Effect of Sowing Dates on Development, Seed Yield and Quality of Some Peanut (*Arachis hypogaea* L.) Genotypes

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ABSTRACT

A field study was conducted at the experimental farm of the College of Agriculture, University of Salahaddin-Erbil / Iraq, during growing season of 2012, to evaluate the effect of sowing dates on crop growth cycle, seed yield and quality of peanut. A split-plot arrangement in a randomized complete block design with three replicates was used. Sowing dates were assigned to main plots, and genotypes to the sub-plots. The planted crop needed at the first date (April 22) more days to attain emergence and flowering stage (16.3 and 57.8 days respectively), than the other three dates. It is pointed out that the plants of June, 3 date required longer period from flowering to maturity than those of April, 22 (150.1 and 137.8 days respectively). Plants needed more accumulated heat units to reach emergence when planted in April, 22, to reach flowering at May, 20 date and to reach maturity at June, 3 date. Soodary genotype took the longest period for flowering and from flowering to maturity, and accumulated the highest quantity of heat units up to mature stage. The third date (May 20) and the genotype ICGV8623 gave the highest pod, seed yield, oil and protein yields (3.2, 2.0, 0.836 and 0.398 t/ha) and (3.3, 1.9, 0.784 and 0.394 t/ha) for the same date and the genotype respectively. Seeds of last date (June 3) and Soodary genotype were recognized by high oil content (44.3% and 45.7%) respectively. First date (April 22) surpassed in protein percentage (22.0%). A highly significant negative relationship was found between number of days from flowering to maturity and number of days from sowing to flowering (r = -0.557), the seed yield was positive and significantly correlated with seeds /pod and 100-seed weight (r = 0.341 and 0.385) respectively, and there was a positive, high significant correlation between seed yield and pod yield (r = 0.695).

Keywords: Peanut growth stages, Seed quality, Seed Yield, Sowing date.

INTRODUCTION

Peanut plant is considered one of important economic crops of the world, especially after the 2nd World War. Its importance is deeply related to the high nutritional value of seeds (50% oil and 30% protein) (Abbas, 2001). The world annual peanut production is around 37.196 million t and the top three producers were China, India and the USA (FAO, 2012). Pod yield of peanut in Iraq is about 2448 t from the 808 hectare of harvested area (FAO, 2011). Planting of this crop in Iraq, in particular Kurdistan Region is limited; the researchers are experiencing difficulties with lack of information availability over methods of its management and serving such as; planning dates, selection of suitable varieties for Kurdistan Region conditions. Planting date plays an important role on the peanut yield, the variations of planting dates may interact with differences in climatic conditions in particular; temperature degree,

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photoperiod and relative humidity which affect the physiological processes by performance and behavior of genotype, and when climatic conditions are not suitable for need of one of yield components, it would negatively affect the seed yield (Baldwin, 2005). Williams (2000) suggested that physiological processes are the best tools to explain the variation in peanut yield, which are the pod filling period and the rate of pod establishment. Growing degree days (GDD) is often used in agronomy to estimate or predict the lengths of the different phases of development. Peanut crop needs during growing season 1450 and 1550 (GDD) at 10 and 13.5°C, in addition to 313 and 360 (GDD) up to onset of flowering respectively (Craufurd *et al.*, 2002). Prasad *et al.* (2000) showed that peanut flowering period is negatively affected by high temperature degrees; the planting dates may set the timing of ultimate harm by frost and high degrees. Chapin and Thomas (2010) demonstrated that when peanut was planted on May 15, emergence occurred on May 22 and seedling stage occurred between May 22 and July 12. Furthermore, onset of flowering occurred at 35 days and pod formation occurred 45 days after flowering. Azab (1993) found out that dry matter of plant declined from 33.3 g/plant to 18.0 g/plant when delaying planting date from April to June. Naab *et al*. (2004) indicated that early planting produced 20% to 50% greater pod yield than late planting. Canvin (1965) showed that the rise of temperature degrees above 20°C during seed-filling stage resulted with increase in protein percentage and decrease in oil percentage. Holaday and Jack (1974) pointed out that the low temperature degrees increase oleic and linoleic acids content. Other studies indicated that oil content decreases at late planting dates, on the contrary, protein content increases at late planting date (Cheng *et al*., 2006). Other study showed that in early stages i.e. 1st and 15th of April, the oil percentage increased by 23.3% compare to other dates (Al-Aubaidy and Al-Aubaidy, 2011).

