41 Egypt. J. Agron. Vol. 47, No. 3, pp: 481 - 497 (2025)

Egyptian Journal of Agronomy

http://agro.journals.ekb.eg/

Influence of sowing dates on yield and its components on performance of new genotypes of soybean (*Glycine max* L.) in Middle and North Egypt

Sayed Ahmed Safina[1]; **Hashim Abdel-Lattif** [1]; **Mostafa Mohamed Soliman**[2] and **Esraa Eraky Hassan**[2*]

[1]*Agronomy Dept., Fac. of Agric., Cairo University, Egypt*

[2] *Legume Crops, FCRI, Agric. Res. Center, Egypt*

SOYA BEANS yields are influenced by numerous factors, including environmental conditions, location, and agricultural practices. Field experiments were conducted during the 2023 and 2024 summer seasons at Mallawi and Etai El Barood Agricultural Research Stations to evaluate the performance of five new soybean genotypes (H6 L198 "Misr 6", H10 L288 "Misr 10", H1 L3, H4 L4, H18 L54) compared to two standard cultivars (Crawford and Giza 111) under Three sowing dates (May 15, May 30, and June 15). The objective was to assess the interaction effects of genotype and sowing date on seed yield and its components. Results showed significant variation in pod number, seed number per pod, 100-seed weight, and overall yield depending on the genotype, sowing date, and location. The highest number of pods per plant and seed yield per plant and feddan were generally recorded for the Crawford cultivar sown on May 15 at Mallawi. At Etai, genotype H4 L4 sown on May 15 outperformed other entries. In contrast, late sowing on June 15 significantly reduced pod and seed production across genotypes, especially in H10 L288 and Giza 111. The highest 100-seed weight was observed in Crawford when sown early, while Giza 111 under late sowing produced the lowest weights. These findings highlight the importance of selecting appropriate genotypes and optimal sowing dates for maximizing soybean productivity in different agro-climatic zones. Early sowing of high-performing genotypes, particularly Crawford and H4 L4, are recommended to enhance yield potential under Egyptian conditions.

Keywords: Soybean, Environmental Conditions, Climate, Genotype Adaptation, Agronomic Performance.

Introduction

The Soybean (*Glycine max* L.) is a crucial legume crop globally, valued for its high protein and oil content, making it essential for human and animal nutrition as well as industrial processing is well-documented, with its high protein content, balanced essential amino acids, oil, and soluble sugar content (Sudaric *et al*., 2019). Soybean can also help maintain soil fertility (Ngalamu *et al*., 2013). Global statistics from USDA (2025) report that in 2024, soybean planted on approximately 146.43 million hectares worldwide, with a production of 420.67 million tons and an average yield of 2.87 tons per hectare. Photoperiod and temperature are critical factors influencing soybean growth and development, significantly restricting its cultivation range. Soybean are highly sensitive to temperature throughout their lifecycle, from germination to maturity (Cai *et al*., 2020). Optimal temperatures range from 15–22°C for emergence, 20–25°C for flowering, and 15–22°C for maturity (Liu *et al.,* 2008). Achieving high yields requires selecting suitable cultivars and implementing appropriate agricultural practices adapted to environmental conditions. Sowing date plays a vital role in determining yield and quality, as it affects both vegetative and reproductive growth. Genetic improvement and agronomic practices contribute equally to yield enhancement (Park *et al*., 1987; Mayers *et al*., 1991; Tyagi *et al.,* 2011 and Rowntree *et al*., 2013). Climate change further impacts agricultural productivity, making it essential to understand limiting environmental factors. Variations in precipitation, temperature,

*Corresponding author email: adebayoruth101@gmail.com - benteraky266@gmail.com
Received: 11/05/2025; Accepted: 15/06/2025
DOI: 10.21608/agro.2025.383894.1692

humidity, soil moisture, and photoperiod influence the plant's phenological stages, ultimately shaping soybean growth, maturation, and yield (Setiyono *et al.,* 2007; Divito *et al.,* 2016; Nico *et al*., 2019; Ali and Abdel-Aal, 2021). However, unfavorable climatic conditions during growth can significantly reduce yields. Selecting well-adapted genotypes is crucial for optimizing production, alongside the application of appropriate agricultural practices. Among these, sowing time plays a key role, as it influences plant growth and development by affecting environmental factors such as precipitation, temperature, soil moisture, and photoperiod, ultimately impacting yield and quality (Vidić *et al*., 2010 and Mandić *et al*., 2017).

In Egypt, climate change poses a significant threat to agricultural productivity, including soybean cultivation. The country is among the most vulnerable to rising temperatures and sea-level rise. Soybean is a short-day plant, but its response to photoperiod varies by genotype. Day length plays a crucial role in determining flowering, maturity, plant morphology, and seed yield, which are also influenced by planting date. Ultimately, soybean yield depends on the interaction between genetic potential and environmental conditions. Sadek *et al*. (2011) found that maize hybrids Gm 1, Gm 5, Gm 8, Gm 3, and Gm 4 outperformed the check hybrids in yield and earliness, showing stable performance across multiple locations. Similarly, Maamoun and Abd El Gawad (2013) reported that early peanut sowing (April 20th) significantly improved growth and yield traits, while late sowing (June 10th) led to consistently lower values over two seasons. Morsy *et al*. (2016) studied the impact of three planting dates on the seed yield and quality of ten soybean genotypes at Sakha Agricultural Research Station, Egypt, during the 2013 and 2014 summer seasons. Delaying planting from mid-May to mid-June reduced 100-seed weight (15.92 to 12.39 g) and seed yield (1.613 to 1.053 t/fed). However, it increased seed protein content (33.23% to 39.09%), while oil content declined (23.06% to 19.18%). Among genotypes, DR101 had the highest 100-seed weight (17.2 g), while Giza 111 produced the highest yield (1.625 t/fed). The study suggests that Giza 111, Toano, and DR101 maintain good seed quality when planted in early June, while early-maturing genotypes like H30, H32, and Giza 35 should be sown around mid-June for optimal viability.

Mandić *et al.* (2020) find that late sowing led to lower yields due to reduced pod number, seed weight, and 1000-seed weight, likely caused by accelerated senescence and adverse climatic conditions during seed filling. Proper genotype selection and sowing time optimize soil and water use, affecting both yield and seed composition, particularly under water stress.

Anjum *et al*. (2023) investigated the impact of different planting dates on the quantitative and qualitative traits of soybean in coastal environments. The study evaluated three sowing dates—mid-January, early February, and mid-February using three soybean varieties (NARC-I, NARC-II, and Rawal) in a CRD experiment. The results showed significant effects of planting date on growth, yield, and quality traits, as well as notable varietal differences in these parameters. Significant variations were observed in plant height, pods per plant, pod length, seed weight per plant, total biomass weight, harvest index, number of nodules per plant, protein content, and oil content across the different sowing dates. Early February sowing produced the highest biomass weight. The interaction of variety NARC-II with mid-February sowing resulted in the highest protein content, while NARC-II sown in early February yielded the highest oil content.

