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RESEARCH ARTICLE

The effect of sowing dates on the pod yield and some agronomic and quality characteristics of 'Virginia'-type peanut variety 'Halisbey' in the Mediterranean environment

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Abstract

The objective of this study was to determine the effect of different sowing dates on pod yield and some agronomic characteristics of the 'Virginia'-type peanut cultivar 'Halisbey', and to determine the optimal sowing date in the Mediterranean region. This study was conducted in 2018 and 2019 at the Experimental Research Farm of Agricultural Faculty, Cukurova University in Adana, Turkey. The seeds were sown on seven dates: March 28, April 8, April 18, April 28, May 8, May 18 and May 28 each year. The experiment included a randomized complete block design with three replications. The plants were harvested 160 days after sowing, starting on September 8 every year. Pod number and pod weight per plant, 100 seeds weight, shelling percentage, oil and protein content, pod and kernel yield per hectare were investigated. As a result, pod number and weight per plant, 100 seeds weight, shelling percentage, pods and kernel yield values were found to be the highest at the experimental variant with May 8 sowing date. While the oil content decreased by delaying the sowing date, the protein content was increased. According to a two-year average, the highest pod yield (8136 kg ha^{-1}) and kernel yield (5711 kg ha^{-1}) were also obtained at the experimental variant with May 8 sowing date.

Keywords: *Arachis hypogaea*, peanut, sowing date, pod yield, quality characteristics, agronomic characteristics

Authors' contributions: H. Bakal and B. Onat were engaged in preparing and conducting the biochemical analyses, wrote the methodological part of the research, implemented statistical processing of the experimental data, wrote the manuscript, and formulated conclusions. L. Gulluoglu developed the research concept, and interpreted the results. H. Arioglu wrote the manuscript, interpreted the results, and formulated conclusions.

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Introduction

The peanut (*Arachis hypogaea* L.) is an important human food crop with high edible protein and oil content. The annual peanut production in the world is around 41.9 million tons, and it contributed 7.3% of the total oil seeds production in 2018 (FAOSTAT, 2022). The peanut production in Turkey in 2018 reached 173,800 tons (FAOSTAT, 2022). Peanut seeds are commonly utilized for vegetable oil production and other products such as snacks,

groceries, peanut butter in many countries (Caliskan et al., 2008).

The agronomic characteristics and pod yield of peanuts vary depending on applied cultivars and growing conditions. The growth and yield of peanuts depend on several factors; however, climate plays the crucial role. The oil seed crops, particularly peanuts, are sensitive to climatic parameters such as radiation and temperature (Banik et al., 2009). Hence, the role of solar radiation, temperature, humidity, and rainfall is vital for peanuts. Caliskan et al. (2008) indicated that complex, uncontrolled environmental factors significantly influence the growth and development of peanuts. The yield components of peanuts are strongly influenced by air temperature, and the high air and soil temperature negatively affect the pod yield. Peanut cultivars differ in their sensitivity to high temperatures.

The Mediterranean climate has suitable temperature regimes for the growth and development of peanut plants. The peanut production period in the Mediterranean region (Turkey) varies between April and November, depending on the planting date as a primary and secondary crop. The environmental factors that affect the growth and development of peanut plants, especially day and night temperature, are the most influential for the pod yield and seed quality. The growing period is also significant for peanut production. Caliskan et al. (2008) indicated that the Mediterranean climate offers a long and suitable environment having at least 160 days or 2400–2500 °C thermal times for both primary and secondary crop production of the peanut with acceptable yield levels.

Banik et al. (2009) indicated that the planting date plays an essential role in the peanut yield. The variations of planting dates may interact with differences in climatic conditions, particularly temperature degree, photoperiodicity, and relative humidity, which affect the physiological processes by performance and behavior of genotype. When climatic conditions are not suitable for the need of one of the yield components, it would negatively affect entire seed yield. Williams (2000) suggested that physiological processes (i.e., the pod-filling period and the rate of pod formation) are the best tools to explain the variation in peanut yield.