2. OBJECTIVES

The aim of this study was to determine the most suitable sowing date in Kurdistan/Erbil and to investigate the effect of different sowing dates on growing pattern, yield, yield components and quality of three peanut genotypes

3. MATERIALS AND METHODS

A field study was conducted at the experimental field, kardarush/College of Agriculture-Erbil (latitude 36° 7' N and longitude 44° 2' E, 415 meters above sea level)-Kurdistan Region during season of 2012. Split-plot based on randomized complete block design, with three replicates was used. At two weeks interval, four sowing dates (April 22, May 6, May 20 and June 3) were assigned as the main plots, whereas genotypes (Esmaeila, Soodary and ICGV8623) as sub-plots.

The sub-plot size was 6 m^2 (2 m × 3 m) consisting of four rows, three meter long and 50 cm apart. Two seeds were placed in each hole of 20 cm apart at planting depth of 3 cm. Weeds were removed manually throughout the growing season. Nitrogen fertilizer was applied at a rate of 100 N kg ha^{-1} in the form of urea (46% N) at two intervals; the first at sowing date, and the second at flowering stage. Also P_2O_5 was drilled near the seeds and covered at rate of 80 kg ha^{-1} in the form of triple superphosphate (46% P_2O_5). Daily observations were recorded to obtain the number of days from sowing to emergence, number of days from sowing to the flowering stage, number of days from sowing to the maturity stage and number of days from flowering to mature stage (seed and pod filling stages). Growing degree days (GDD) for the same growth stages (except from flowering to maturity) were recorded (appendix 2). The growing degree days were calculated as follows:

$$GDD = \frac{[(T_{Max.} + T_{Min.})]}{2} - T_{base}$$

Where $T_{Max.}$ and $T_{Min.}$ are the daily maximum and minimum air temperature, respectively, whereas T_{base} is the base temperature of 10°C (Caliskan *et al*., 2008)

At flowering, leaf area per plant was carried out using the disk method (Watson and Watson 1953). Number of leaves $plant^{-1}$ and dry matter (g/m^2) were also recorded.

At harvesting stage, plant length, number of branches $plant^{-1}$ and number of pods $plant^{-1}$ were calculated as an average of three harvested plants per plot. Forty pods from the three harvested plants were threshed and the number of seeds per pod was calculated. The 100-seed weight was recorded after being dried with a forced-air dryer. The actual harvest time for each sowing date is after yellowing of leaves and some of them fall off, the pods' shells are hardened and seeds are covered with brown coat. Total yield was obtained by pulling up ten plants sample from the mid row to calculate pod and seed yields per hectare. Pod number of the plants previously mentioned and number of undamaged and matured pods (pods having matured and undamaged seeds) were used to calculate percentage rate of matured pods using the following equation:

$$\text{Matured Pods \%} = \frac{\text{No. of matured pods}}{\text{No. of Total pods}} \text{X } 100$$

The quality characteristics were measured as following:

1- Determination of oil percentage: Oil was extracted from peanut seeds using (Soxhlet), and oil percentage was estimated according to Association of Official Analytical Chemists (A.O.A.C., 1980).

2- Determination of protein percentage: Nitrogen percentage in seeds was estimated using (Micro-Kjeldahl) method according to Association of Official Analytical Chemists (A.O.A.C., 1980). Protein percentage was calculated according to the following equation: Protein percentage = Nitrogen percentage (N %) x 6.25.

3- Determination of oil yield (kg/ha): It was calculated by: oil percentage × seed yield (kg/ha).

4- Determination of fatty acids percentage: Percentages of saturated and unsaturated fatty acids were determined by using Gas Liquid Chromatography (GLC) using International Union of Pure and Applied Chemistry (IUPAC, 1979) method. The data was computed by computer within the (GLC), both provided by Hewlett Packard to record Area % and Peak Area of each peak of fatty acids. Data was taken for all samples of oil extracted from seeds to identify how much the variation in fatty acids percentages during planting dates, also the variation in fatty acid percentages for the genotypes studied. To diagnose the fatty acids in the oil, the following standard fatty acids were used:

Palmitic acid (C16:0), Stearic acid (C18:0), Oleic acid (C18:1), Linoleic acid (C18:2), Linolenic acid (C18:3) and Arachidic acid (C20:0).

Analysis of variance (ANOVA) was done for the obtained data by using the statistical analysis system (SAS Institute 2005). Least significant difference was used to determine the differences among means and correlation coefficients were calculated to determine the relationship between the seed yield and the other parameters and among the parameters themselves.

4. RESULT AND DISCUSSION

Planting seeds emergence delayed in first date (April 22) in a comparison to other dates, seed of first, second, third and fourth dates took 16.3, 11.4, 11.6 and 11 days respectively to emerge (Table 1). These results are not in agreement with Chapin and Thomas (2010) who demonstrated that the emergence of peanut seeds was in 7 days when planted on May, 15 compared to delay dates. Emergence delay induced by the first date was probably related to low temperatue effect (Appendix 2) which reduces the diffusion rate of water and the enzyme activity breakdown process of complex substances into simple ones which the embryo need for division of cells and then emergence (Sukkary *et al.*, 1988).