Genotype × sowing date interactions indicate that early sowing provides the best yield under favorable climatic conditions, with the potential for higher seed yield if optimal sowing times and genotypes are chosen (Setiyono *et al.,* 2006; Hu and Wiatrak, 2012). Izgı (2023) conducted a study in Mardin, Türkiye, during 2018 and 2019 to evaluate the effects of sowing dates on 12 soybean cultivars under double-cropping conditions. Four sowing dates were tested: April 16 and April 25 (main crop) and June 15 and June 30 (second crop). The highest seed yields were recorded for A-3127 (3700 kg/ha) and Gapsoy-16 (3694 kg/ha), while the highest oil yields were obtained from Arısoy, Gapsoy-16 (676 kg/ha each), A-3127, and Cinsoy (662 kg/ha each). Results indicated that early sowing increased yield, whereas late sowing reduced seed yield by an average of 30%. The study suggests that early-maturing cultivars should be used for second-crop production in regions with similar agricultural conditions to help address food and oil deficits. Given the increasing challenges posed by climate change, understanding the response of newly developed soybean genotypes to varying environmental factors is essential for improving crop resilience and ensuring sustainable agricultural practices. This study evaluates the impact of environmental conditions on the growth, yield, and physiological responses of selected soybean genotypes, contributing to the ongoing efforts in crop improvement and breeding programs.

Materials and Methods

Experimental site and climate-soil conditions.

A field experiments was conducted at the experimental farms of Malawi Agricultural Research Station, El-Mania Province Middle Egypt, and Etai-El Barood Agricultural Research Station, El-Behera Province, North Delta Egypt, during two successive summer seasons of 2023 and 2024. The location of the experimental site is illustrated in Fig.1.

Fig. 1. Location of the study area.

The soil physical, chemical properties and soil moisture constants at the experimental site, determined according to Jackson (1967), are listed in Tables 1. The minimum, maximum and mean daily temperature as well as relative humidity at monthly intervals during the growing seasons, are shown in Table 2.

Table 1. Some soil physical and chemical properties at the experimental sites in Malawi Agricultural and Etai-El Barood Research Station (means of 2023 and 2024 season).

Soil properties	Locations	
	Mallawi	Etai AL-Baroud
Particle size distribution (%)		
Clay	40.5	53.7
Sand	22.4	18.8
Silt	37.3	27.5
Textural class	Clay	Clay
OM%	0.89	0.68
CaCo3	0.92	3.15
pH (1:2.5)	7.71	7.8
EC (ds/m)	1.05	1.93
Soluble cations (meq/L)		
Ca++	1.3	6.12
Mg++	2.1	3.54
K+	0.14	1.56
Na+	1.6	8.17
Soluble anions (meq/L)		
Cl-	2	10.11
HCo3--	2.2	0.85
So4--	0.94	8.43

Experimental design and tested treatments:

A split plot design in a randomized complete block arrangement was used with three replications. The main plots were devoted to sowing dates (April 15, and June 15,30) and the sub-plots will be assigned to the soybean genotypes.

Soybean genotypes were obtained from Food Legume Research Department, Agricultural Research Center, and Giza, Egypt. Maturity group, growth habit and pedigree of those materials are presented in Table (3). The preceding crop was berseem in both growing seasons. The surface system, irrigation interval is used based.

Table 2. Meteorological values of long years (2023-2024) growing seasons in Malawi and Etai-El Barood.

Month	*Air temperature °C*								*Mean RH%*	
	Season 2023				**Season 2024**					
	Mallawi		**Etai-El Barood**		**Mallawi**		**Etai-El Barood**			
	Max	**Min**	**Max**	**Min**	**Max**	**min**	**max**	**Min**	**Mallawi**	**Etai**
January.	24.1	5.4	23.7	5.6	24.5	5.2	23.4	5.1	73	75
February	27.9	7.9	26.8	6.8	28.6	7.6	26.7	6. 5	60	62
March	30.1	9.7	28.2	8.9	30.5	9.4	27.6	8.4	54	58
April	31.5	12.4	29.3	11.7	32.1	11.7	28.5	10.7	52	55
May	35.1	12.6	32.9	10.8	34.5	11.8	32.1	8.8	53	58
June	40.2	12.7	38.2	11.3	39.5	12.3	37.4	10.7	67	69
July	38.5	14.7	35.7	12.7	38.7	15.3	34.8	11.4	72	72
August	38.1	16.3	35.8	14.5	37.9	16.7	34.6	15.4	68	70
September	37.4	18.6	34.9	14.2	37.7	18.9	34.5	13.7	70	71
October	36.4	16.4	34.5	12.6	35.5	16.6	33.7	11.8	68	70
November	29.2	13.5	28.5	12.2	28.2	13.6	27.1	10.9	75	77
December	27.9	7.9	26.7	10.9	27.9	7.9	26.4	8.9	82	83

Weather bureau station, RH%= relative humidity %

Table 3. Maturity group, growth habit and pedigree of soybean genotypes

Genotype	Pedigree	Maturity Group	Growth Habit
H6L198 (Misr 6)	Toano × Nena	IV	Indeterminate
H10 L288 (Misr 10)	N92-831 × Giza-111	IV	Indeterminate
H1 L3	H20 L3 × Gasoy-17	IV	Indeterminate
H4 L4	DR101 × Lamar	IV	Indeterminate
H18 L54	Crawford × Dekabig	IV	Indeterminate
Giza-111	Crawford × Celest	IV	Indeterminate
Crawford	USA Origin	IV	Indeterminate

IV: Maturity Group 4

Cultural practices

The experimental field was fertilized with phosphorus at rate of 30 kg P_2O_5 fedden^{-1} (calcium superphosphate 15.5% P_2O_5). A starter dose of 15 kg N feddan^{-1} in the form of urea (46.5% N) was added at sowing. Seed was inoculated with the specific Brady Rhizobium japonicum, 15 minutes before sowing. Sowing took place on Three sowing dates in hills 20 cm apart on both sides of the ridge in both seasons. Irrigation water was added to all plots immediately after seeding. Thinning was done two weeks after sowing at 2 seedlings hill^{-1} to attain the desired population of 140,000 plants fed^{-1}. Plots were kept weed-free throughout the growing seasons. The normal agricultural practices of growing soybean were followed.