In particular, Azab (1996) found out that plant dry matter declined from 33.3 g plant^{-1} to 18.0 g plant^{-1} the planting date was delayed from April to June. The yields of plant components and their respective rates of flower, peg, and pod numbers were significantly affected by planting date in other experiments too (Kasai et al., 1999). Naab et al. (2005) indicated that early planting produced 20 % to 50 % greater pod yield than late planting. Canavar & Kaynak (2008) reported that the suitable planting date was May 20 for Aydın (in the east of Turkey). Caliskan et al. (2008) reported that the sowing date significantly affected the number of pods per plant, pod yield, shelling percentage, and 100 seeds weight in peanut. They obtained the highest pod number when the sowing date was on May 15. Shaban et al. (2009) reported that planting peanuts on May 8 resulted in the highest number of pods, weight of pods, weight of seeds per plant, shelling percentage, and pod and seed indices, compared to that plants planted on March 27, April 17, May 8, May 29, June 19, and July 10. Al-Ubaidi & Al-Obidy (2011) indicated that the early sowing of peanuts (April 1 and April 15) resulted in 23.3 % higher oil content compared to later dates. Bala et al. (2011) found that delaying peanut sowing from mid-June to mid-July caused a 27.3 % decline in the number of formed pods per plant.

Crop management practices such as variety selection, time of sowing, and duration of variety's life cycle may influence peanut's growth, yield, and seed quality. Sowing date is a vital production aspect that can be manipulated to counter the adverse environmental effects (Mozingo et al., 1991). Determining the optimum planting date for peanuts to achieve maximum yield and grade has been a goal of many researchers. The objective of this study was to assess the effect of different sowing dates on pod yield and some agronomic characteristics of the 'Virginia'-type peanut cultivar 'Halisbey' and determine the optimum sowing date in the Mediterranean region.

Material and methods

Field experiments were conducted in 2018 and 2019 at the Experimental Farm of Agricultural Faculty, Cukurova University (Adana, Southern

Table 1. The climate conditions during the 2018–2019 growing period and long-term (LT) average (1929–2019).

Months	Average temperature (°C)			Precipitation (mm)			Relative humidity (%)		
	2018	2019	LT	2018	2019	LT	2018	2019	LT
March	16.8	13.8	13.4	38.2	93.0	65.1	71.6	69.0	65.2
April	20.1	17.0	17.5	33.0	61.4	51.1	61.2	67.0	60.1
May	24.4	24.1	21.7	25.6	2.6	47.1	62.8	57.6	63.2
June	26.4	27.1	25.6	27.0	13.8	20.5	70.2	68.7	70.2
July	29.1	28.4	28.2	0.0	28.0	6.2	69.8	68.8	67.5
August	29.7	29.6	28.7	0.0	0.0	5.5	68.8	68.0	68.5
September	27.9	27.3	26.1	1.2	0.0	17.6	63.6	62.1	65.4
October	22.9	24.2	21.6	64.0	22.8	42.4	58.6	61.6	60.3
November	16.9	18.5	15.8	23.4	22.2	71.1	64.1	69.3	67.4

Turkey, 36° 59′ N, 35° 18′ E, 23 m a.s.l.). In this research, a semi-spreading cultivar A. *hypogaea* 'Halisbey' from the 'Virginia' market type was used as plant material. This cultivar was registered by the Field Crops Department of the Faculty of Agriculture, Cukurova University in 2006. It is a medium late cultivar with large seeds and high yielding.

The soil texture was clay loam. The soil tests indicated a pH of 7.6 with high concentrations of K_2O and low concentrations of P_2O_5. The soil's organic matter and nitrogen content were very low. The lime content in the soil was 21.1%.