In a comparison to other dates, the cause of reduction in flowering period by movement from the first to the last date, is the rise of temperature degree (Appendix 2) in these dates (May 6, May 20 and June 3) which has great effect in reducing this period by 5.2, 4.8 and 11.7 days, over the first date, respectively (Table 1). This result is in accordance with Prasad *et al.* (2000) who confirmed that peanut flowering period length was clearly shortened by the high temperature degrees. Soodary genotype took longer period to show flowers, while Esmaelia genotype attained the flowering stage with fewer numbers of days. This is possibly related to the fact that the genotypes variate in their degree of response to various temperature levels, which consequently reflects their performance up to flowering (Sardana and kandhola, 2007). Planting dates, genotypes and their interactive combination have significant effect on number of days which the plant needs from onset of flowering to maturity stage (Tables 1 and 2). Plants of fourth date took 150.1 days from flowering to maturity, while first date plants passed the same period with 137.8 days. From data of appendix 1, it is noticed that there is a high significant negative correlation relationship between number of days from flowering to maturity and number of days from planting to flowering (-0.557), and high significant positive correlation with number of days from planting to maturity (0.814). It is also noticed that genotype Soodary needed more number of days to attain maturity stage starting from flowering comparing to the rest of two genotypes (Table 1).

Table 1. The effect of sowing dates and genotypes on some growth periods, heat units and plant characteristics of peanut

Sowing dates	Number of days from				Heat units			No. of leaves/plant	Leaf Area (cm^2)	Dry Matter (g/m^2)
	Sowing to Emergence	Sowing to Flowering	Sowing to Maturity	Flowering to Maturity	Sowing to Emergence	Sowing to Flowering	Sowing to Maturity			
April 22	16.3a*	57.8a	195.3	137.8d	216.2b	1079.2c	4041.0a	49.9ab	611.9a	44.2a
May 6	11.4b	52.6b	196.6	144.0b	215.2b	1083.6c	3975.8b	39.1c	524.5ab	35.6b
May 20	11.6b	53.0b	194.6	141.4c	245.5a	1174.9a	3796.3c	50.0a	485.6bc	38.2ab
June 3	11.0b	46.1c	195.8	150.1a	251.2a	1122.7b	3576.5d	44.3bc	368.3c	26.2c
$L.S.D_{0.05}$	0.9	0.7	N.S	0.7	18.6	14.7	16.1	5.7	117.0	7.9

Genotypes	Number of days from				Heat units			No. of leaves/plant	Leaf Area (cm^2)	Dry Matter (g/m^2)
	Sowing to Emergence	Sowing to Flowering	Sowing to Maturity	Flowering to Maturity	Sowing to Emergence	Sowing to Flowering	Sowing to Maturity			
Esmaelia	14.5a	51.3b	189.5c	137.0c	285.8a	1116.4	3795.4c	51.7a	535.4ab	44.2b
Soodary	13.6b	52.9a	202.3a	150.8a	275.3a	1127.8	3886.5a	56.0a	603.1a	58.5a
ICGV8623	13.4b	52.8a	194.b	142.2b	254.2b	1121.3	3860.2b	37.3b	511.8b	38.4b
$L.S.D_{0.05}$	0.6	0.8	1.5	1.4	13.1	N .S	5.6	6.1	75.1	6.1

*Within each column, Means for each variable having different letters are significant different at the 5% level of probability, according to LSD Test

The second planting date's plants (May 6), which did not differ from plants of April 22, accumulated lower values of heat units up to emergence stage, when compared to other dates. This is due to the higher levels of recorded temperatures for third and fourth planting dates (May 20 and June 3) in a comparison to those recored for first and second dates (April 22 and May 6) (Appendix 2) (Canavar and Kaynak, 2010). The genotypes significantly varied among them in this trait. Plants planted in the third date (May 20) required more heat units to attain flowering stage compare to the other dates. Heat units accumulated at mature stage were affected by planting dates and genotypes (Table 1). Plants planted in first date (April 22) reached maturity with higher values of accumulated heat units than that in other dates. Soodary genotype differed from the other genotypes; it needed more heat units to achieve maturity stage, because of the difference in maturity growing period of this genotype (202.3 days).

The results illustrated in tables 1 and 2 revealed significant effect of planting dates, genotypes and interaction between them on the characteristics of plants. Plants of the second date (May 6) produced the least average leaf number/plant (39.1) compared with the other three dates, where there was no significant difference among them. From statistical point of view, Soodary and Esmaelia genotypes' plants produced the highest average leaf number/plant (56.0 and 51.7), respectively.