Measurements of crop yield

1- Plant height (cm): It was measured from soil surface up to the top of leaf tip of the plant from ten plants randomly chosen from the central three ridges
2- Number of branches per plant
3- Number of pods per plant
4- Number of seeds per pod
5- Number of seeds per plant
6- Seed index (100-seed weight) was recorded for each plot).
7- Seed yield per plant (grams)
8- Seed yield per plot, which transformed to seed yield per feddan (ton) 1 feddan = 4200 m^2.

Statistical analysis

Test of normality distribution was carried out according to Shapiro and Wilk, method (1965), by using SPSS v. 27.0 (2020) computer packages. Combined analysis of variance of a split plot design arranged in RCBD across the two seasons was computed after carrying out Bartelt test according to Snedecor and Cochran (1994). Means of treatments were compared by least significant difference test (LSD) at 0.05 level of probability significance by used MSTAT-C program.

Results and Discussion

The following discussions of the results of all studied characteristics are based on combined analyses across two locations of Mallawi and Etai-El Barood and across 2023 and 2024 seasons.

1- Plant height (cm)

Results recorded in Tables (4 and 5) represent the means of plant height (cm) as affected by sowing date, soybean genotypes and interaction based on combination over the two locations of Mallawi and Etai-El Barood across 2023 and 2024 seasons.

a. Effect of sowing dates

The results indicated that sowing dates significantly affected plant height (cm) in both locations and seasons (Table 4). The mean plant height was significantly decreased due to late sowing. In general, the highest value of plant height was obtained from the early sowing on May 15th that reached to 112.69 cm at Mallawi and 102.31 cm in combined, but at Etai, the highest plant height was obtained from the mid sowing on May 30th, with the value of 93.10 cm, while plants sown on June 15th were shorter than those sown on May 15th that reached to 81 cm at Mallawi, 91.93 cm at Etai, and 90.44 cm in combined. These results may be attributed to the difference in the elongation of photo periods due to different planting dates. The variation in soybean plant height under different sowing dates can be explained by the interaction between environmental factors (such as temperature, photoperiod, and soil moisture) and the plant's growth cycle. Conversely, when planting is delayed, the soybean plants are exposed to shorter days and higher temperatures earlier in their development. These conditions can accelerate flowering and pod development (R1 stage), thereby reducing the duration of vegetative growth and resulting in shorter plants (Egli and Bruening, 2000). These results are in harmony with recorded by Zhang *et al*., (2015), Morsy *et al*., (2016) and Fordoński *et al*., (2023).

Table 4. Number of branches per plant and plant height of seven soybean genotypes as affected by sowing date and genotype combined over location and across 2023 and 2024 seasons.

Genotypes	Plant height (cm)			Number of branches/ plant		
	Mallawi	Etai	Combined	Mallawi	Etai	Combined
Sowing date (A)						
May 15th	112.69	92.74	102.31	3.21	1.34	2.27
May 30th	104.86	93.10	98.98	2.60	1.16	1.88
June 15th	81.00	91.93	86.87	1.91	0.87	1.39
LSD at $_{0.05}$	3.74	2.69	2.12	0.08	0.06	0.10
Soybean genotypes (B)						
H6 L198-Misr 6	92.17	88.72	90.44	2.79	1.16	1.98
H10 L288-Misr 10	100.83	85.17	93.00	2.99	0.99	1.99
H1 L3	98.56	100.94	99.75	2.52	1.17	1.84
H4 L4	109.67	87.28	98.47	2.31	1.29	1.80
H18 L54	105.22	88.28	96.75	2.13	1.00	1.56
Crawford	105.28	101.17	103.22	3.11	1.28	2.20
Giza 111	84.89	96.56	90.72	2.18	0.94	1.56
LSD at $_{0.05}$	4.42	3.30	2.74	0.16	0.18	0.12

b. Effect of soybean genotype

The results indicated that soybean genotype significantly affected plant height (cm) in both locations and seasons (Table 4). The tallest plants were obtained from Crawford cultivar that reached to 105.28 cm at Mallawi, 101.17 cm at Etai and 103.22 cm in combined, while plants of H6 L198-Misr 6 genotype were the shortest that reached to 92.17 cm at Mallawi and 90.44 cm in combined, but at Etai, the shortest plants were obtained from the genotype H10 L288-Misr 10 with the value of 85.17 cm. Plant height in soybean is a complex trait influenced by genetic makeup and environmental factors. Different genetic structures, or *genotypes*, show variation in plant height due to differences in the specific alleles they carry at key loci controlling growth. These results are Agree with those obtained by Suo *et al.,* (2021), Yang *et al.*, (2021) and Amoanimaa-Dede *et al*., (2022).

a. ***Effect of (sowing date × soybean genotype) interaction:***

Results recorded in Table (5) showed clearly that the means of plant height as affected by (sowing date × soybean genotype) Interaction based on combination over the two locations of Mallawi and Etai-ElBarood in 2023 and 2024 seasons.

The results indicated that interaction between soybean genotype and sowing date significantly affected plant height (cm) in both locations and seasons. The tallest plants were obtained from Crawford cultivar sown on May 15th that reached to 101 cm at Etai and 109.33 cm in combined, but at Mallawi, the tallest plants were obtained from H4 L4 genotype with the value of 124.17 cm, while plants of Crawford cultivar were the shortest that reached to 66.67 cm at Mallawi, 82.5 at Etai and 74.58 cm in combined, in both growing seasons. Late sowing typically shortens the vegetative period, leading to reduced plant height, especially in photoperiod-sensitive genotypes. Soybean genotypes vary in their sensitivity to photoperiod. Early or delayed sowing changes the day length and temperature conditions during key growth stages, affecting internode elongation and node development differently across genotypes. These results are in accordance with those obtained by Zhang *et al*., (2015), Morsy *et al*., (2016) and Fordoński *et al*., (2023).

Table 5. Number of branches per plant and plant height of seven soybean genotypes as affected by sowing date, genotype and their interaction combined over location and across 2023 and 2024 seasons.