Adana province has a Mediterranean environment. In this region, winters are mild and rainy, whereas summers are dry and warm, typical for the Mediterranean climate. The average monthly air temperature during the research period (March–November) varied from 16.8 °C to 29.7 °C in 2018, whereas it was from 13.8 °C to 29.6 °C in 2019. The average air temperature was higher during the research period in both years than the long-term average temperature. The total rainfall was 212.4 mm and 243.8 mm during the growing period in 2018 and 2019, respectively. The average relative humidity ranged from 58.6% to 71.6% in 2018 and from 57.6% to 69.3% – in 2019. The differences between the years and long-term climate data were low (Table 1).

The experiment had a randomized complete block design with three replications. 300 kg ha^{-1} of diammoniumphosphate (54 kg ha^{-1} of N and 138 kg ha^{-1} of P_2O_5) fertilizer was applied and incorporated into the soil before planting. Urea (46% of N) at the rate of 400 kg ha^{-1} was used two times; before first (beginning of flowering) and third (pod formation) irrigations (200 kg ha^{-1} and 200 kg ha^{-1}, respectively) each year. Plot size was 2.8 × 5.0 m (14.0 m^2). Spacing between rows and plants was 70 and 15 cm, respectively. Before sowing, the seeds were treated with fungicide (80% of Thiram) at the rate of 4 g kg^{-1} to prevent the crown rot. Two seeds per hill were sown, and 20 days later seedlings were thinned to one plant per hill. The seeds were sown by hand with a ten-day interval starting from the end of March (March 28, April 8, April 18, April 28, May 8, May 18, and May 28) on seven different dates each year (Table 2).

During the growing period, recommended pesticides and fungicides were applied at proper time intervals to control insects and diseases. Sprinkler irrigation was applied at ten-day intervals to maintain soil moisture close to field capacity. The remaining cultural practices, such as inter-row cultivation and weed control, were used during the growing period. The plants were harvested by hand 160 days after sowing (starting from September 8) each year.

At the harvest time, all pods from each plot were harvested from inter two rows (1.4 × 5.0 = 7 m^2) and air-dried until 9% moisture. After that, the total pod yield per plot was calculated. Twenty plants were randomly selected from plots at the harvesting times, and the number of pods per plant, pod weight

Table 2. Sowing and harvesting dates.

Nr	Sowing dates	Harvesting dates
1	March 28	September 8
2	April 8	September 18
3	April 18	September 28
4	April 28	October 8
5	May 8	October 18
6	May 18	October 28
7	May 28	November 8

per plant, 100 seeds weight, and shelling percentage of plots were recorded. Pod yield per hectare was calculated using the plot yield. Kernel yield per hectare was calculated as the pod yield per hectare × shelling percentage (Rasekh et al., 2010).

The oil was extracted from peanut seeds using a Soxhlet extractor to determine the oil content. The oil percentage was estimated according to AOAC (2010). Nitrogen percentage in seeds was assessed using the micro-Kjeldahl method according to AOAC (2010). Protein percentage was calculated according to the following equations: protein percentage = nitrogen percentage (N, %) × 6.25.

The collected data on different parameters were statistically processed to stress the significance level using JMP 8.1.0 package with a split-plot design. The means differences were compared with the Least Significant Differences (LSD, 5%).

Results and discussion

Pod number

The pod number varied from 23.2–42.1 pods plant^{-1} in 2018 to 24.1–42.9 pods plant^{-1} in 2019 with 23.7–42.5 pods plant^{-1} on a two-year average (Table 3). The differences between the sowing dates for the pod number per plant were statistically significant. Pod number per plant increased when the sowing date was delayed from March 28 to May 8, and then it started to decrease after May 18. According to a two-year average, the number of pods per plant increased from 23.7 pods plant^{-1} to 42.5 pods plant^{-1} as sowing was delayed from March 28 to May 8, and then it decreased to 31.2 pods plant^{-1} at the experiment variant with May 28 sowing date. Pod number per plant was the highest (42.5 pods plant^{-1}) on May 8 and the lowest (23.7 pods plant^{-1}) in the earliest sowing period (March 28) on a two-year average.