Plants planted in first date (April 22) produced the largest leaf area/plant (611.9 cm^2) compare to plants of the May, 20 and June, 3 dates. Superiority of the first date (April 22) could be related to the fact that the recorded temperature levels were less than what recorded in the other dates (Appendix 2) which was the cause of prolonging the required duration for flowering in the first date (April 22) (Table 1) (Muldoon, 1985). There was a positive and highly significant correlation between this characteristic and number of days from planting to flowering (0.481) (Appendix 1). Soodary and Esmaelia genotypes plants achieved the largest leaf area/plant (6031 and 535.4 cm^2 respectively).

First date plants (April 22) produced the largest dry matter yield, while plants of last date (June 3) gave the least dry matter. The reason for decrease of dry matter was because of rise of temperature degrees for last date which led to speeding up the emergence and flowering duration, consequently led to reduction in leaf area (Table 1), hence decrease of plant efficiency to intercept the sunlight and transfer CO_2 to dry matter (Sukkary *et al*., 1988). Soodary genotype's plants produced the highest dry matter (58.5 g/m^2) compared to the other two genotypes. The surpass of this genotype over the others is an indirect result of its distinction in prolonging the growing duration from planting to flowering which prolonged photosynthesis period and hence increases the products, as dry matter accumulation, leaves number and leaf area (Table 1).

It is noticed that plants planted in third date (May 20) attained the highest length (43.7 cm), while the lowest length was for plants planted in last date (June 3) (33.1 cm), this is due to lack in number of branches/plant in terms of this date (Table 3), this assisted penetration and distribution of sunlight more efficiently at the bottom of the plant leading to photoperiodically auxin breakdown and increase of stalk thickness and short of internodes in plants of last date (June 3) (Mohamed and Younis, 1991), and through a high significant positive correlation between plant length and number of primary branches (0.766) (Appendix 1). For the same reason, plants of Soodary genotype's plants produced the highest length (43.6 cm) compared to ICGV8623 genotype plants (Table 3).

Table 2. The effect of interaction between sowing dates and genotypes in some growth periods, heat units and plant characteristics of peanut

Sowing dates	Genotypes	No. of days from				Heat Units			No. of Leaves/plant	Leaf Area (cm^2)	Dry Matter (g/m^2)
		Sowing to Emergence	Sowing to Flowering	Sowing to Maturity	Flowering to Maturity	Sowing to Emergence	Sowing to Flowering	Sowing to Maturity			
April 22	Esmaelia	15.7c*	57.3b	183.0g	126.3k	244.3df	1053h	3923e	50.3bcd	693.2b	48.3de
	Soodary	16.3b	59.3a	203.7ab	146.7e	249.3cd	1115cdfg	4127a	56.7abc	924.0a	55.0cd
	ICGV8623	17.0a	56.7b	199.3cd	140.3g	271.8bc	1069fgh	4073b	42.7def	518.6cde	29.3f
May 6	Esmaelia	12.0e	52.0de	187.0f	135.0j	219.6fg	1069fgh	3909f	47.3cde	377.4e	25.9f
	Soodary	10.7g	51.7e	204.7a	153.0b	230.6df	1061gh	4025c	37.0ef	563.6bcd	40.6e
	ICGV8623	11.7f	54.0c	198,0d	144.6f	196.0gh	1120bcdf	3993d	33.0f	632.4bc	40.3e
May 20	Esmaelia	17.0a	52.3de	193.0e	139.7h	347.4a	1175ab	3773i	48.7bcde	632.6bc	75.3b
	Soodary	15.7c	52.7d	201.7bc	149.0c	333.7a	1183a	3817g	67.7a	433.6de	108.8a
	ICGV8623	17.0a	54.0c	189.0f	135.7i	355.4a	1166abc	3799h	33.7f	390.6e	62.4c
June 3	Esmaelia	13.3d	47.7f	195.0e	147.0de	332.6a	1168abc	3576j	60.3ab	438.2de	27.1f
	Soodary	11.7f	44.0h	199.0cd	154.7a	287.4b	1071dfgh	3577j	62.7a	491.1de	29.6f

Sowing	Genotypes	No. of days from				Heat Units			No. of	Leaf	Dry
	ICGV8623	8.0h	64.7g	193.3e	148.7c	193.5h	1129abc	3576j	40.0def	505.8cde	21.8f
$L.S.D_{0.05}$		1.3	1.0	3.0	0.5	26.2	57	11	12.3	150.2	12.2

*Within each column, Means for each variable having different letters are significant different at the 5% level of probability, according to LSD Test

Table 3. The effect of sowing dates and genotypes on some growth parameters and yield characteristics of peanut