Sowing date (A)	Soybean genotypes (B)	Plant height (cm)			Number of branches / plant		
		Mallawi	Etai	Combined	Mallawi	Etai	Combined
May 15th	H6 L198-Misr 6	101.67	83.67	92.67	3.53	1.43	2.48
	H10 L288-Misr 10	107.00	83.83	95.42	3.48	1.27	2.38
	H1 L3	107.67	102.83	105.25	2.97	1.38	2.18
	H4 L4	124.17	86.00	105.08	2.88	1.52	2.20
	H18 L54	128.00	84.83	106.42	2.70	1.23	1.97
	Crawford	117.67	101.00	109.33	4.07	1.42	2.74
	Giza 111	102.67	101.33	102.00	2.85	1.10	1.98
May 30th	H6 L198-Misr 6	99.33	85.00	92.17	2.70	1.18	1.94
	H10 L288-Misr 10	109.83	83.33	96.58	3.05	1.07	2.06
	H1 L3	101.83	103.33	102.58	2.58	1.07	1.83
	H4 L4	114.17	86.67	100.42	2.30	1.60	1.95
	H18 L54	109.17	85.83	97.50	2.10	0.90	1.50
	Crawford	114.33	101.67	108.00	3.15	1.27	2.21
	Giza 111	85.33	105.83	95.58	2.35	1.03	1.69
Jone 15th	H6 L198-Misr 6	75.50	97.50	86.50	2.15	0.87	1.51
	H10 L288-Misr 10	85.67	88.33	87.00	2.43	0.65	1.54
	H1 L3	86.17	96.67	91.42	2.00	1.07	1.53
	H4 L4	90.67	89.17	89.92	1.73	0.77	1.25
	H18 L54	78.50	94.17	86.33	1.58	0.87	1.23
	Crawford	83.83	100.83	92.33	2.12	1.17	1.64
	Giza 111	66.67	82.50	74.58	1.35	0.68	1.02
LSD at *0.05*		4.74	5.72	4.74	0.29	0.31	0.213

2- Number of branches per plant

Results recoded in Tables (4 and 5) represent the means of number of branches per Plant as affected by sowing date, soybean genotypes and interaction based on combination over the two locations of Mallawi and Etai-ElBarood in 2023 and 2024 seasons.

b. Effect of sowing dates

The results indicated that sowing dates significantly affected number of branches per plant in both locations and seasons. The mean number of branches per plant was significantly decreased in late sowings. In general, the highest number of branches per plant was obtained from the early sowing on May 15th that reached to 3.21 at Mallawi, 1.34 at Etai, and 2.27 branches in combined, while plants sown on June 15th were lower branched than those sown on May 15th that reached to 1.91 at Mallawi, 0.87 at Etai, and 1.39 branches in combined. These results may be attributed to the difference in the elongation of photo periods due to different planting dates. Soybean is a photoperiod-sensitive crop. Early or late sowing changes the length of daylight and temperature conditions during key growth stages. These results are in accordance with obtained by Ewais (2021); she found that the date (1st June) gave the highest values in plant length, number of branches/plant and stem length in both seasons, number of branches/plant in the first season. However, the sowing date (1st April) significantly increased the 100 green seeds weight and net ratio of green pods in both seasons too. But the sowing date (1st May) gave a significant effect on green pod number of green pod/plant, total yield of green pod.

c. Effect of soybean genotypes

The results indicated that soybean genotypes significantly affected number of branches per plant in both locations and seasons. The highest number of branches per plant was obtained from Crawford cultivar that reached to 3.11 at Mallawi, 1.34 and 2.27 branches in combined, but at Etai, the highest number of branches per plant was obtained from H4 L4 genotype that its plants reached to 1.29 branches, while plants of H18 L1 genotype was the lowest branched that reached to 2.13 at Mallawi, the lowest branched genotype at Etai was Giza 111 cultivar that reached to 0.94 branches and in combined, both H18 L1 genotype and Giza 111 cultivar were the lowest branched genotypes that attained 1.56 branches each. Genotypic variation significantly influences branch number through several biological and genetic mechanisms and also, differences in genotypes influence the activity of axillary meristems, which are responsible for branch formation. These results are in harmony with recorded by Hassan *et al.* (2002).

c. ***Effect of (sowing date × soybean genotype) interaction:***

The data of Table (5) represent the means of number of branches per plant as affected by (sowing date × soybean genotype) interaction based on combination over the two locations of Mallawi and Etai-ElBarood in 2023 and 2024 seasons. The results indicated that the interaction between soybean genotype and sowing date significantly affected number of branches per plant in both locations and seasons. The highest number of branches per plant were resulted from Crawford cultivar sown on May 15th that its plants reached to 4.07 at Mallawi, and 2.74 branches in combined, but H4 L4 genotype sown on May 30th was the highest branched genotype at Etai that its plants reached to 1.6 branches, while Giza 111 cultivar was the lowest branched genotype sown on June 15th that their plants reached to 1.35 branches at Mallawi, and 1.02 branches in combined, but the lowest branched genotype at Etai sown on June 15th was H10 L288-Misr 10 that its plants reached to 41.5 branches, in both growing seasons. The number of branches per soybean plant is a critical trait influencing overall plant architecture and yield potential. This trait is affected not only by genetic factors (genotype) but also by environmental conditions, particularly the sowing date. These results are in agreement with those obtained by Khalil *et al.* (2011) Out of ten studied soybean yield and yield component traits, 7 traits were significantly affected by seasonal variations. Air temperatures and relative humidity during the growing periods indicated that the 2010 season was characterized by higher temperatures and RH.

3- Number of pods per plant

Results recoded in Tables (6 and 7) illustrated that the means of number of pods per Plant as affected by sowing date, soybean genotypes and interaction based on combined analyses across the two locations of Mallawi and Etai-El Barood in 2023 and 2024 seasons.

a. Effect of sowing date

Results recoded in Table (6) showed clearly that sowing dates significantly affected number of pods per plant in both locations and seasons. The mean number of pods per plant was significantly decreased in late sowings. In general, the highest number of pods per plant was obtained from the early sowing on May 15^{th} that reached to 56.17 pods at Mallawi, 55.18 at Etai, and 55.68 pods in combined, while plants sown on June 15^{th} carried lower number of pods than those sown on May 15^{th} that reached to 35.27 pods at Mallawi, 42.43 pods at Etai, and 38.85 pods in combined. These results may be attributed to the difference in the elongation of photo periods due to different planting dates. These results are in accordance with those obtained by Mandić *et al.* (2020).

b. Effect of soybean genotype

The results indicated that soybean genotypes significantly affected number of pods per plant in both locations and seasons (Table 6). The highest number of pods per plant was obtained from Crawford cultivar that reached to 56.38 pods at Mallawi, 53.9 pods at Etai and 57.09 pods in combined, while plants of the genotype H18 L54 carried the lowest number of pods per plant in combined that reached to 43.95 pods, genotype H4 L4 at Mallawi, with the value of 41.14 pods and H10 L288-Misr 10 genotype at Etai, with the value of 40.54 pods in both growing seasons. These results are in harmony with recorded by Khalil *et al.* (2011) .

c. Effect of (sowing date × soybean genotype) interaction

The data in Table (7) represent the means of number of pods per Plant as affected by (sowing date × soybean genotype) interaction based on combined analyses across the two locations of Mallawi and Etai-El Barood in 2023 and 2024 seasons.