Kasai et al. (1999) reported that the peg and pod numbers in peanuts were significantly affected by planting date. Mortley et al. (2004) indicated that the air temperature affects the pod number per plant. While the pod number was the lowest at the temperature of 20 °C / 16 °C (day / night), it increased to a maximum at the temperature of 28 °C / 24 °C, and then it started to decrease when the temperature reached 32 °C / 28°C. Caliskan et al. (2008) reported that the sowing date significantly affected the number of pods per plant, pod yield, shelling percentage, and 100 seeds weight in peanut. Authors registered the highest pod number when the sowing date was on May 15. Sogut et al. (2016) indicated that pod number per plant declined by 42% when the sowing date was delayed from April 15 to June 25. Similar tendencies were observed by Canavar & Kaynak (2008) and Sarkees (2015).

Pod weight

The differences between the sowing dates for the pod weight per plant were statistically significant (Table 3). The pod weight per plant varied between 48.6 g plant^{-1} and 84.5 g plant^{-1} in 2018, between 51.4 g plant^{-1} and 77.0 g plant^{-1} in 2019, and between 50.0 g plant^{-1} and 80.7 g plant^{-1} in a two-year average. Pod weight per plant increased as sowing was delayed from March 28 to May 8, and then it started to decrease after May 18 in both study years. The earliest sowing date produced the lowest pod weight per plant in both years. The pod weight per plant showed a similar trend with pod numbers in both years. According to a two-year average, the highest pod weight was obtained from May 8 sowing date. While the pod weight per plant was 50.0 g plant^{-1} at the March 28 sowing date, it increased to 80.7 g plant^{-1} at the May 8 sowing date, and then it decreased to 63.0 g plant^{-1} at the May 28 sowing date. As a two-year average, pod weight per plant was increased by 61.4% when the sowing date was delayed from March 28 to May 8, and then it decreased by 21.9% as the sowing date was delayed from May 8 to May 28.

Table 3. The effect of sowing dates on pod number and pod weight per plant in peanut production.

Sowing dates	Pod number (pods plant^{-1})			Pod weight (g plant^{-1})		
	2018	2019	Two-year average	2018	2019	Two-year average
March 28	23.2 ^{d}	24.1 ^{e}	23.7 ^{e}	48.6 ^{e}	51.4 ^{d}	50.0 ^{e}
April 8	23.8 ^{d}	24.3 ^{e}	24.0 ^{de}	63.6 ^{cd}	61.4 ^{c}	62.5 ^{d}
April 18	26.1 ^{d}	27.4 ^{d}	26.7 ^{d}	72.8 ^{bc}	64.5 ^{bc}	68.6 ^{c}
April 28	32.9 ^{bc}	34.1 ^{c}	33.5 ^{c}	77.3 ^{ab}	68.6 ^{b}	73.0 ^{bc}
May 8	42.1 ^{a}	42.9 ^{a}	42.5 ^{a}	84.5 ^{a}	77.0 ^{a}	80.7 ^{a}
May 18	36.3 ^{b}	38.5 ^{b}	37.4 ^{b}	76.3 ^{ab}	74.7 ^{a}	75.5 ^{b}
May 28	30.7 ^{c}	31.6 ^{c}	31.2 ^{c}	61.3 ^{d}	64.7 ^{bc}	63.0 ^{d}
LSD (5%)	3.57	2.94	2.96	9.29	4.79	5.14

Note. The means of different combinations with the same lowercase letters are not significantly different at P≤0.05.

