybeans. *Crop Soils.* 33(4):7-8.

Bharati M. P., Whigham D. K. and Voss R. D. (1986). Soybean response to tillage and nitrogen, phosphorus, and potassium fertilization. *Agron. J.* 78:947–950.

Blum A. (2011). Breeding crop varieties for stress environments.CRC Critical Reviews in Plant Sciences. 2:199-237.

Boeurlein J. E. (1988). Yield of indeterminate and determinate semi dwarf soybean for several planting dates, row spacing and seeding rates. J. Prod. Agric., 1: 300 – 303.

Carpenter A. C. and Board S. (1997). Growth dynamic factors controlling soybean yield stability across plant population. *Crop Sci.* 37: 1520-1526.

Cober E. R. and Voldeng H. D. (2000). Developing high protein, high- yield soybean populations and lines. *Crop Sci.* 70: 39-42.

Cooper R. L. (1971). Influence of early lodging on yield of soybean (Glycin max L.). *Agron. J.* 63: 449-450.

De Bruin J. L and Pederson P. (2008). Effect of spacing and seeding rate on soybean yield. *Agron. J.* 100:704-710.

Dekeeijer T. J., Debuck A. J., Wossink G. A. A., Onema J., Renkema J. A. and Struik P. C. (2003). Annual variation in weather: its implication for sustainability in the case of optimizing nitrogen input in sugar beet. Evroup.Agron.J. 19:251.

Delka E., Oplinger S., Eynor T. M. T., Utman D. H. P., Oll J. D. D, Kling K. A., Durgan B. R. and Notzel D. M. (2005). Safflower. University of Wisconsin-Extension pub.Cooperative Plant and Animal Products and the Minnesota *Extension Service.* 300Pp.

Deviation., 1. FAO. (2011). Legume inoculants and their use. Food and Agriculture Organization(FAO) of the United Nation. Rome. Italy. FAO Statistics.

Domingues C. and Hume D. J. (1973). Flowering, abortion and yield of early maturing soybean at three densities. *Agron. J.* 70: 801 – 805.

Fehr W. R., Caviness C. E., Burmood D. T. and Pennington J. S. (1971). Stage of development description for soybean. *Crop Sci.* 11:929–931.

Fontes L. A. N. and Ohlrogge A. J. (1972). Influence of size and population on yield and other characteristics of soybean [(Glycin max L.) Merrill]. *Agron. J.* 64: 833-836.

Gan Y., Stulen H., Keulen H., H. and Ckuiper P.J. (2002). Physiological response of soybean varieties to plant density. *Field Crops Res.* 74- Iss.No. 378-4290- p 231-241.

Goli A. and Olsen F. (1983). Response of three soybean cultivars to different seed rates. Trans. I11. *State Acad. Sci.* 76: 195-202.

Gupta B. S., Johnson D. E., Hinds F. C. and Minor H. C. (1973). Forage potential of soybean straw. *Agron. J.* 65:538-541.

Isik M., Tekeoglu M., Onceler Z. and Cakir S. (1997). The effect of plant population density on dry Bean (*Phaseolus vulgaris* l.).

Jason K. N. and Emerson R. S. (2005). Effect of row spacing and soybean genovarieties on main stem and branch yield. *Agron. J.* 97:919-923.
Johnson D. R and Major D. J. (1999). Harvest index of soybean as effected by planthing date and maturity rating. *Agron. J.*71:538-540.
Khalili A. (2005). Position of oilseeds in the national economy vegetative oil. *Industry Magazine*.30-31,28-30p.(In Farsi).
Mayers J. D., Lawn R. J. and Byth D. E. (1991). Adaptation of soybean to the dray season of the tropics. 1: Genotypic and environmental effects on phonology. *Aust. J. Agric. Res.* 42: 497-515.
Pandy J. P. and Torrie J. H. (1993). Path coefficient and analysis of seed yield component in soybean. Crop Sci. 13: 505 – 507.
Parks, W. L. and Manning C. D. (1980). The effect of row spacing and plant population on the fruiting characteristics and yield of four soybean varieties. *Farm Home Sci.* 115: 6.
Parvez. A. Q., Gardner F. P. and Boote K. J. (1989). Determinate and indeterminate-varieties soybean cultivars response to pattern, density and planting date. *Crop Sci.* 29: 150-157.
Sedaghati H. (2003). Development of oilseeds cultivation.Vegetative Oil Industry Magazine. 8:6-7.
Suhre J. and Davis V. M. (2008). Genetic gain * Management interaction in soybean: seeding rate effect. *Crop Sci.* Available on line al: http//Handle.net/2142/42401/ (accessed 27 November).
Torrie. J. H. and Briggs G. M. (1995). Effect of planting date on yield and other characteristics of soybean. *Agron. J.* 47: 210-212.
Walker E. R., Mengistu A., Bellaloui N., Koger C. H., Roberts R. K. and Larson J. A. (2009). Plant population and Row- Spacing Effects on Maturity Group III Soybean. *J. Wells, R.* 1993. Dynamics of soybean growth in variable planting pattern. *Agron. J.* 85:44-48.
Wright D. L., Shokes F. M. and Sprenkel P. K. (1984). Planting method and population influence on soybean. *Agron. J.* 76: 921-924.
Zaman Q. U and Malik M. A. (2002). Rice bean Productivity under various maize-rice bean intercropping system. *Agri. Biol.* 3: 255-257.