The results illustrated that the interaction between soybean genotype and sowing date significantly affected number of pods per plant in both locations and seasons. The highest numbers of pods per plant were resulted from Crawford cultivar sown on May 15th that its plants reached to 70.15 pods at Mallawi, and 65.31 pods in combined, but H4 L4 genotype sown on May 15th was the highest pods genotype at Etai that its plants reached to 68.52 pods, while the plants of Giza 111 cultivar caried the lowest number of pods that sown on June 15th and their plants reached to 29.18 pods at Mallawi, and 34.2 pods in combined, but the lowest branched genotype at Etai sown on June 30th was Misr 10 that its plants reached to 33.27 pods, in both growing seasons. These results are in accordance with those obtained by Izgı (2023).

Table 6. Number of pods per plant and number of seeds per pod of seven soybean genotypes as affected by sowing date and genotype combined across location in 2023 and 2024 seasons.

	Number of pods/plant			Number of seeds/pod		
	Mallawi	**Etai**	**Combined**	**Mallawi**	**Etai**	**Combined**
Sowing date (A)						
May 15th	56.17	55.18	55.68	2.34	2.86	2.60
May 30th	50.01	53.11	51.56	2.59	2.89	2.74
June 15th	35.27	42.43	38.85	3.39	3.14	3.26
LSDat $_{0.05}$	0.74	6.22	2.885	0.07	0.28	0.138
Soybean genotypes (B)						
H6 L198-Misr 6	50.13	57.46	53.79	2.41	2.91	2.66
H10 L288-Misr 10	51.95	40.54	46.25	2.43	3.07	2.75
H1 L3	42.58	46.48	44.53	2.72	2.90	2.81
H4 L4	41.14	53.24	47.19	3.17	3.21	3.19
H18 L54	45.65	42.26	43.95	3.11	3.15	3.13
Crawford	56.38	57.79	57.09	2.48	2.92	2.70
Giza 111	42.24	53.90	48.07	3.08	2.58	2.83
LSD at $_{0.05}$	**2.35**	**5.10**	**2.791**	**0.14**	**0.33**	**0.180**

4- Number of seeds per pod

a. Effect of sowing date

The results showed that sowing dates significantly affected number of seeds per pod in both locations and seasons (Table 6). The mean number of seeds per pod was significantly increased in late sowings. In general, the highest number of seeds per pod was obtained from the late sowing on June 15th that reached to 3.39 seeds at Mallawi, 3.14 seeds at Etai, and 3.26 seeds in combined, while plants sown on May 15thcaried pods with lower number of seeds than those sown later that reached to 2.34 seeds at Mallawi, 2.86 seeds at Etai, and 2.6 seeds in combined. These results may be attributed to the difference in the elongation of photo periods due to different planting dates. These results are in agreement with those obtained by Anjum *et al.* (2023) .

b. Effect of soybean genotype

The results indicated that soybean genotype significantly affected number of seeds per pod in both locations and seasons (Table 6). The highest number of seeds per pod was obtained from the genotype H4 L4 that reached to 3.17 seeds at Mallawi, 3.21 seeds at Etai and 3.19 seeds in combined, while plants of the genotype Misr 6 carried pods with the lowest number seeds at Mallawi that reached to 2.41 seeds and in combined that reached to 2.66 seeds, but the plants of Giza-111 cultivar at Etai carried pods with the lowest number seeds with the value of 2.58 seeds in both growing seasons. These results are in harmony with recorded by Morsy *et al.* (2016).

c. Effect of (sowing date × soybean genotype) interaction:

Results recoded in Table (7) showed clearly that average the means of number of number of seeds per pod as affected by (sowing date × soybean genotype) interaction based on combined analyses across the two locations of Mallawi and Etai-El Barood in 2023 and 2024 seasons.

Table 7. Number of pods per plant and number of seeds per pod of seven soybean genotypes as affected by sowing date, genotype and their interaction combined across location in 2023 and 2024 seasons.

Sowing date (A)	Soybean genotypes (B)	Number of pods/plant			Number of seeds/pod		
		Mallawi	Etai	Combined	Mallawi	Etai	Combined
May 15th	H6 L198-Misr 6	60.18	59.05	59.62	2.22	2.67	2.44
	H10 L288-Misr 10	59.80	46.67	53.23	2.27	2.99	2.63
	H1 L3	49.88	54.22	52.05	2.53	2.91	2.72
	H4 L4	49.15	68.52	58.83	2.47	2.88	2.67
	H18 L54	56.02	42.45	49.23	2.39	2.98	2.68
	Crawford	70.15	60.47	65.31	2.12	3.05	2.58
	Giza 111	48.03	54.87	51.45	2.38	2.58	2.48
May 30th	H6 L198-Misr 6	51.63	57.33	54.48	2.31	2.88	2.60
	H10 L288-Misr 10	56.83	41.70	49.27	2.43	3.03	2.73
	H1 L3	44.80	47.13	45.97	2.59	2.88	2.74
	H4 L4	41.97	54.88	48.43	3.06	3.31	3.18
	H18 L54	46.10	42.07	44.08	2.99	3.25	3.12
	Crawford	59.23	61.02	60.13	2.34	2.49	2.42
	Giza 111	49.52	67.62	58.57	2.39	2.36	2.37
Jone 15th	H6 L198-Misr 6	38.57	56.00	47.28	2.72	3.16	2.94
	H10 L288-Misr 10	39.22	33.27	36.24	2.59	3.20	2.90
	H1 L3	33.05	38.10	35.58	3.04	2.92	2.98
	H4 L4	32.30	36.32	34.31	3.98	3.45	3.71
	H18 L54	34.83	42.25	38.54	3.96	3.21	3.59
	Crawford	39.77	51.88	45.83	2.99	3.21	3.10
	Giza 111	29.18	39.22	34.20	4.47	2.82	3.64
LSDat $_{0.05}$		4.08	8.84	4.84	0.24	0.58	0.31

The results indicated that the interaction between soybean genotype and sowing date significantly affected number of seeds per pod in both locations and seasons (Table 7) . The highest numbers of seeds per pod were resulted from the plants of Giza 111 cultivar sown on June 15th that its pods with 4.47 seeds at Mallawi, but H4 L4 genotype sown on June 15th caried pods with the highest numbers of seeds at Etai that its plants pods reached to 3.45 seeds, and 3.71 seeds in combined, while the lowest numbers of seeds per pod were resulted from H6 L198-Misr 6 genotype that sown on May 15th and their plants reached to 2.22 seeds at Mallawi, and from Giza 111 cultivar sown on June 30th both at Etai with 2.37 seeds and in combined, with 2.36 seeds, in both growing seasons. These results revealed that numbers of seeds per pod is very sensitive to that the interaction between soybean genotype and sowing date. These results are in accordance with those obtained by (Setiyono *et al.,* 2007; Divito *et al.,* 2016; Nico *et al.,* 2019).