Baldwin (2005) indicated that the planting date plays an essential role in the peanut yield. The variations of planting dates may interact with differences in climatic conditions, particularly temperature degree, photoperiodicity, and relative humidity. Together they affect the plant physiological processes. When climatic conditions are not suitable for the needs of one of the yield components, they negatively affect the entire yield. Azab (1996) found out that plant dry matter declined from 33.3 g plant^{-1} to 18.0 g plant^{-1} when delaying the planting date from April to June. Abouziena et al. (2013) found that delaying planting from the middle of April to the midle of May also decreased the number and weight of pods per plant and seed yield by 20.1%, 19.5%, and 18.7%, respectively, compared to early sowing.

Shelling percentage

As shown in Table 4, shelling percentage values varied between 63.11% and 69.37% in 2018, between 64.83% and 71.00% in 2019, and between 63.97% and 70.19% on a two-year average. The differences between the sowing dates for the shelling percentage were found significant. The shelling rate was increased by delaying of sowing date until May 8, and then it started to reduce in both years. According to a two-year average, the shelling percentage increased from 63.97% to 70.19% when the sowing date was delayed from March 28 to May 8, and then it decreased by 67.80% at the May 28 sowing date. Hence, according to a two-year average, the highest shelling percentage was obtained at May 8 sowing date.

Cox (1979), Ketring (1984), and Caliskan et al. (2008) indicated that optimal mean air temperature for reproductive growth of peanuts ranges from 22°C to 24°C. The optimum diurnal air temperature for photosynthesis of peanuts varies from 30°C to 35°C. If the day temperature is above 35°C during the pod filling period, it reduces dry matter production (Caliskan et al., 2008). The high air temperature negatively influences the shelling percentage of peanuts.

For the early sowing dates (April), the pod filling period was between July 15 and August 15. During this period, the temperature was high, differences between the day and night temperatures were close, and the balance between photosynthesis and respiration was low. For these reasons, pods were not well developed, and the shelling percentage was low at the early sowing date. For the May 8 sowing date, the pod filling period was between September 15 and October 15. The night temperature was lower on this date, and dry matter consumption by respiration was low too. For this reason, the shelling percentage was the highest in case of sowing date of May 8. Similarly, Abouziena et al. (2013) found that the shelling rate increased as the sowing was delayed from April 15 to May 1.

Table 4. The effect of sowing date on shelling percentage and 100 seeds weight in peanut production.

Sowing dates	Shelling percentage (%)			100 seed weight (g)		
	2018	2019	Two-year average	2018	2019	Two-year average
March 28	63.11 ^{d}	64.83 ^{d}	63.97 ^{d}	116.9 ^{d}	113.8 ^{d}	115.4 ^{e}
April 8	64.81 ^{cd}	66.36 ^{cd}	65.59 ^{cd}	123.8 ^{c}	119.6 ^{c}	121.7 ^{d}
April 18	66.66 ^{bc}	68.24 ^{bc}	67.45 ^{bc}	127.0 ^{b}	123.6 ^{b}	125.3 ^{c}
April 28	68.05 ^{ab}	69.63 ^{ab}	68.84 ^{ab}	129.4 ^{b}	125.3 ^{b}	127.4 ^{b}
May 8	69.37 ^{a}	71.00 ^{a}	70.19 ^{a}	135.6 ^{a}	134.0 ^{a}	134.8 ^{a}
May 18	67.58 ^{ab}	69.16 ^{ab}	68.37 ^{ab}	127.9 ^{b}	124.4 ^{b}	126.1 ^{bc}
May 28	66.09 ^{bc}	69.51 ^{ab}	67.80 ^{bc}	122.5 ^{c}	119.7 ^{c}	121.1 ^{d}
LSD (5%)	2.59	2.27	2.37	2.60	3.12	1.47

Note. The means of different combinations with the same lowercase letters are not significantly different at P≤0.05.

