IRAQI Academic Scientific Journals
العراقية المجلات الأكاديمية العلمية
ISSN:1813-1646
Tikrit Journal for Agricultural Sciences
Journal Homepage: http://tujas.tu.edu.iq
TJAS
Tikrit Journal for Agricultural Sciences

Aryan R. Kareem[1] *
Hasan Serin[1]
Khalid Khalil Ahmed[2]

[1] *Kahramanmaraş Sütçü İmam University Department of Bioengineering and Sciences*

[2] *Kirkuk University, College of Agriculture - Hawija*

KEY WORDS:
Fragmentation, Plant Densities, Growth and Yield, Soybean.

ARTICLE HISTORY:
Received: 20/05/2018
Accepted: 30/09/2018
Available online: 01/04/2019

The Role of Fragmentation of Plant Densities in The Growth and Yield of Three Varieties of Soybean *Glycine max* L.

ABSTRACT

The experiment was carried out using three varieties of soybean (Lee74, Taqa and Aeman), cultivated at six plant densities (285714, 200000, 153846, 142857 and 100000 and 76923 plants . ha^{-1}) using the Randomized Complete Block Design in the two regions,(Bany Maqan and Kani panka) belonging to the province of Sulaymaniyah in northern Iraq. The results showed in Bany Maqan , Taqa variety was superior in plant yield and the total yield (19.19 g . plant^{-1} and 2963.9 kg) respectively, in addition to the number of vegetative branches and the number of pods. plant^{-1}. Lee74 was superior in flowering characteristics, plant height, number of seeds and percentage of oil, while Aeman exceeded, seed index and protein ratio. For the Kani Banka site, Lee74 was superior in number of days till flowering, plant height, , number of branches, plant yield(16.13 g . plant^{-1}) , total yield (2574.2 kg.ha^{-1}) and protein ratio. The results of the plant densities test showed plant density (200000 plants . ha^{-1}) superior in plant yield and total yield . The interactions of varieties and plant density showed (200000 plant . ha^{-1}) , and Taqa cultivar regarding total yield and plant yield in Bani maqan site was superior , but in Kani panka the interaction of Lee 74 with density (200000 plant . ha^{-1}) was superior for same above characteristics.

1. INTRODUCTION

Soybeans, Glycine sp. are about 25-200 cm tall, and its fruit is straight or slightly curved pods contain 2 or 3 seeds, which are spherical, oval or flat-spaced, is a member of the family of Leguminosae. Soybeans are an important annual herbaceous crop because of its global source of human and animal food and for its wide industrial uses. Its grains are characterized by two very important components: protein and oil. For that many researchers pay high attention for different categories. Has been an important protein source for millions of people for more than 5000 years and can grow in different types of soils and diverse climates stretching from the tropical regions of Brazil to the snowy islands of northern Japan (Kayal et al., 1998). the first real start of soybeans in America was in 1940 and despite its vast knowledge of East Asia but 55 percent of the worldwide production is in the United States. The United States produced 75 million tons of soybeans in 2000, and most of the US production of soybeans is used in food processing or as animal feed or for export. The chemical composition of soybean seeds consists of 40.3% protein, 21% oil, 33.9% carbohydrate and 4.9% ash (Smith, 1978).

Many researchers interested in this crop in order to find varieties suitable to the climatic conditions of the country through introduction and breeding, resulting in the development and registration and

* *Corresponding author: E-mail*: zozan_a_m@yahoo.com

adoption of some varieties that have the desired agricultural and production characteristics (Mahdawi et al, 2002 ; Obeidi, 2009 ; Daudi, 2012), the increase in plant density led to a significant increase in the (Hermandez and Hill, 1983), and that an increase in the seed rate more than the ideal limit caused a significant decrease in soybean seed yield. The method of soybean cultivation and optimum plant density is of great importance in determining the level of production (faronikov, 1998 ; Daroish , et al, 2005). Based on the above, the aim of this study is to determine the appropriate verities and plant density for the province of Sulaymaniyah within the Kurdistan region of Iraq.

3. MATERIALS AND METHODS OF WORK

Three soybean varieties were obtained from the Faculty of Agriculture / University of Salahadeen - Erbil. The study was carried out in the province of Sulaymaniyah / Kurdistan Region / Iraq during 2016 in two locations: The first location: Bany Maqan's Research Center, which is located 75 km west of the center of the governorate, Second location: Kani Panaka's Research Center, 35 km southwest of the governorate center, The seeds of the three cultivars were planted, the characteristics of the soil for both locations showed below. Using three varieties of soybean (Lee74, Taqa and Aeman), using six plant densities (285.714, 200000, 153846, 142857, 100000 and 76923 plants . ha^{-1})planted in three distances between lines 35, 50 and 65 cm and distances between plants 10 and 20 cm.The soil of the experiment was plowed with a depth of 30 cm twice in a perpendicular manner, and then smoothing, leveling and splitting were carried out.

Table (1) Soil analysis results for the study sites.

EC ds/m	pH	O.M.%	K ppm	P ppm	N ppm	Soil texture	clay %	Silt %	sand %	location
0.45	7.6	2.55	192,6	2,75	385	Loom	18,475	33.95	47,58	Bany maqan
2,18	7,3	4,4	280.5	8,56	455	Clay loom	27,725	27,125	45.15	Kani panka

The seeds were planted on the first location (bani maqan) , on May 8th, 2016 and at the second location (Kani panaka) on may10 th, 2016 in the form of lines. Three seeds were placed in each seed's place, at a depth of 3-5 cm. The field was supplied with a drip irrigation system, and irrigated as much as needed. 130 g (NPK) used for each experimental unit (4 meter square) before planting during soil preparation . After 45 days of cultivation, urea fertilizer (N% 46) was added at 80 g for each experimental unit.15 days later replanting and thinning was done.Weed control was carried out t A brief presentation of the studied characteristics is recorded as an average of five plants randomly selected from each experimental unit (days to first flower , Plant height, branches per plant, No. pods per plant, No. seeds per pod, weight of 100 seeds, yield per plant , yield Kg. ha^{-1} , oil and protein percentage,)

The statistical analysis was conducted as a factorial experiment according to a RCBD , based on the SAS program. The averages were compared according to the Duncan's test (Duncan,1955). Statistical analysis calculated according to (Statistical Analysis System) by (SAS, 1985).).