Sowing dates	**Plant length (cm)**	**No. of branches/ plant**	**Pod maturity (%)**	**No.of pods/plant**	**No. of seeds/pod**	**100-seed weight (g)**	**Pod yield (kg/ha)**	**Seed yield (kg/ha)**
April 22	38.6b*	9.2ab	70.5c	40.1b	1.1b	25.8b	2100.5b	1156.9c
May 6	40.9b	8.1b	83.2b	35.4b	1.3a	28.6b	2368.3ab	1469.0bc
May 20	43.7a	9.4a	84.2ab	49.6a	1.3a	36.5a	3166.6a	1993.0a
June 3	33.1c	5.3c	88.8a	22.2c	1.4a	37.4a	2866.4ab	1738.6ab
$L.S.D_{0.05}$	2.4	1.2	5.1	8.5	0.2	5.6	998.2	475.7
Genotypes	Plant length (cm)	No. of branches/ plant	Pod maturity (%)	No.of pods/plant	No. of seeds/pod	100-seed weight (g)	Pod yield (kg/ha)	Seed yield (kg/ha)
Esmaelia	40.3b	8.2a	79.7b	29.9b	1.3	30.3b	2285.6b	1311.4b
Soodary	43.6a	9.6a	86.8a	32.6b	1.3	35.9a	2309.2b	1518.4b
ICGV8623	33.4c	6.2b	82.5ab	48.0a	1.3	29.9b	3281.6a	1938.3a
$L.S.D_{0.05}$	1.8	0.9	4.4	4.5	N.S	3.4	708.4	315.6

*Within each column, Means for each variable having different letters are significantly different at the 5% level of probability, according to LSD Test

It is noticed from table 3 that plants planted in third date (May 20) produced the highest number of primary branches (9.4), while the least number of branches was related to fourth date (June 3) plants (5.3), this is due to the reduction in growing season length from planting to flowering for that date led to shortage of assigned duration to promote the sprouts of primary branches, consequently number of branches (Canavar and Kaynak, 2008). Soodary and ICGV8623 genotypes produced the highest and lowest number of primary branches (9.6 and 6.2) respectively, this result is probably related to the genetic nature of branches formation.

Plants of the fourth date (June 3), which did not differ from plants of May 20, recorded the highest percent of matured pods (88.8%) in comparison to the other dates. The reason of this superiority is due to the decline of pods numbers in this date (22.2) (Table 3). This is in accordance with Al-Maliky (2003) who pointed out that the rate of matured pods is inversely related to number of pods. From statistical point of view, Soodary genotype accompanied ICGV8623 in registering the highest percentage (86.8% and 82.5%) respectively, while Esmaelia genotype produced the least percentage of matured pods (79.7%).

Third date (May 20) plants recorded the highest number of pods (49.6) compare to the other dates, especially the last date (June 3) (22.2 pods), this decline is attributed to shortness of plants length of this date (Table 3), where it led to lack of dry matter and translocation of nutritional materials from the stem and branches to flowers and ovaries and then to pods' sprouts by pigs which had a negatively effect on number of pods of plants (Muldoon, 1985). ICGV8623 genotype plants produced the highest number of pods (48.0) while Esmaelia genotype plants produced the least number (29.9).

Last date plants (June 3) (which did not differ from the second and third dates) produced the highest percentage of seeds/pod (34.29%) in comparison to first date (April 22); it produced the least percentage of seeds/pod (1.1). Last date (June 3) plants produce the highest number of seeds/pod which is owing to small pods, branches and shortness of growing season (Table 3) where the sunlight was permitted to penetrate into the pods and promote carbon assimilation in photosynthesis and provide nutritive materials and its translocation to storage sinks (seeds) to provide nutritive materials to grow and increase seed weight during its filling stage, also lack of competition between flowers for sunlight and nutritional materials which promoted the producing of ovaries, consequently increase of seeds/pod (Gardner *et al*., 1985).

It is noticed from table 3 that the highest number of pods/plant was produced by plants of May 20 date and the highest 100-seed weight was recorded by June 3 planting date. But both dates did not differ in seed yield (1993.0 and 1738.6 kg/ha respectively). ICGV8623 and Soodary genotypes surpassed in pods/plant and 100-seed weight respectively, but the first genotype surpassed the other genotypes in seed yield and pod yield (1938.3 and 3281.6 kg/ha respectively).

Data of table 3 indicates that planting at third date (May 20) (which did not differ from May 6 and June 3) produced the highest pod yield, while earliness of planting at April 22 resulted in yield decline of 33.7% compare to the date of May 20. Increase of pod yield of May 20 is attributed to increase in number of pods/plant for this date (49.6 pod) (Table 3), this was in agreement with Mills (2004) and Bladwin (2005) who illustrate that peanut pod yield was higher at late planting, and this was not in agreement with Wang *et al*. (2004) who pointed out that pods yield declined linearly with every five days delaying in planting after April. For the same reason, there was an increment in pod yield of ICGV8623 genotype (3281.6 kg/ha) compare to other genotypes as a result of having more number of pods/plant (48.0 pod) (Table 3).