100 seed weight

As shown in Table 4, 100 seeds weight was 116.9–135.6 g in 2018, 113.8–134.0 g in 2019, and 115.4–134.8 g on a two-year average. The differences between the sowing dates for the 100 seeds weight were statistically significant in both years. According to a two-year average, 100 seeds weight was the lowest at the early sowing date (March 28), and it increased to the highest value on May 8 sowing date, and after that, it reduced at May 28 sowing date.

Gulluoglu et al. (2018) indicated that 100 seeds weight was increased at the late sowing date (in secondary crop) due to lower air temperature and lower dry matter consumption by the respiration during the pod filling period. Similarly, Caliskan et al. (2008) reported that the 100 seeds weight of the peanut was increased with a delay of the sowing date. Gulluoglu et al. (2016, 2017) and Arioğlu et al. (2016) reported that the 100 seed weight of the peanut varied between 112.52 g and 138.05 g depending on the growing period and cultivars. Laurence (1983) indicated that the average 100 seed weight increased from 85.9 g to 89.5 g by late sowing. Sarkees (2015) reported that the 100 seed weight increased from 25.8 g to 37.4 g when the planting was delayed from April 22 to June 3. Onat et al. (2017) reported that the 100 seeds weight of A. *hypogaea* 'Halisbey' varied between 121.4 g and 138.5 g. While the 100 seeds weight was 73.0 g on April 15, it grew to 97.1 g at the June 15 sowing date.

Oil content

The oil content varied from 43.02% to 47.67% in 2018, from 44.16% to 48.40% in 2019, and from 43.59% to 48.04% on a two-year average at the different sowing dates (Table 5). The differences between the sowing dates for the oil content were significant. The oil content decreased with a delay of the sowing date in both years. According to a two-year average, the oil percentage decreased from 47.91% to 43.59% when the sowing date was delayed from March 28 to May 28. Hence, the highest oil percentage was obtained on March 28 sowing date.

Isleib et al. (2008) and Arioğlu et al. (2018) noted that the oil content is an important characteristic of peanut seeds. The oil content of peanut seeds is affected by environmental and genetic factors and the interaction of both. Sardana & Kandhola (2007) indicated that the increases of oil content in early sowing dates could be attributed to the increment in temperature compared to late sowing dates, which is also associated with the formation of seed and seed-filling stage. Holaday & Pearson (1974) found that higher temperatures during the last four weeks before harvest resulted in higher oil content. Abouziena et al. (2013) and Gulluoglu et al. (2016) indicated that early sowing resulted in significantly more oil production. Gulluoglu et al. (2017) reported that the oil content of peanut cultivars varied between 46.97% and 51.52% in the primary crop, and between 43.52% and 50.48% in

Table 5. The effect of sowing date on oil and protein content in peanut production.

Sowing dates	Oil content (%)			Protein content (%)		
	2018	2019	Two-year average	2018	2019	Two-year average
March 28	47.67 [a]	48.40 [a]	48.04 [a]	23.84 [d]	23.21 [e]	23.52 [e]
April 8	47.56 [a]	48.27 [a]	47.92 [a]	24.58 [d]	24.04 [d]	24.31 [d]
April 18	46.58 [b]	47.52 [a]	47.05 [b]	25.64 [c]	25.25 [c]	25.44 [c]
April 28	45.20 [c]	46.29 [b]	45.74 [c]	26.47 [b]	26.26 [b]	26.36 [b]
May 8	44.42 [cd]	45.32 [c]	44.87 [d]	26.54 [b]	26.43 [b]	26.48 [b]
May 18	43.59 [de]	44.58 [cd]	44.08 [e]	27.15 [ab]	26.39 [b]	26.77 [b]
May 28	43.02 [e]	44.16 [d]	43.59 [e]	27.89 [a]	27.45 [a]	27.67 [a]
LSD (5%)	0.85	0.90	0.58	0.74	0.20	0.43

Note. The means of different combinations with the same lowercase letters are not significantly different at P≤0.05.

secondary crop growing season. Sogut et al. (2016) reported that sowing time affected the oil content of peanut varieties and early sowings resulted in higher oil content than late sowing. Asibuo et al. (2008) and Chowdhury et al. (2015) indicated that the oil content of peanut varieties varied in a range of 43.00-54.95% and 49.20-50.76%, respectively.