RESULTS AND DISCUSSION

Number of days to flowering

Shown in Table (2) that Lee74 had the lowest number of days of planting until the flowering at the site of Bani Maqanas average of 58.5 days, followed by Taqa as an average 80.78 days while the Aeman was the most delayed one which was an average 88.33 days from planting to flowering. On the second site, Kani Panka noted that the cultivar Lee74 also had the lowest number of days of planting until the flowering was 60.06 days, while Aeman needed 91.33 days to reach the flowering

stage. These results are consistent with the findings of (Obeidi, 2003; Oya et al , 2004), who obtained a variation in the number of days from planting to flowering.

The results of Table (2) showed that the differences between the two study sites were not significant for Plant densities for the characteristics of number of days from planting to flowering. The properties in the site of Bani Maqan were built between 75.44 and 76.22 days from planting to flowering for densities of 100000 and 285714 plants.ha^{-1}, respectively. At Kani Panka the number of days from planting to flowering reached 79.78 days for densities of 100000 and 76923 plants.ha^{-1} and 80.22 days for densities 285714 and 142857 plants.ha^{-1}. The increase in plant density (narrow planting distances) increased the period required for flowering.

and the interaction between varieties and plant densities showed in table (2) was significant between the interactions, it is noticed that the Lee74 cultivar at plant density of 100000 plants.ha^{-1} at the site of Bani Maqan was 57.67 days from planting till flowering which is the best average, Aeman variety with plant density of 153 846 plants.ha^{-1} , the highest rate was 88.67 days from planting until flowering. In the Kani panka site, the best interactions were for Lee74 with all plant densities. The lowest number of days from planting to flowering was 59.67 days at plant densities 153846 and 142857 and 100000 plants.ha^{-1} . The Aeman interactions with different densities recorded the highest rates for the number of days from planting to flowering, and the highest rate of this status was 92 days for the Aeman type at the density of 142857 plant.ha^{-1} . In general it is noted that the interference of this characteristics was influenced by the genotype (category) more than the environmental factor (plant densities).From the comparison of the general average of the characteristics in the study sites shown in Table (2), we note that the first site Bani Maqan was superior with the average of 75.87 days from planting to flowering.

Table (2): Effect of plant density and varieties and their interactions on No. days to flowering

Locations	Bani Maqan				Kani Banka			
Verities Populations	Lee74	Taqa	Aeman	Means of Populations	Lee74	Taqa	Aeman	Means of Populations
285714	59.33c	81b	88.33a	76.22a	61c	88.33b	91.33a	80.22a
200000	58cd	80.67b	88.67a	75.78a	60.33c	88.33b	91a	79.89a
153846	58.67cd	81b	88.67a	76.11a	59.67c	88.33b	91.67a	79.89a
142857	58.67cd	80.67b	88.33a	75.89a	59.67c	89b	92a	80.22a
100000	57.67d	80.67b	88a	75.44a	59.67c	88.67b	91a	79.78a
76923	58.67cd	80.67b	88a	75.78a	60c	88.33b	91a	79.78a
MEANS OF Verities	58.5c	80.78b	88.33a	75.87	60.06c	88.5b	91.33a	79.96

Values followed by the same letter are not significantly different from each other.

Height of plant

table (3) showed the both locations for the characteristics of plant heights in all three verities the difference was significant, Where the superiority of Lee74 was highest with 100.7 and 128.24 cm in the first and second positions respectively, with significant differences from the other two varieties, followed by Taqa with average of 78.4 and 89.12 cm for both locations respectively while. Aeman was the lowest plant height with an of average 71.34 and 81.07 cm for both location respectively (Al Jumaily, 2011; Rahman and Hossain, 2011).

For the effect of plant densities on plant height, which is known to be highly affected by plant density, showed in table (3) differences between the six plant densities at the sites of the study, which indicated the superiority of the high plant density 285714 plants.ha^{-1} as a highest rates of plant height of 90.44 and 104.9 cm for the two sites Bani Maqan and Kani Panake respectively, while the plant density 142857 plants.ha^{-1} was the less plant height at Bani Maqan builder of the rate of 79.47 cm, and the plant density 100000 plants.ha^{-1} was the less height of the plant 92.38cm at Kanye Panke. This can be explained by the fact that high density (narrow farming distance) stimulates the plant to grow towards light and thus cause elongation of the stem. These results are consistent with the findings of Aljumaily and Sarhan , 2010 ; Douby et al., 2001; Abdul Aziz (2007); Hijab (2005); Çalişikan et al (2007) ; Rahman and Hossain, 2011).

Table (3): Effect of plant density and varieties and their interactions for plant height.

Locations	Bani Maqan				Kani Banka			
Verities Populations	Lee74	Taqa	Aeman	Means of Populations	Lee74	Taqa	Aeman	Means of Populations
285714	113.07a	85.53ef	72.73ghi	90.44a	143a	89.8d	81.93d	104.9a
200000	91de	77.4fg	75.6fg	81.33bc	130.73ab	93.47d	78.93d	101.04a
153846	99.53bcd	85.4ef	62.933i	82.62bc	128.5abc	88.33d	77.93d	98.27ab
142857	104.47ab	69.267ghi	64.667hi	79.47c	130.73ab	90.93d	79.33d	100.33ab
100000	94cde	73.667gh	77.2fg	81.62bc	114.73c	84.07d	78.33d	92.38b
76923	102.13bc	79.13fg	74.933g	85.4ab	121.73bc	88.13d	89.93d	99.93ab
MEANS OF Verities	100.7a	78.4b	71.34c	83.48	128.24a	89.12b	81.07c	99.48

Values followed by the same letter are not significantly different from each other.