5- Number of seeds per plant

Results recorded in Tables (8 and 9) showed clearly that the means of number of seeds per plant of as affected by sowing date, soybean genotype and interaction based on combined analyses across the two locations of Mallawi and Etai-El Barood in 2023 and 2024 seasons.

a. Effect of sowing date

The results illustrated that sowing dates significantly affected number of seedsper plant in both locations and seasons (Table 8). The mean number of seeds per Plant was significantly decreased in late sowings. In general, the highest number of seeds per plant was obtained from the early sowing on May 15th that reached to 132.02 seeds at Mallawi, 150.88 seeds at Etai, and 141.45 seeds in combined, while plants sown on June 15th caried lower number of seeds than those sown on May 15th that reached to 111.42 seeds at Mallawi, 130.54 seeds at Etai, and 120.98 seeds in combined. These results may be attributed to the difference in the elongation of photo periods due to different planting dates. These results are in harmony with recorded by (Cai *et al*., 2020).

b. Effect of soybean genotype

The results indicated that soybean genotype significantly affected number of seeds per Plant in both locations and seasons (Table 8). The highest number of seeds per plant was obtained from Crawford cultivar that reached to 135.35 seeds at Mallawi and 146.54 seeds in combined, but at Etai, the genotype H4 L4 attained the highest number of seeds per plant with 161.97 seeds, while plants of the genotype H1 L3 carried the lowest number of seeds per plant at Mallawi, with 114.51 seeds, Giza 111 cultivar at Etai, with the value of 120.18 seeds and in combined with the value of 118.97 seeds in both growing seasons. These results are in agreement with those obtained by Park *et al*., (1987), Mayers *et al*., (1991), Tyagi *et al.,* (2011) and Rowntree *et al*., (2013).

Table 8. Number of seeds per plant and seed index (Weight of 100 seeds) of seven soybean genotypes as affected by sowing date and genotype combined across location in 2023 and 2024 seasons.

	Number of seeds/plants			Seed index (Weight of 100 seeds)		
	Mallawi	**Etai**	**Combined**	**Mallawi**	**Etai**	**Combined**
Sowing date (A)						
May 15th	132.02	150.88	141.45	16.86	15.09	15.97
May 30th	126.81	141.07	133.94	14.67	14.74	14.70
June 15th	111.42	130.54	120.98	12.44	14.49	13.46
LSD at $_{0.05}$	5.44	6.69	3.97	0.21	0.21	0.14
Soybean genotypes (B)						
H6 L198-Misr 6	116.79	161.94	139.36	15.86	13.48	14.67
H10 L288-Misr 10	124.33	122.84	123.58	16.18	14.40	15.29
H1 L3	114.51	133.28	123.89	14.49	15.49	14.99
H4 L4	121.92	161.97	141.95	13.83	15.28	14.56
H18 L54	133.26	127.88	130.57	13.35	13.83	13.59
Crawford	135.35	157.74	146.54	16.04	15.48	15.76
Giza 111	117.76	120.18	118.97	12.86	15.42	14.14
LSD at $_{0.05}$	9.11	12.34	7.62	0.15	0.53	0.28

c. Effect of (sowing date × soybean genotype) interaction:

The data in Table (9) represent the means of number of seeds per plant as affected by (sowing date × soybean genotype) Interaction based on combined analyses across the two locations of Mallawi and Etai-El Barood in 2023 and 2024 seasons. The results indicated that the interaction between soybean genotype and sowing date significantly affected number of seeds per plant in both locations and seasons. The mean number of seeds per Plant was significantly decreased in late sowings. In general, the highest number of seeds per plant was obtained from Crawford cultivar early sown on May 15th that reached to 149.19 seeds at Mallawi, from the genotype H4 L4 sown on May 15th that attained 193.39 seeds at Etai, and 158.8 seeds in combined, while plants sown on June 15th caried lower number of seeds than those sown on May 15th the genotype H1 L3 that attained 100.17 seeds at Mallawi, from Giza 111 cultivar at Etai with the value of 103.54 seeds and from H10 L288-Misr 10 genotype that reached to 103.96 seeds in combined. These results may be attributed to the difference in the elongation of photo periods due to different planting dates. These results are in accordance with those obtained by Ngalamu *et al*. (2013).

6- **Weight of 100 seeds (g)**

a. Effect of sowing date

The results showed that sowing dates significantly affected weight of 100 seeds (g) in both locations and seasons (Table 8). The mean weight of 100 seeds (g) was significantly decreased in late sowings. In general, the highest weight of 100 seeds (g) was obtained from the early sowing on May 15th that reached to 16.86 grams at Mallawi, 15.09 grams at Etai, and 15.97 grams in combined, while plants sown on June 15thcaried lower weight of 100 seeds (g) than those sown on May 15th that reached to 12.44 grams at Mallawi, 14.49 grams at Etai, and 13.46 grams in combined. These results may be attributed to the difference in the elongation of photo periods due to different planting dates. These results are in harmony with recorded by Setiyono *et al*., (2006).

b. Effect of soybean genotype

The results indicated that soybean genotype significantly affected weight of 100 seeds (g) in both locations and seasons (Table 8). The highest weight of 100 seeds (g) was obtained from H10 L288-Misr 10 genotype that reached to 16.18 grams at Mallawi, the genotype H1 L3 attained the highest weight of 100 seeds (g) at Etaiwith15.49 grams and Crawford cultivar attained the highest weight of 100 seeds (g) in combined with 15.76 grams, while plants of the Giza 111 cultivar attained the lowest weight of 100 seeds (g) at Mallawi, with 12.86 grams and in combined with the value of 14.14 grams and also the genotype H6 L198 (Misr 6) attained the lowest weight of 100 seeds (g) at Etai with the value of 13.48 grams in both growing seasons. Different soybean genotypes exhibit diverse plant heights due to the presence of multiple genes, known as quantitative trait loci (QTLs), that regulate cell division, elongation, and hormonal signaling pathways (such as auxin and gibberellins). Soybeans (*Glycine max* L.), variations in specific genes directly influence important agronomic traits such as weight of 100 seeds (g). These results are in agreement with those obtained by Liu *et al*. (2008) and Zhang *et al*. (2010).

b. Effect of (sowing date × soybean genotype) interaction:

Results recorded in Table (9) showed that the means of seed index-weight of 100 seeds (g) as affected by (sowing date × soybean genotype) interaction based on combined analyses across the two locations of Mallawi and Etai-El Barood in 2023 and 2024 seasons. The results indicated that the interaction between soybean genotype and sowing date significantly affected weight of 100 seeds (g) in both locations and seasons. The highest weight of 100 seeds (g) was obtained from Crawford cultivar sown on May 15th that reached to 18.6 grams at Mallawi, 16.73 grams at Etai and 16.73 grams in combined, while plants of Giza 111 cultivar sown on June 15th attained the lowest weight of 100 seeds (g) at Mallawi, with 9.97 grams and in combined with the value of 12.95 grams also Crawford cultivar sown on June 15th attained the lowest weight of 100 seeds (g) at Etai with the value of 13.03 grams in both growing seasons. These results are in accordance with those obtained by Hu and Wiatrak, (2012).