Data of tables 3 and 4 revealed that planting in (May 20) (which statistically did not differ from June 3) produced the highest seed yield 1993.0 kg/ha, while earliness in the date (April 22) caused reduction in yield by 42% compare to May 20. The decline of the yield in the early date is due to the reduction in one or more of its components such as seeds number/pod and 100-seed weight (Table 3). One of the reasons of yield increase is due to having more number of branches and longer growing season of this date, this resulted with higher dry matter production, better translocation of photosynthetic products to flowers, more pollination rate, and then pods formation. Also from data of appendix (1), the yield showed significant positive correlation with seed number/pod and 100-seed weight (0.341 and 0.385) respectively. Also it is noticed from the appendix (1) that there is a highly significsnt positive correlation between seed yield and pod yield (0.695), and depending on the last correlation, ICGV8623 genotype yield was surpassed (1938.3 kg/ha) and showing 27.7 and 47.8% of increment in a comparison to seed yield of Soodary and Esmaelia genotypes respectively. This was in agreement with Canavar and kaynak (2008) who pointed out that the date (May 20) produced the highest yield.

Table 4. The effect of interaction between sowing dates and genotypes on some growth parameters and yield characteristics of peanut

Sowing dates	Genotypes	Plant length (cm)	No. of branches/ plant	Pod maturity (%)	No.of pods/plant	No. of seeds/pod	100-seed weight (g)	Pod yield (kg/ha)	Seed yield (kg/ha)
April 22	Esmaelia	40.3bc*	8.7cd	61.3d	28.5c	0.9d	26.3de	1597.2c	938e
	Soodary	43.0b	10.7b	76.7bc	59.7a	1.2c	30.3cd	2226.8bc	1120de
	ICGV8623	32.5e	8.2de	73.4c	60.7a	1.1c	20.9e	2477.6bc	1413cde
May 6	Esmaelia	40.0bc	8.2de	82.1abc	24.0cd	1.5a	25.1de	2306.1bc	1254de
	Soodary	47.3a	10.0bc	90.3a	29.7c	1.3bc	31.3cd	2157.6ec	1422cde
	ICGV8623	35.5de	6.0f	77.1bc	52.5ab	1.2c	29.2cd	2641.2bc	1731bcd
May 20	Esmaelia	42..3b	9.3bcd	87.3ab	47.0b	1.4ab	31.2cd	2210.2bc	1524bcde
	Soodary	46.7a	12.0a	73.8c	23.3cd	1.2c	43.5a	2565.6bc	1985ab
	ICGV8623	42.0b	7.0ef	91.5a	50.0b	1.3bc	34.7bc	4724.1a	2470a
June 3	Esmaelia	38.3cd	6.7ef	87.9a	20.0cd	1.4ab	38.6ab	3028.8b	1529bcde
	Soodary	37.3cd	5.7f	90.4a	17.7d	1.3bc	38.7ab	2286.9bc	1547bcde
	ICGV8623	23.7f	3.7g	88.0a	29.0c	1.5a	34.9bc	3283.6b	2140ab
$L.S.D_{0.05}$		3.7	1.7	10.8	8.9	0.2	6.8	1416.9	631.2

* Within each column, Means for each variable having different letters are significantly different at the 5% level of probability, according to LSD Test

The data revealed that seeds of the last date (June 3) and Soodary genotype's seeds were characterized by recording the highest oil percentage (44.3% and 45.7%) respectively while, the early date (April 22) and

ICGV8623 genotypes demostrated the lowest percentage of 39.5% and 40.1% respectively (Table 5). The decline in oil percentage of first date plants (April 22) could be attributed to the increment in temperature, compare to late planting dates, which was associated with growing and formation of seed (Appendix 2) (Sardana and Kandhola, 2007). Soodary genotype produced the highest oil percentage (48.1%) when it was planted in last date (June 3) (Table 6), this is because of the difference in genotypes response in addition to variant response of some genotypes at seed-filling stage (flowering-maturity) to temperature degrees recorded at different planting dates (Table 2) (Sharma *et al*., 2013) .