Number of branches per plant

The differences in the number of the vegetative branches between the plant species are often genetic differences which are related to the characteristics of the main species, shown in Table (4), which indicates that the differences between the species in the second site are greater than in the first site. We note that the Taqa cultivar with the highest number of branches per plant, while Lee74 at Kani Banka achieved the highest rate of 8 branches per plant. These results are similar with the previous finding by Al Jumaily, (2011) ; Rahman and Hossain, (2011), and these results are different with the finding by Aljumaily and Sarhan (2010) which were not found a significant differences of the number of branches between cultivars.

The effect of plant density on the number of vegetative branches per plant Table (4) showed sig. As for the first site (Bani Maqan), the highest density was 285714 plants.ha^{-1}, the highest rate was 8.96 Branches per plant, while was totally different in the Kani Panka. The low density was 76923 plants.ha^{-1}, the highest number of branches of vegetables, with 7.9 branches per plant. This is due to the fact that the competition between the plants on medium conditions in the low density is less, so the plants tend to grow side by side, and these results was found by Aljumaily and Sarhan, (2010) ; Daroish et al ,(2005).

For the effect of overlap between varieties and plant densities, shown in Table (4) it was showed a significant differences between the different combinations of the different types of plant and plant densities. In Bani Maqan,a high number of vegetative branches was recorded by cultivation of Aeman cultivar which a high density of 285714 plants.ha^{-1}, and reached 9.73 branches per plants. While the highest rate of number of branches was recorded at the Kani Banake by cultivating the cultivar of Lee74 at low density of 76923 plants.ha^{-1} which amounted to 8.8 branches per plant. Obaidi (2009); Kajo (2009) ; Daroish et al. (2005) ; Aljumaily and Sarhan, (2010) showed that there was no effect of overlap on the number of vegetative branches.

Overall, in the case of the rate of general characteristics, it can be seen from the Table (4) that the site of Bani Maqan was achieved the highest rate of the average number of vegetative branches which amounted to 8.48 branches per plant.

Table (4): Effect of plant density and varieties and their interactions for branches in plants.

Locations	Bani Maqan				Kani Banka			
Verities Populations	Lee74	Taqa	Aeman	Means of Populations	Lee74	Taqa	Aeman	Means of Populations
285714	8.6a-d	8.53a-d	9.73a	8.96a	7.47bcd	6.2de	6.13e	6.6b
200000	6.93f	8.93a-d	9a-d	8.29ab	8.07abc	7.33b-e	6.8cde	7.4a
153846	7.27ef	9.53abc	8.2de	8.33ab	7.4b-e	6.93cde	7.47bcd	7.27a
142857	9.6ab	8.73a-d	8.07def	8.8ab	7.73abc	7.07cde	7cde	7.27a
100000	8.3cde	8.27de	8.2de	8.27ab	8.5ab	8.07abc	6.4de	7.67a
76923	8.07def	8.4b-e	8.2de	8.22b	8.8a	7.13cde	7.87abc	7.9a
MEANS OF Verities	8.13b	8.73a	8.57ab	8.48	8a	7.12b	6.94b	7.36

Values followed by the same letter are not significantly different from each other.

Number of pods per plant

The number of pods in the soybean crop is one of the most important components of the crop and gives a clear indication of the production of the seed yield.showed that differences between the species in the both sites as shown in the Table (5). It was also noticed that Taqa cultivar is superior to the number of pods in each of the Bani Maqan and Kani Panka sites with values of 134.63 and 108.74 pods per plant respectively. The number of pods per plant depends on the environmental conditions surrounding the species and their use in the process of photosynthesis, which helps to increase the flow of processed food from the source to the downstream and thus increase the number of pods in the plant (Sahuki, 2006 ; Shamsi and Kobraee , 2009). These results are consistent with Tremblay et al. (2002); Daroish et al. (2005), and Rahman and Hossain (2011), which they obtained significant differences between the studied species for the number of pods in the plant, and the effect of plant densities in the number of pods in the plant. The results of the shown in Table (5) . noticed that although the average plant densities are not significantly different from each other, density 153846 plant.ha^{-1} achieved the highest rate of counting the plant density was 131.96 pods per plant at the Bani Maqan, while the low density was 76923 plants.ha^{-1} at Kani Banka, the highest number of pods in the plant was 112.6 pods per plant and a significant difference from some other densities. This may be due to the fact that increasing the plant density in the area unit and increases the competition between the plants, or reducing the plant nutrition area. Then the decreasing in the number of plant pods, and the decreasing in the number of pods in the plant and the lack of organic stocks resulting from photosynthesis, which caused a significant decrease in this indicator (Ibrahim and Hala, 2007; Çalişikan, Et al., 2007) showed a significant effect of density of the number of pods per plant. Hijab, (2005); Norsworthy and Emerson (2005) ; Aljumaily and Sarhan, (2010); Rahman and Hossain (2011) they found that the number of pods in the plant increased when plant density decreased, and also Daroish et al. , (2005) showed that increased number of pods in plants with increased plant density. The effects between the species and plant densities on the number of pods per plant . In the table (5) was shown there are significant differences between the different types of combinations between plant varieties and densities. It was noticed that the superior of Taqa cultivar in Bani Maqan, there is 153846 plants . ha^{-1} at the highest rate of this type, 159.6 pods .plant^{-1}, and significant difference from most other interactions. In the Kani Banka, the suprior of Lee74, exceeded 200000 plants . ha^{-1} with the highest number of pods, which was a 125.87 pods per plant. In the previous studies Kajo, (2009); Daroish et al (2005); Aljumaily and Sarhan (2010) showed that there was a significant effect of the interaction between the cultivars and the plant densities, while Obeidi, (2009) showed the increasing the number of pods in low density and all genotypes compared to high density.

As for the general rate of number of pods at the both sites of the study, it is noticed from Table (5) that the site of Bani Maqan achieved the highest rate of this value, which amounted to 121.46 pods per plant, while the site of Kani Banka average rate of 104.97 pods per plant.