Protein content

As shown in Table 5, in our study the protein content varied from 23.84% to 27.89% in 2018, from 23.21% to 27.45% in 2019, and from 23.52% to 27.67% on a two-year average. The differences between the sowing dates for the protein content were statistically significant in both years, and the protein percentage increased with delaying the sowing date in both years. According to a two-year average, protein content was 23.52% at the early sowing date (March 28), and two months later (May 28) it increased to 27.67%. A negative correlation between the oil and protein percentage was observed. While the protein percentage increased, the oil percentage decreased with delaying the sowing date.

Asibuo et al. (2008) and Chowdhury et al. (2015) respectively indicated that the protein percentage in 'Virginia'-type peanut cultivars was 18.92–25.78% and 30.62–38.88%. Sogut et al. (2016) reported that the protein percentage increased with delaying the sowing date. While the protein percentage was 21.97% at the early sowing, it increased to 23.96% at the late sowing. Sogut et al. (2016) suggested that higher protein content in late sowing could be explained by a lack of seed maturation resulting in a shorter seed filling period. Results from mentioned reports on the effect of sowing date on protein content are consistent with our findings.

Pod yield

As can be seen from Table 6, pod yield varied between 4627–8041 kg ha^{-1} in 2018, 4736–8231 kg ha^{-1} in 2019, and 4681–8136 kg ha^{-1} on a two-year average. The differences between the sowing dates for the pod yield were statistically significant. The highest pod yield was obtained as a result of sowing on May 8, and the lowest was registered on March 28 sowing date. While the pod yield was 4681 kg ha^{-1} at the March 28 sowing date, it increased to 8136 kg ha^{-1} at the May 8 sowing date, and then it reduced to 5942 kg ha^{-1} on May 28, on a two-year average. The yield components such as pod number and pod weight per plant, 100 seeds weight, and shelling percentage values were the highest at the May 8 sowing date too (Tables 3 & 4). The environmental conditions were optimal for the growth and development of peanut plants and pod formation in case of sowing on May 8. On this sowing date, the dry matter production by photosynthesis was the highest, and its consumption by respiration was the lowest.

Table 6. The effect of sowing date on pod and kernel yield in peanut production.

Sowing dates	Pod yield (kg ha^{-1})			Kernel yield (kg ha^{-1})		
	2018	2019	Two-year average	2018	2019	Two-year average
March 28	4627 ^{e}	4736 ^{d}	4681 ^{d}	2914 ^{d}	3069 ^{e}	2991 ^{d}
April 8	6056 ^{cd}	6200 ^{c}	6128 ^{c}	3927 ^{c}	4116 ^{d}	4021 ^{c}
April 18	6927 ^{bc}	7091 ^{b}	7009 ^{b}	4624 ^{b}	4846 ^{bc}	4735 ^{b}
April 28	7356 ^{ab}	7530 ^{ab}	7443 ^{ab}	5013 ^{ab}	5251 ^{ab}	5132 ^{ab}
May 8	8041 ^{a}	8231 ^{a}	8136 ^{a}	5578 ^{a}	5844 ^{a}	5711 ^{a}
May 18	7264 ^{ab}	7282 ^{b}	7273 ^{b}	4908 ^{b}	5036 ^{b}	4972 ^{b}
May 28	5833 ^{d}	6051 ^{c}	5942 ^{c}	3853 ^{c}	4207 ^{cd}	4030 ^{c}
LSD (5%)	884.0	817.0	830.0	663.4	671.4	657.7

Note. The means of different combinations with the same lowercase letters are not significantly different at P≤0.05.