It was noticed, from table (5 and 6), that the highest oil yield was related to genotypes' seeds in third date (May 20) (which, statistically, did not differ from the date of June 3) (836.8 kg/ha), while the rate of this yield declined at the early date; it was 453.2 kg/ha in first date. The reason for oil seed increase in the third date (May 20) is due to the increase in seed yield (1993.0 kg/ha) (Table 3) which showed high significant positive correlation with seed yield (r = 0.883) (Appendix 1). The contrary was related to the first date (April 22); because of both yield decline and low oil percentage which led to drop in oil yield. ICGV8623 genotype produced the highest oil yield of 784.6 kg/ha (which did not differ statistically from Soodary genotype of 693.5 kg/ha); the respective percentage of increase for these two genotypes were 30.5 and 21.4% compare to Esmaelia genotype.

Table 5. The effect of sowing dates and genotypes on some seed quality of peanut

Sowing dates	**Oil content (%)**	**Oil yield (kg/ha)**	**Protein content (%)**	**Protein yield (kg/ha)**	**Saturated fatty acids**		**Unsaturated fatty acids**			
					Palmitic acid C16:0	**Stearic acid C18:0**	**Oleic acid C18:1**	**Linoleic acid C18:2**	**Linolenic acid C18:3**	**Arachidic acid C20:0**
April 22	39.5d*	453.2c	22.0a	255.9b	10.6	0.6	2.2	47.2	35.7	2.9
May 6	43.5b	643.8b	20.9b	310.1ab	10.2	0.6	2.2	46.6	35.5	2.9
May 20	41.9c	836.8a	19.9c	398.6a	10.7	0.5	2.2	48.3	34.9	2.9
June 3	44.3a	764.2ab	19.8d	338.4ab	10.6	0.5	2.2	47.5	35.1	3.0
$L.S.D_{0.05}$	0.1	188.6	0.04	94.1	N.S	N.S	N.S	N.S	N.S	N.S
Genotypes	Oil content (%)	Oil yield (kg/ha)	Protein content (%)	Protein yield (kg/ha)	Saturated fatty acids		Unsaturated fatty acids			
					Palmitic acid C16:0	Stearic acid C18:0	Oleic acid C18:1	Linoleic acid C18:2	Linolenic acid C18:3	Arachidic acid C20:0

Esmaelia	41.1b	545.4b	20.5	268.9b	10.5	0.5	2.2	47.7	35.3	2.8
Soodary	45.7a	693.5a	20.8	313.9b	10.5	0.5	2.2	47.6	35.3	2.9
ICGV8623	40.1b	784.6a	20.6	394.4a	10.5	0.5	2.2	46.8	35.3	2.9
$L.S.D_{0.05}$	0.1	132.1	N.S	64.4	N.S	N.S	N.S	N.S	N.S	N.S

* Within each column, Means for each variable having different letters are significantly different at the 5% level of probability, according to LSD Test

Table 6. The effect of interaction between sowing dates and genotypes on some seed quality

Sowing dates	Genotypes	Oil content (%)	Oil yield (kg/ha)	Protein content (%)	Protein yield (kg/ha)	Palmitic acid C16:0	Stearic acid C18:0	Oleic acid C18:1	Linoleic acid C18:2	Linolenic acid C18:3	Arachidic acid C20:0
April 22	Esmaelia	39.7i*	372.4	20.5d	193.6	10.3	1.4	2.2	45.3	35.9	2.7
	Soodary	44.0d	492.7	21.4c	235.2	10.1	0.3	2.2	45.6	36.4	2.9
	ICGV8623	34.9k	494.5	24.2a	339.1	11.5	0.1	2.3	50.7	34.9	3.2
May 6	Esmaelia	41.5l	526.7	20.1e	250.8	10.2	0.1	2.2	48.9	34.1	3.0
	Soodary	44.1d	625.6	20.5d	298.6	10.3	1.4	2.2	45.3	35.8	2.7
	ICGV8623	44.9c	779.0	22.2b	380.8	10.1	0.3	2.2	45.6	36.3	2.9
May 20	Esmaelia	39.5j	609.9	20.1e	304.9	11.5	0.1	2.3	50.7	34.9	3.2
	Soodary	46.4b	913.1	20.0f	396.9	10.2	0.1	2.2	48.9	34.0	3.0
	ICGV8623	39.9h	987.7	19.6g	494.0	10.3	1.4	2.2	45.3	35.8	2.7
June 3	Esmaelia	43.8e	672.9	21.4c	326.5	10.1	0.3	2.2	45.9	36.3	2.9
	Soodary	48.1a	742.5	21.4c	324.9	10.5	0.1	2.3	50.7	34.9	3.2
	ICGV8623	40.8g	877.2	16.5h	363.7	10.2	0.1	2.2	45.9	34.1	3.0
$L.S.D_{0.05}$		0.2	N.S	0.06	N.S	N.S	N.S	N.S	N.S	N.S	N.S

* Within each column, Means for each variable having different letters are significantly different at the 5% level of probability, according to LSD Test