Table (5): Effect of plant density and varieties and their interactions for No. pods per plant

Locations	Bani Maqan				Kani Banka			
Verities Populations	Lee74	Taqa	Aeman	Means of Populations	Lee74	Taqa	Aeman	Means of Populations
285714	121bc	105.6bcd	132.5abc	119.71a	107.7b-f	96.67e-h	87.93h	97.44c
200000	84.4d	140.53ab	137.67ab	120.87a	125.87a	102.47c-h	96.13fgh	108.16ab
153846	109bcd	159.6a	127.3abc	131.96a	92.67gh	111.27b-e	101.1c-h	101.69bc
142857	97.33cd	132.07abc	122.93bc	117.444a	105.2b-g	107.4b-g	99.9d-h	104.18bc
100000	112.27bcd	132.73abc	112.8bcd	119.267a	99.13d-h	119ab	99.2d-h	105.78ab
76923	97.67cd	137.27ab	123.67bc	119.533a	109.1b-f	115.67abc	113.1a-d	112.6a
MEANS OF Verities	103.61b	134.63a	126.14a	121.46	106.61a	108.74a	99.57b	104.97

Values followed by the same letter are not significantly different from each other.

Number of seeds per pod

Table (6) showed that a significant differences in both sitesthe number of seeds in the pod, whicha a Lee74 cultivar was the highest in terms of the number of seeds per pods at the Bani Maqan, which was 2.39 seeds per pod and significantly higher than Aeman cultivar, and with no significant difference from the Taqa cultivar. Taqa cultivar achieved the highest number of seeds per pods at the site of Kani Banaka, which amounted to 2.44 seed per pods. These findings are consistent with what Al-Jumaily (2011); Daroish et al (2005); Aljumaily and Sarhan (2010); Rahman and Hossain (2011) which they found that differences between the studied species in the number of seeds per pods and in different environments.

Table (6): Effect of plant density and varieties and their interactions for No. seeds per pod

Locations	Bani Maqan				Kani Banka			
Verities Populations	Lee74	Taqa	Aeman	Means of Populations	Lee74	Taqa	Aeman	Means of Populations
285714	2.34ab	2.3abc	2.15d	2.28b	2.36bcd	2.44bc	2.41bc	2.4ab
200000	2.387ab	2.3a-d	2.34ab	2.35ab	2.25d	2.43bc	2.48ab	2.38b
153846	2.37ab	2.16cd	2.257bcd	2.26b	2.44bc	2.59a	2.37bcd	2.47a
142857	2.38ab	2.49a	2.347ab	2.41a	2.46b	2.48ab	2.337bcd	2.42ab
100000	2.47a	2.34ab	2.427ab	2.41a	2.397bc	2.3cd	2.38bcd	2.36b
76923	2.37ab	2.3a-d	2.327abc	2.34ab	2.37bcd	2.39bc	2.31cd	2.36b
MEANS OF Verities	2.39a	2.33ab	2.31b	2.34	2.38b	2.44a	2.38b	2.4

Values followed by the same letter are not significantly different from each other.

In the case of the effect of plant densities on the number of seeds per pod, the results showed significant differences at the between plant densities at the Bani Maqan and Kani Banka sites respectively, shown in Table (6) the densities of 142857 and 100000 plants.ha^{-1} with the highest number of seeds per pods reaching 2.41 seeds per pod for each density in the Bani Maqan. The density was 153846 plants.ha^{-1}. Ibrahim, Hala, (2007) ; Rahman and Hossain, (2011) showed that the increasing of the number of seeds per pod by increasing the planting distance between plants. Aljumaily and Sarhan, (2010); Sarhan and Aljumaily, (2015) showed that the increasing of the

number of seeds per pod by increasing plant density and reducing plant spacing between plants, Daroish et al., (2005) showed that there was no significant effect of the plant densities used in the number of seeds per pod, due to variability of species behavior in different environments.

Interference between different plant varieties and plant densities showed in Table (6). The highest rate of number of seeds per pod at the site of Bani Maqan was achieved by cultivating the Taqa cultivar on a density of 142857 plant.ha^{-1}, which reached 2.49 seeds per pod , While The same cultivar with a plant density of 153 846 . ha^{-1} , the highest number of seeds per pod at the site of Kani Banka by average of 2.59 seed per pod, these results agree with Kajo, (2009), which found a significant effect of the interaction between plant varieties and densities in the number of seeds per pod. Daroish et al., (2005) and Aljumaily and Sarhan (2010) in their study, found that this was not affected by the overlap between the varieties and the densities.The Kani Banka site achieved the highest overall mean of the number of seeds per pod, which was 2.4 seeds.pod^{-1} as shown in Table (6), while the public average reached 2.34 seeds.pod^{-1}.

Weight of 100 seeds

Seed index is one of the important technological characteristics that gives an indication of the size of the seeds of different varieties and their extent.in Table (7) The results of showed significant differences which showed that the Aeman cultivar was significantly higher at 6.23 and 6.59 g per 100 seeds at the Bani Maqan and Kani Banka sites, respectively. Tremblay et al (2002); Aljumaily and Sarhan (2010); Al-Jumaily (2011) ; Rahman and Hossain (2011) found significant differences between the studied seed category. The effect of plant densities on the seed index Indicates table (7) show that the .In the Bani Maqan site, there was no significant difference between the six plant. densities in this characteristic.highest density of 142857 plants .ha^{-1} in the site of Bani Maqan which recording of 6.2 g per 100 seeds. The reason for the decrease in the seed index at high density is due to increased competition among plants, which is consistent with Hijab (2005) which pointed out. Others have suggested that increased planting distance between plants leads to the production of heavy seeds (Norsworthy, Emerson, 2005; Ibrahim and Hala,2007 ;Rahman and Hossain, 2011). While the highest density was 285,714 plants / ha at the Kani Banka site at the highest seed index level of 6.85 g per 100 seeds. In this regard, other researchers confirmed that the seed index is not affected by plant density, including (Aljumaily and Sarhan, 2010).