Caliskan et al. (2008) reported that the pod yield was 3.6 ton ha^{-1} in case of April 15 sowing, it increased to 4.8 ton ha^{-1} on May 15 sowing, and then it decreased to 3.9 ton ha^{-1} on June 15 in a Mediterranean environment (in Turkey). Canavar & Kaynak (2008) indicated that planting date influenced the pod yield. The pod yield decreased when the planting was delayed from May to June. They obtained the highest pod yield from sowing on 20–21 May. Bala et al. (2011) reported that pod and seed yields declined (for 44.9% and 45.2%, respectively) with a sowing delay from middle of June to the end of June or the middle of July. Similarly, Sarkees (2015) found out that the pod yield was higher at May 20 sowing date compared to April 22. The increase in pod yield on May 20 was attributed to the the number of pods and pod weight per plant.

Kernel yield

The kernel yield was 2914–5578 kg ha^{-1} in 2018, 3069–5844 kg ha^{-1} in 2019, and 2991–5711 kg ha^{-1} on a two-year average. The differences between the sowing dates for the kernel yield were statistically significant. The data for kernel yield showed a similar trend with pod yield in both years. According to a two-year average, the highest kernel yield was obtained in case of May 8 (5711 kg ha^{-1}) sowing date. While the lowest kernel yield (2991 kg ha^{-1}) – in case of March 28 sowing date. As a two-year average, kernel yield increased by 90.9% when the sowing date was delayed from March 28 to May 8 and then it decreased by 29.4% with further delaying the sowing date to May 28. Similar results were reported in several other publications (Caliskan et al., 2008; Canavar & Kaynak, 2008; Bala et al., 2011; Sarkees, 2015).

Conclusions

The agronomic characteristic yield of peanuts vary depending on growing conditions and varieties. The yield of peanuts is influenced by air temperature; the high air and soil temperature negatively affect pod yield. In this study, pod and kernel yield and yield components (i.e., pod number and pod weight per plant, 100 seeds weight, and shelling percentage) were the highest at the experiment variant sown on May 8. As a result, we can conclude the optimal sowing date for the 'Virginia'-type peanut cultivars in the Mediterranean environment (i.e., in Turkey) is a beginning of May.

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Вплив строків посіву на врожайність стручків та деякі агротехнічні та якісні характеристики арахісу сотру ‘Halisbey’ типу ‘Virginia’ у середземноморському середовищі

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Метою цього дослідження було визначити вплив різних строків посіву на врожайність та деякі агрономічні характеристики арахісу сорту “Halisbey” типу “Virginia”, а також визначити оптимальний термін його посіву в Середземноморському регіоні. Це дослідження проводилося у 2018 та 2019 роках на експериментальній дослідній ділянці сільськогосподарського факультету Університету Чукурова в Адані, Туреччина. Насіння сіяли в сім термінів: 28 березня, 8 квітня, 18 квітня, 28 квітня, 8 травня, 18 травня і 28 травня кожного року. Експеримент включав рандомізовану блокову конструкцію з трьома повтореннями. Рослини збирали через 160 днів після посіву, починаючи 8 вересня щороку. Досліджували кількість бобів та масу бобів на рослині, масу 100 насінин, відсоток лущення, вміст олії та білка, урожай бобів та ядер з гектара. В результаті кількість і маса бобів на рослину, маса 100 насінин, відсоток лущення, урожайність бобів і ядер виявились найвищими у дослідного варіанту з датою посіву 8 травня. У той час як вміст олії зменшувався через затримку строку посіву, вміст білка збільшувався. За середнім дворічним показником найвищу врожайність бобів (8136 кг га$^{-1}$) та врожайність ядер (5711 кг га$^{-1}$) було також отримано у дослідного варіанту з датою посіву 8 травня.

Ключові слова: *Arachis hypogaea*, арахіс, терміни посіву, урожайність, якісні характеристики, агротехнічні характеристики