The dates induced different effects on protein percentage trait compare to oil percentage trait (Table 5). The first date (April 22) surpassed other dates in protein percentage (22.0%), these results are in agreement with (Branch *et al*., 2006 and Al-Aubaidy and Al-Aubaidy, 2011) while the least protein percentage was for last date

(June 3) (19.8%). This variation is due to the difference of temperature degrees during seed-filling stage; the slight reduction in temperature degrees at first date led to decrease in oil percentage and increase of protein percentage because of inverse relationship between them. These results are in agreement with Canvin (1965) who indicated that the rise of temperature degrees to more than 20°C at seed-filling stage led to increase in protein percentage. The highest protein percentage was 24.2% for ICGV8623 genotype when it was planted at April 22 (Table 6); this was in agreement with Al-Aubaidy and Al-Aubaidy (2011) who demonstrated that the highest protein percentage (23.77%) was for Saadia variety when planted at April.

The highest protein yield was realized by the third date (May 20) and ICGV8623 genotype (398.6 and 394.4 kg/ha) respectively (Table 5), this is because there was a high significant positive correlation between seed yield and protein yield (r = 0.955) (Appendix 1).

Planting dates, genotypes and their interaction resulted with insignificant differences among values of saturated fatty acid percentage (Palmitic and Stearic acids) and unsaturated fatty acid percentage (Oleic, Linoleic, Linolenic and Arachidic acids) (Tables 5 and 6); perhaps, temperature degrees were suitable during seed-filling and seed maturing stage which is the period in which saturated fatty acids begin to be synthesized firstly, then followed by the unsaturated fatty acids (oleic, linoleic and linolenic).

It is concluded that the early peanut planting led to prolongation of emergence and flowering duration, consequently, accumulation of more heat units, leaves, larger leaf area and the highest dry matter. The highest pod yield, seed yield, oil and protein yields were for plants planted on May, 20 and for ICGV8623 genotype.

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تأثير مواعيد الزراعة على دورة نمو المحصول وحاصل ونوعية بذور فستق الحقل

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ملخص

أجريت دراسة حقلية في حقل التجارب التابع لكلية الزراعة، جامعة صلاح الدين، اربيل / العراق، خلال الموسم الزراعي 2012، لتقييم تأثير مواعيد الزراعة على دورة نمو المحصول وحاصل ونوعية بذور فستق الحقل. استخدم ترتيب القطع المنشقة في تصميم القطاعات العشوائية الكاملة وبثلاث مكررات. مثلت مواعيد الزراعة المعاملات الرئيسة والتراكيب الوراثية المعاملات الثانوية. مقارنة بالمواعيد الاخرى، احتاج المحصول المزروع في الموعد الأول (22 نيسان) الى أيام أكثر لتحقيق البزوغ ومرحلة التزهير (16.3 و 57.8 يوما) على التوالي. اتضح أن نباتات 3 حزيران احتاجت الى فترة اطول من التزهير الى النضج من نباتات 22 نيسان وقد بلغت (150.1 و 137.8 يوما) على التوالي. احتاجت النباتات الى تجميع وحدات حرارية اكثر للوصول الى مرحلة البزوغ عند موعد الزراعة 22 نيسان وللتزهير عند موعد 20 ايار وللنضج عند موعد 3 حزيران. استغرق التركيب الوراثي Soodary الى مدة اطول للوصول الى التزهير ومن التزهير الى النضج وتجمعت معظم الوحدات الحرارية عند مرحلة نضجه. أعطى الموعد الثالث (20 May) والتركيب الوراثي ICGV8623 أعلى حاصل من القرون والبذور وحاصل الزيت والبروتين (3.2، 2.0، 0.836 و0.398 طن/هـ) و(3.3، 1.9، 0.784 و0.394 طن/هـ) لنفس الموعد والتركيب الوراثي على التوالي. تميزت بذور الموعد الاخير (3 حزيران) والتركيب الوراثي Soodary بمحتوى زيت عالي (44.3% و45.7%) على التوالي. تفوق الموعد الأول (22 نيسان) في نسبة البروتين (22.0 ٪). وجدت علاقة ارتباط عالي المعنوية لكنه سالبا بين عدد الايام من التزهير الى النضج وعدد الايام من الزراعة الى التزهير (r = -0.557)، كان ارتباط حاصل البذور موجبا ومعنويا مع عدد البذور/قرن ووزن 100 بذرة (r = 0.341) و(r = 0.385) على التوالي، كما كان الارتباط بين حاصل البذور وحاصل القرون عالي المعنوية وموجبا ايضا (r = 0.695).

الكلمات الدالة: مواعيد الزراعة، نمو المحصول، بذور فستق الحقل.

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