Table (7) showed significant differences between the different combinations of varieties with plant densities, showing Taqa cultivar superior at the density of142857 plants.ha^{-1} with the highest rate of seed index at the site of Bani Maqan which was 6.45 g per 100 seed, while the Aeman variety with the density of 200,000 plants.ha^{-1} surpassed the highest seed index at Kani BanKa, which was 7.28 g per 100 seed, and the results of previous studies Kajo (2009) and Aljumaily and Sarhan (2010) showed significant effects of the correlation between plant varieties and densities on seed characteristics, while Daroish et al. (2005) indicated no significant effect of the overlap between the varieties and densities. The Kani Banka site has the highest overall seed rating of 6.59 g per 100 seed, while the site of the Bani Maqan registered a general rate of 6.02 g per 100 seeds.

Table (7): Effect of plant density and varieties and their interactions for White of 100 seeds

Locations	Bani Maqan				Kani Banka			
Verities Populations	Lee74	Taqa	Aeman	Means of Populations	Lee74	Taqa	Aeman	Means of Populations
285714	6.06a-d	5.93bcd	6.29abc	6.09ab	6.84a-d	6.54c-f	7.18ab	6.85a
200000	4.98f	6.3abc	6.41ab	5.91b	6.75b-e	6.14fgh	7.28a	6.72ab
153846	5.39ef	6.43a	6.08a-d	5.97ab	6.73b-e	6.35d-g	7.11ab	6.73ab
142857	6.02a-d	6.45a	6.13abc	6.2a	6.41c-g	6.3e-h	6.73b-e	6.48b
100000	5.64de	5.64de	6.4ab	5.89b	6.44c-g	6.35d-g	6.88abc	6.56b
76923	5.89cd	6.19abc	6.06a-d	6.05ab	5.97gh	5.87h	6.76b-e	6.199c
MEANS OF Verities	5.66b	6.16a	6.23a	6.02	6.52b	6.26c	6.99a	6.59

Values followed by the same letter are not significantly different from each other.

Yield per plant (gm.)

Plant yield is one of the most important field attributes on which to evaluate varieties. in Table (8) showed that the Taqa variety superiority was higher in the single plant at 19.19 g.plant^{-1} with no significant difference Aeman who followed, that the superiority of the Taqa variety was supported by achieved the highest rate of number of pods in the plant, in addition to the balanced rates of the number of seeds in the pod and the seed index, while the yield of Lee74 at Kani Banka was the highest rate of the individual plant yield at 16.13 g.plant^{-1} with no significant difference from the other varieties which were close to it. The variety of Lee74 in the status of the individual plant, despite the lack of superiority in any of the components to achieve balanced and acceptable rates in the characteristics of the composition of the product and this is a suitable indicator of the quality, as the superiority of the seed in the seed indicates the high efficiency in the exploitation of environmental factors surrounding it to serve the representation light. Obeidi, (2009) ; Rahman and Hossain, (2011) found a disparity between the subjects studied in the plant's characteristics, while the Aljumaily and Sarhan, (2010) showed no significant differences between the studied cultivars.

In the case of the effect of plant densities on the status of plant yield.in Table (8), which showed that there were no significant differences between plant densities to exceed the density of 200,000 plants.ha^{-1} at the highest rates of plant yield of 17.39 and 16.57 g.plant^{-1} in the Bani Maqan and Kani Banka respectively. The reason for the plant density is more than 200,000 plants.ha^{-1} in the individual plant characteristics, which is achieved by high and balanced rates in the constituent traits. These results are not consistent with the results of Hijab (2005), Çalişikan et al (2007), Rahman and Hossain, (2011), They obtained significant differences between plant densities studied for individual plant status.

Table (8): Effect of plant density and varieties and their interactions for Yield per plant (gm.)

Locations	Bani Maqan				Kani Banka			
Verities Populations	Lee74	Taqa	Aeman	Means of Populations	Lee74	Taqa	Aeman	Means of Populations
285714	18.503a-e	14.343c-f	17.64a-f	16.83a	16.1b-e	14.9cde	14.82cde	15.28a
200000	11.58f	21.84a	18.7a-e	17.39a	18.58a	15.4b-e	15.75b-e	16.57a
153846	13.12ef	21.383ab	17.45a-f	17.32a	14.39e	17.7ab	14.86cde	15.65a
142857	13.25def	19.52a-d	16.79a-f	16.52a	17.1a-d	16.3a-e	15.7b-e	16.37a
100000	15.07b-f	17.697a-f	17.19a-f	16.65a	14.68de	17.3abc	14.16e	15.39a
76923	13.757def	20.39abc	17.59a-f	17.24a	15.9b-e	14.66de	17.85ab	16.16a
MEANS OF Verities	14.21b	19.19a	17.57a	16.99	16.13a	16.06a	15.53a	15.9

Values followed by the same letter are not significantly different from each other

Table (8), which was shown that Taqa variety has a higher density of 200,000 plants / ha at the highest plant yield per plant at 21.84 g.plant^{-1}. In the case of the variety of Lee74 at the same density achieved 200,000 plants.ha^{-1} at the highest plant yield of 18.58 g.plant^{-1}. It was noticed that the behavior of varieties varies according to plant densities because of the complexity of the traits and their wide genetic associations and their impact on surrounding environmental conditions. In previous studies, both Kajo (2009); Daroish et al. (2005); Aljumaily and Sarhan, (2010) showed that there were significant differences between the different treatments of plant varieties and intensities studied by the individual plant. From the results of Table (8), it was noticed that the site of Bani Maqan achieved an increase of 6.86% on the site of Kani Banka in the status of plant yield. The sites gave general rates of this status reached 16.99 and 15.9 g.plant^{-1} at the sites respectively.

Yield (kg. ha^{-1})

The number of seeds is the final outcome and the last objective of the cultivation of any crop, and the total amount of its components is estimated by type of crop, and some researchers point out that this capacity is a quantity controlled by a large number of genes, in addition to the great impact on environmental conditions, in Table (9), which indicated that the Taqa variety superiority in the

site of Bani Maqan with the highest rate of total score of 2963.9 k. ha^{-1}, achieving an increase rate of 32.4 and 4.5% for the two varieties of Lee74 and Aeman respectively, although there are no significant differences between the varieties. Although there were no significant differences between the three varieties. In the second site, Kani Banka, where the differences between the varieties did not reach the limits of statistical significance, the difference between the varieties was less than in the first location. The achievement of the Lee74 was the highest mean of the total grain yield at 2574.2 $kg.ha^{-1}$, achieving a percentage increase of 0.86 and 5.76% respectively for Taqa and Aeman respectively. These results differ from those of Tremblay et al. (2002) and Rahman and Hossain (2011), who found significant differences between the studied cultivars of the area unit.

The effect of the plant densities on the overall yield was significant at the probability level of 1%, as shown by the results of the analysis of the variance of the Bani Maqan and the Kani Banka as a total, as shown in supplementary of 1 and 2. In Table (14), the plant density exceeds 200000 $plant.ha^{-1}$ with the highest total yield of 3733.4 and 3578.4 $kg.ha^{-1}$ in the Bani Maqan and Kani Banka respectively and significant differences from some other densities. These results are consistent with the findings of Dorrance (2002), Daroish et al (2005); Darwish et al. (2005); Hijab (2005) Çalişan et al., (2007); Ibrahim and Halk (2007); Cho and Sok-Dong (2010); which showed that a significant difference between the different plant densities of the plant total. For the effect of the overlap between plant varieties and densities on the total yield, in Table (9) showed significant differences between the different combinations of plant varieties and intensities. The Taqa cultivars were more than 200000 plants / ha at the site of Bani Maqan with a grain yield of 5039.6 kg / ha. In the Kani Banka site, Lee74 exceeded the same density of 200,000 $plants.ha^{-1}$ with the highest cereal yield of 4056.5 $kg.ha^{-1}$, significantly higher than most other interactions. Previous studies in this field indicated that both Assaf, (2000) ; Daroish et al (2005); Obeidi, (2009); Kajo, (2009); Daoudi, (2012); showed that there were no significant differences in the results of this study.

For the general average of the recipe, the results of Table (9) show that the site of Bani Maqan has a higher general rate of 2680.02 $kg.ha^{-1}$, while the Kani Banka site has a general average of 2520.16 $kg.ha^{-1}$.

Table (9): Effect of plant density and varieties and their interactions for Yield (kg. ha^{-1})

Locations	Bani Maqan				Kani Banka			
Verities Populations	Lee74	Taqa	Aeman	Means of Populations	Lee74	Taqa	Aeman	Means of Populations
285714	4006ab	2920.5b-e	3912.6abc	3613a	3299.7ab	3073.9b	3097.5b	3157.1a
200000	2254b-e	5039.6a	3906.8abc	3733.4a	4056.5a	3368.3ab	3310.5ab	3578.4a
153846	2685b-e	3685.4a-d	3670.1a-d	3346.8a	2971.9b	3725.1ab	3156.5b	3284.5a
142857	1441.7e	2149.9b-e	1908.1cde	1833.3b	1864.6c	1774.3c	1683c	1774b
100000	1632.1e	1955.9cde	1769.4de	1785.8b	1569.6c	1813.5c	1506.1c	1629.7b
76923	1412e	2032.3b-e	1859.1de	1767.8b	1683.1c	1558.5c	1850.2c	1697.3b
MEANS OF Verities	2238.5a	2963.9a	2837.7a	2680.02	2574.2a	2552.3a	2434a	2520.16

Values followed by the same letter are not significantly different from each other.

Oil percentage

shown in Table (10) of the percentage of oil in the seeds that the three cultivars, which were not significantly different from each other. The results of the showed the superiority of Lee74 in the Bani Maqan site and the Aeman at Kani Banka with the highest oil percentage of 23.62 and 23.52% respectively. The results were consistent with Aljumaily and Sarhan (2010), there was no significant difference between the studied cultivars Oil, and differ with Daroish et al. (2005); Kajo, (2009) who obtained significant differences.

The results of the effect of plant densities on seed oil showed significant differences shown in Table (10) The highest density was 285,714 $plants.ha^{-1}$ at the site of the Bani Maqan highest yield of 23.91% for all other plant densities, while the density was more than 200,000 $plants.ha^{-1}$ at Kani Banka with the highest rate of oil in seeds, which reached 23.63% , and these results are consistent with the results of the study of Aljumaily and Sarhan, (2010) and Daroish et al (2005).

Table (10): Effect of plant density and varieties and their interactions for Oil percentage

Locations	Bani Maqan				Kani Banka			
Verities Populations	Lee74	Taqa	Aeman	Means of Populations	Lee74	Taqa	Aeman	Means of Populations
285714	24.1a	23.9ab	23.73a-d	23.91a	23.1e	23.3b-e	23.63a-d	23.34bc
200000	23.7a-d	23.567bcd	23.83abc	23.7b	23.2cde	23.17de	23.23cde	23.2c
153846	23.3d	23.43cd	23.43cd	23.4d	23.6a-e	23.5a-e	23.7abc	23.6ab
142857	23.67bcd	23.63bcd	23.6bcd	23.63bc	23.5a-e	23.7a-d	23.67a-d	23.6ab
100000	23.43cd	23.367d	23.5bcd	23.43cd	23.5a-e	23.87a	23.57a-e	23.63a
76923	23.5bcd	23.4d	23.3d	23.41d	23.77ab	23.6a-e	23.33b-e	23.57ab
MEANS OF Verities	23.62a	23.55a	23.57a	23.58	23.43a	23.517a	23.52a	23.49

Values followed by the same letter are not significantly different from each other.

and the effect of overlap between varieties and plant densities. The results of in Table (10) showed significant differences between the different combinations of plant varieties and densities. For the site of Bani Maqan Lee74, the highest yield was 285,714 plants.ha^{-1} with the highest percentage of seed oil at 24.1%. In the previous studies, Daroish et al. (2005) showed a significant effect on the correlation between plant varieties and densities of oil ratio, while Aljumaily and Sarhan (2010) showed no significant interaction between the types and densities studied in the ratio of oil. Table (10) shows that the general characteristics of the sites of the study were close to 23.58 and 23.49% for the Bani Maqan and Kani Panka, respectively.

Protein percentage

Soybean protein content is an important characteristic to be studied for the importance of this crop in human and animal nutrition. in Table (11) The results showed that Aeman was superior in Bani Maqan and Lee74 in Kani Banka, which rates amounted to 28.28 and 28.68% respectively, with no significant difference from other species in each sites. Daroish et al. (2005) ; Kajo (2009) showed that the presence of significant effects of the genotypes in the proportion of protein and within different environments , but Aljumaily and Sarhan, (2010) . pointed out that the items studied by them did not differ significantly from each other.

In the case of the effect of plant densities in the percentage of protein in seeds. in Table (11) showed significant differences between the mean plant densities, where the low density was 76923 plants.ha^{-1} at the site of Bani Maqan with the highest rated protein content of 28.87% with a significant difference from all other densities. While the highest density was 285,714 plants.ha^{-1} at Kani Banka with the highest protein percentage of 29.32%, with a significant difference from most other plant densities. These results were consistent with Ibrahim and Halk (2007), Aljumaily and Sarhan (2010) and Daroish et al (2005) found.

Table (11): Effect of plant density and varieties and their interactions for Protein percentage

Locations	Bani Maqan				Kani Banka			
Verities Populations	Lee74	Taqa	Aeman	Means of Populations	Lee74	Taqa	Aeman	Means of Populations
285714	27.5ef	27.5667ef	28.13a-e	27.73c	29.47a	29.27a	29.23a	29.32a
200000	28.17a-e	28.43a-d	28.2a-e	28.27b	29.07ab	29.1a	29.33a	29.17a
153846	28.13a-e	27.93cde	28.73abc	28.27b	28.27c	28.3c	28.37c	28.31b
142857	28.1b-e	28.43a-d	28.67a-d	28.4b	28.4c	28.37c	28.47bc	28.42b
100000	28.6a-d	27.8edf	27f	27.8c	28.33c	28.1c	28.1c	28.18b
76923	29a	28.67a-d	28.93ab	28.87a	28.5bc	28.5bc	28.47bc	28.49b
MEANS OF Verities	28.25a	28.14a	28.28a	28.22	28.68a	28.61a	28.66a	28.65

Values followed by the same letter are not significantly different from each other.

According the effect of overlap between plant varieties and densities in protein content .The results of the in Table (11) showed significant differences between the different combinations of varieties with plant densities. The Lee74 cultivars with low density were 76923 plants.ha^{-1} in the site of Bani Maqan and with a high density of 285,714 plants.ha^{-1} and with the highest rates of 29 and 29.47% respectively. (Darwish et al., 2005) showed significant differences between cultivars and plant densities, while Aljumaily and Sarhan (2010) did not achieve an effect For this overlap on protein properties.

The overall rate of protein content at the Kani Banka site was 28.65% and was higher than that for the Bani Maqan site which recorded an average of 28.22% according to the results of Table (11).

REFERENCES

Abdul Aziz, M. (2007). Effect of plant density and phosphate fertilization on the growth and productivity of the fava bean variety, Journal of Agricultural Research and Development in Minia, Minia University, Faculty of Agriculture. Vol. 27, No. 1, pp. 135-150.

Al Jumaily, J. M. A. (2011). Growth and seed yield of soybean under planting dates, The Iraqi Journal of Agricultural Sciences, 42 (5):38- 45.

Al Jumaily, J. M. A. and Sarhan , I. A. (2010). Effect of plant densities and time of potassium fertilizer on growth and yield of two Soybean cultivars (*Glycine max* L. Merrill). Journal of Alanbar for Agricultural Sciences. 8 (4) p:373-393.

Al-Mahdawi, H. O. , Abdul J. M. , Adel Y. N., Abdul rahman Kh. S., Ali H. A., Amal N. H., Abdul jabbar S. H., Jalal N. M. (2002). The development of genotypes of soybeans suitable for the conditions of Iraq (scientific note) Journal of Studies, Agricultural Sciences Volume (29), Number (1), pp. 65-72.

Assaf, I. (2000). Behavior of some soybean cultivars in Wadi al-Fawrad under the influence of different agricultural techniques, Tishreen University Journal of Studies and Scientific Research, Agricultural Science Series Vol 22, No. 10, pp. 241-258.

Calişikan, S., Mehmet, A., Ilhan, Ü., Mehmet, E. C. (2007). The effects of row spacing on yield and yield components of full season and double-cropped soybean. Turk J Agri. for 31 (2007) 147-154.

Cho, Y. and Sok-Dong, K. (2010). Growth parameters and seed yield compenets by Seeding time and seed density of non-few branching soybean cultivars in drainned paddy field. Asian J. Plant Sci., 9 (3): 140-145.

Daoudi, A. H. R. (2012). Effect of seed inoculation with EMI and phosphate fertilizer in the growth, yield and quality of two varieties of soybean (Glycine max (L)), Thesis of the Faculty of Agriculture and Forestry, University of Mosul.

Daroish, M., Hassan, Z. and M. Ahad (2005). Influence of planting dates and plant densities on photosynthesis capacity, grain and biological yield of soybean *Glycine max* L. Merr. in Karaj, Iran. Jour. Of Agronomy. 4 (3): 230- 237.

Dorrance, A. (2002). Soybean Seed Treatment and Seeding Population Study. Ohio State Extension Plant Pathology Department.

Duncan, D. B., (1955). Multiple range and Multiple F-Test Biometrics. (11). 1-42.

EL – Douby, .K. A, Mansour, S.H. and Zohry, A.A. (2001). Food Legunes. Field Crops Res. Inst. A.R.C. Giza. Egypt. (Abstracts).

Faronikov, F. S. (1998). Productivity of the soybean class Kharkov-40 in the irrigated areas on the River Dnieper, the tenth soybean research conference, Gerkasy, Ukraine: pp. 100 -109.

Hermandez, L.G. and G.D. Hill (1983). Effect of plant population and inoculation on yield and yield components of chickpea (*Cicer arietinum* L.). Pro. Argon. Soc. New Zealand. 37 (10): 75-79.

Hijab, R. (2005). Effect of loading systems and density of soybean plants and nitrogenous fertilizers on yields and their components of maize and soybeans, Thesis, University of Aleppo.

Ibrahim, S.A. and Halak, T. (2007). Growth. yield and chemical constituents of soybean *Glycine max L* . plants as affect by plant spacing under different irrigation intervals. Research Journal of Agriculture and Biological Sciences. 3 (6): 657 – 663.

Kajo, O. N. (2009). A study the effect of plant density and main and intensive planting date on growth and productivity of some Soybean varieties in Syrian coast condition. Thesis of Master. Department of Field Crops, Faculty of Agriculture, Tishreen University, Syria.

Kayal, H., Mahmoud S. and Yousef N. (1998). Industrial Crops, Damascus University Publications, 1998.

Norsworthy, J.K. and Emerson, R.S. (2005). Effect of raw spacing and soybean genotype on main stem and branch yield. Agronomy Journal, 97:919-923.

Obeidi, S. H. J. (2003). Genetic Behavior and Determination of Determination Factors for Specimens of Species Of soybean *Glycine max* L Merrill, Master of Science - Faculty of Agriculture - University of Tikrit.

Obeidi, S. H. J. (2009). Effect of plant density in seven varieties of soybean *Glycine max* L .Merril), Tikrit Journal of Agriculture Sciences. 9: 101- 115

Oya, T., Nepomuceno, A.L., Neumaier, N., Farias, J.R.B., Tobita, S. and Ito, O. (2004). Drought tolerance characteristics of Brazilian soybean cultivars- evaluation and characterization of drought tolerance of various Brazilian soybean cultivars in the field. Plant Prod. Sci., 7: 129-137.

Rahman, M.M., and M.M. Hossain (2011). Plant density effects on growth, yield and yield components of two soybean varieties under equidistant planting arrangement. *Asian Journal of Plant Sciences, 10: 278-286.*

Sahuki, M. M. (2006). Genetic-physiologic and genetic-morphologic components in soybean, Journal of Iraqi Agricultural Science, 37 (2): pp 63-68.

Sarahan, I.A. and J.M.A. Aljumaily (2015). Effect of cycocel and foliar nutrition of nitrogen and boron on growth of soybean cultivars. The Iraqi Jou. Of Agri. Sci., 46 (2): 120-135

SAS (1985). Statistical Analysis System. SAS Institute Inc. Cary, Nc. USA 25

Shamsi, K. and S. Kobraee (2009). Effect of plant density on the growth, yield and yield components of three soybean varieties under climatic conditions of Kermanshah, Iran. J. of Animal and Plant Sci. 2: 96-99.

Smith A. K. (1978). Soybeans : Chemistry and Technology . Vol 1. AVI Publishing Co. Inc.Westport, Conn .

Stephenson A., Devlih G. and Horton J.B. (1998). The effects of seed number and prior fruit dominance on the pattern of fruit produ- ction in *Cucurbita pepo* L. (Zucchini squash). Annals of Botany. AB ST. 62:653- 661.

Tremblay, G.J., Gangnon, L. and Saulnier, M. (2002). Effect de la densite depeuplement sur trios cultivars de soya. Canadian Journal of plant science. 82 (4; 675 -680).

دور تجزئة الكثافة النباتية على نمو وحاصل ثلاثة أصناف من فول الصويا *Glycine max*

ئاريان رشيد كريم، حسين سيرين، خالد خليل احمد[1]

[1] كلية الزراعة/ الحويجة– جامعة كركوك– العراق.

المستخلص

أجريت تجربة باستخدام ثلاثة أصناف من فول الصويا (Lee 74 و طاقة وايمان) تم زراعتها في ستة كثافات نباتية (285714 , 20000 , 153846 , 142857 , 100000 , 76923) نبات . هـ$^{-1}$ ، باستخدام تجربة عاملية لتصميم القطاعات العشوائية الكاملة في منطقتي (باني مقان و كاني بنكا) في محافظة السليمانية، شمال العراق.

أظهرت النتائج في منطقة باني مقان، أن الصنف طاقة قد تفوق معنويا في حاصل النبات والحاصل الكلي (19.19 غم. نبات$^{-1}$ و 2963.9 كغم.هـ$^{-1}$) على التوالي إضافة الى عدد الأوراق الخضرية وعدد القرنات . نبات$^{-1}$ ، بينما تفوق الصنف Lee 74 في صفات الازهار وارتفاع النبات وعدد البذور. نبات$^{-1}$ ونسبة الزيت، اما الصنف ايمان فتفوق في صفتي دليل البذور ونسبة البروتين. اما في منطقة كاني بنكا فتفوق الصنف Lee 74 في عدد الأيام للإزهار وارتفاع النبات وعدد الافرع وحاصل النبات (16.13 غم.نبات$^{-1}$) والحاصل الكلي (2574.2 كغم. هـ$^{-1}$) ونسبة البروتين، كما أن تأثير الكثافة النباتية 200000 نبات.هـ$^{-1}$ والصنف طاقة أعطت اعلى حاصل للنبات والحاصل الكلي في باني مقان، بينما كان الصنف Lee 74 مع نفس الكثافة النباتية هو المتفوق في معظم الصفات المدروسة.

الكلمات المفتاحية: تجزئة، الكثافة النباتية، النمو، الحاصل، أصناف، فول الصويا.