Table 9. Number of seeds per plant and seed index (Weight of 100 seeds) of seven soybean genotypes as affected by sowing date, genotype and their interaction combined across location in 2023 and 2024 seasons.

Sowing date (A)	Soybean genotypes (B)	Number of seeds/plant			Seed index (Weight of 100 seeds)		
		Mallawi	Etai	Combined	Mallawi	Etai	Combined
May 15th	H6 L198-Misr 6	127.77	150.77	139.27	18.07	13.03	15.55
	H10 L288-Misr 10	134.80	138.57	136.68	17.85	14.67	16.26
	H1 L3	126.72	155.77	141.25	16.13	16.08	16.11
	H4 L4	124.22	193.39	158.80	15.97	16.35	16.16
	H18 L54	143.35	121.75	132.55	15.70	13.65	14.68
	Crawford	149.19	165.35	157.27	18.60	16.73	17.67
	Giza 111	118.11	130.60	124.36	15.70	15.08	15.39
May 30th	H6 L198-Misr 6	117.76	158.08	137.92	15.75	13.20	14.48
	H10 L288-Misr 10	136.62	123.60	130.11	16.25	14.67	15.46
	H1 L3	116.64	136.73	126.68	14.48	15.17	14.83
	H4 L4	124.56	172.43	148.49	13.55	15.12	14.33
	H18 L54	133.96	127.59	130.77	13.23	13.08	13.16
	Crawford	139.36	142.68	141.02	16.55	16.67	16.61
	Giza 111	118.82	126.41	122.61	12.90	15.25	14.08
Jone 15th	H6 L198-Misr 6	104.85	176.96	140.91	13.75	14.20	13.98
	H10 L288-Misr 10	101.57	106.35	103.96	14.43	13.87	14.15
	H1 L3	100.17	107.33	103.75	12.85	15.23	14.04
	H4 L4	116.99	120.10	118.54	11.97	14.38	13.17
	H18 L54	122.49	134.29	128.39	11.12	14.77	12.94
	Crawford	117.49	165.18	141.34	12.97	13.03	13.00
	Giza 111	116.36	103.54	109.95	9.97	15.94	12.95
LSD at 0.05		15.78	21.38	13.19	0.27	0.92	0.43

7- Seed yield per plant (g)

Results recoded in Tables (10 and 11) showed clearly that the means of seed yield per plant (g) as affected by sowing date, soybean genotype and interaction based on combined analyses across the two locations of Mallawi and Etai-El Barood in 2023 and 2024 seasons.

a. Effect of sowing date

The results illustrated that sowing dates significantly affected Seed yield per Plant (g) in both locations and seasons (Table 10). The mean Seed yield per Plant (g) was significantly decreased in late sowings. In general, the highest Seed yield per Plant (g) was obtained from the early sowing on May 15th that reached to 21.8 (g) at Mallawi, 22.95 (g) at Etai, and 22.38 (g) in combined, while plants sown on June 15th produced lower Seed yield per Plant (g) than those sown on May 15th that reached to 13.75 (g) at Mallawi, 18.4 (g) at Etai, and 16.08 (g) in combined. These results may be attributed to the difference in the elongation of photo periods due to different planting dates. late sowing led to lower yields due to reduced pod number, seed weight, and 1000-seed weight, likely caused by accelerated senescence and adverse climatic conditions during seed filling. Proper genotype selection and sowing time optimize soil and water use, affecting both yield and seed composition, particularly under water stress. These results are in harmony with recorded by Mandić *et al*. (2020).

b. Effect of soybean genotype

The results indicated that soybean genotype significantly affected Seed yield per Plant (g) in both locations and seasons (Table 10). The highest Seed yield per Plant (g) was obtained from Crawford cultivar that reached to 21.49 (g) at Mallawi and 22.84 (g) in combined, but at Etai, the genotype H4 L4 attained the highest Seed yield per Plant (g) with 25.08 (g), while plants of Giza 111 cultivar produced lower Seed yield per Plant (g) at Mallawi, with 15.04 (g) and in combined with the value of 16.58 (g), but at Etai, H18 L54 genotype produced lower Seed yield per Plant (g)with the value of 17.43 (g)in both growing seasons. These results are in accordance with those obtained by Morsy *et al*. (2016).

Table 10. Seed yield per plant and seed yield (ton / fed,) of seven soybean genotypes as affected by sowing date and soybean genotype combined across location in 2023 and 2024 seasons.

	Seed yield/ plant			**Seed yield (ton/ fed,)**		
	Mallawi	**Etai**	**Combined**	**Mallawi**	**Etai**	**Combined**
Sowing date (A)						
May 15th	21.80	22.95	22.38	1.71	1.64	1.68
May 30th	18.56	20.51	19.54	1.45	1.53	1.49
June 15th	13.75	18.40	16.08	1.04	1.43	1.24
LSD at 0.05	0.57	0.21	0.460	0.08	0.04	0.037
Soybean genotypes (B)						
H6 L198-Misr 6	18.41	21.73	20.07	1.46	1.57	1.52
H10 L288-Misr 10	19.81	17.58	18.69	1.56	1.37	1.46
H1 L3	16.57	20.21	18.39	1.34	1.49	1.41
H4 L4	16.77	25.08	20.93	1.30	1.76	1.53
H18 L54	18.21	17.43	17.82	1.30	1.45	1.38
Crawford	21.49	24.19	22.84	1.62	1.64	1.63
Giza 111	15.04	18.13	16.58	1.22	1.46	1.34
LSD at 0.05	1.29	1.55	1.01	0.13	0.09	0.08

c. Effect of (sowing date × soybean genotype) interaction:

The data in Table (11) represent the means of seed yield per plant (g) as affected by (sowing date × soybean genotype) Interaction based on combined analyses across both locations in 2023 and 2024 seasons. The results indicated that the interaction between soybean genotype and sowing date significantly affected Seed yield per Plant (g) in both locations and seasons. The highest Seed yield per Plant (g) was obtained from Crawford cultivar sown on May 15th that reached to 26.63 (g) at Mallawi and 27.13 (g) in combined, but at Etai, the genotype H4 L4 attained the highest Seed yield per Plant (g) with 32 (g), while plants of Giza 111 cultivar sown on June 15th produced the lowest Seed yield per Plant (g) at Mallawi, with 11.4 (g) and in combined with the value of 13.79 (g), but at Etai, genotype H10 L288 (Misr 10) sown on June 15th sown on June 15th produced the lowest Seed yield per Plant (g) with the value of 14.43 (g) in both growing seasons. The results are in agreement with those of Moosavi, *et al*. (2011) who studied the cultivar effect and cultivar interaction with sowing date with yield and yield components and showed there was no meaningful effect. Ball et al., (2000), and Ibrahim (2012) results. The results are also in agreement with those of Kang *et al*. (2017) who studied genetic and environmental variation of first pod height in soybean. (Liu *et al*., 2008). Achieving high yields requires selecting suitable cultivars and implementing appropriate agricultural practices adapted to environmental conditions. Sowing date plays a vital role in determining yield and quality, as it affects both vegetative and reproductive growth. Genetic improvement and agronomic practices contribute equally to yield enhancement.

6- Seed yield (ton / fed.)

a. Effect of sowing date

The results showed that sowing dates significantly affected Seed yield (ton / fed.) in both locations and seasons (Table10). The mean Seed yield (ton / fed,) was significantly decreased in late sowings. In general, the highest Seed yield (ton / fed,) was obtained from the early sowing on May 15th that reached to 1.71 (ton) at Mallawi, 1.64 (ton) at Etai, and 1.68 (ton) in combined, while plants sown on June 15th produced lower Seed yield (ton / fed.) than those sown on May 15th that reached to 1.04 (ton) at Mallawi, 1.43 (ton) at Etai, and 1.24 (ton) in combined. These results may be attributed to the difference in the elongation of photo periods due to different planting dates and also, Yield significantly decreased when soybeans were sown in late, due to reductions in pod number per plant, seed weight per plant, and 1000-seed weight. These reductions were likely caused by accelerated senescence and the negative effects of high temperature and low precipitation during the seed-filling stage. The findings are also in agreement with Khan et al. (2004) also found that delaying sowing resulted in smaller seed size, while early planting produced the highest biological and seed yields. Boquet (2007) found that early sowing in June led to higher seed yields compared to late planting in July. Bastidas *et al*. (2008) demonstrated that delaying sowing after May 1 resulted in significant declines in yield, with reductions of 17 kg per ha in 2003 and 43 kg per ha in 2004.

b. Effect of soybean genotype

The results indicated that soybean genotype significantly affected Seed yield (ton/fed.) in both locations and seasons (Table10). The highest Seed yield (ton/fed.) was obtained from Crawford cultivar that reached to 1.62 (ton) at Mallawi and 1.63 (ton) in combined, but at Etai, the genotype H4 L4 attained the highest Seed yield (ton / fed.) with 1.76 (ton), while plants of Giza 111 cultivar produced lower Seed yield (ton/fed.) yield (ton/fed.) at Mallawi, with 1.22 (ton) and in combined with the value of 1.34 (ton), but at Etai, H10 L288 (Misr 10) genotype produced lower Seed yield (ton/fed.) with the value of 1.37 (ton)in both growing seasons. The increase in seed yield (ton/fed) of soybean plants owing to some soybean genotype may be attributed to the it increased yield components i.e. number of pods per plant (Tables 17 and 18), seed weight per plant (Tables 19 and 20) and 100 seed weight (Tables 21 and 22) therefore increased seed yield per feddan. These results are in agreement with those obtained by (Kandil *et al*.,2013; Ksiezak and Bojarszczuk, 2022)

c. Effect of (sowing date × soybean genotype) interaction:

Results presented in Table (11) illustrated that the means of Seed yield (ton / fed,) as affected by (sowing date × soybean genotype) Interaction based on combined analyses across both locations in 2023 and 2024 seasons. The results indicated that the interaction between soybean genotype and sowing date significantly affected Seed yield (ton/fed.) in both locations and seasons. The highest Seed yield (ton/fed.) was obtained from Crawford cultivar sown on May 15th that reached to 2.09 (ton) at Mallawi and 1.95 (ton) in combined, but at Etai, the genotype H4 L4 sown on May 15th attained the highest seed yield (ton / fed.) with 1.99 (ton), while plants of the genotype H1 L3 sown on June 15th produced the lowest Seed yield (ton/fed.) at Mallawi, with 0.95 (ton) and in combined with the value of 1.15 (ton), but at Etai, the genotype (Misr 10) sown on June 15th produced the lowest seed yield (ton/fed.) with the value of 1.15 (ton)in both growing seasons. The results showed that S4 (23 - June) and S5 (30-June) obtained the lowest values of yield components. There were significant differences for number of pods/plants, number of seeds/pods and highly significant difference was obtained in weight of pods/plant, weight of seeds/plant, 100 seed weight, yield and harvest index. The S3 genotype sown on mid-June, obtained the highest values and S5 genotype sown on late-June, gave the lowest values of the above parameters. There were no significant differences between two genotypes of all parameters of yield and yield components except weight of seeds/plant, yields and harvest index. The interaction of different sowing dates and two genotypes of soybean were showed no clear differences. Vidić *et al.* (2010) emphasized the importance of genotype selection and optimal sowing times in ensuring high yield potential. Mandic *et al.* (2017) noted that unfavorable climatic conditions during plant growth significantly contribute to soybean yield loss, highlighting the need for selecting the best-adapted genotypes for specific environmental conditions. Morsy *et al*. (2017) .

Table 11. Seed yield per plant and seed (g) yield (ton/fed,) of seven soybean genotypes as affected by sowing date, genotype and their interaction combined across location in 2023 and 2024 seasons.

Sowing date (A)	Soybean genotypes (B)	Seed yield/ plant (g)			Seed yield (ton/fed,)		
		Mallawi	Etai	Combined	Mallawi	Etai	Combined
May 15th	H6 L198-Misr 6	22.67	19.93	21.30	1.82	1.51	1.66
	H10 L288-Misr 10	23.28	20.23	21.76	1.84	1.51	1.67
	H1 L3	20.10	24.77	22.43	1.69	1.62	1.65
	H4 L4	19.53	32.00	25.77	1.50	1.99	1.74
	H18 L54	22.15	16.65	19.40	1.53	1.51	1.52
	Crawford	26.63	27.63	27.13	2.09	1.81	1.95
	Giza 111	18.25	19.45	18.85	1.51	1.57	1.54
May 30th	H6 L198-Misr 6	18.20	20.65	19.43	1.51	1.48	1.49
	H10 L288-Misr 10	21.48	18.08	19.78	1.65	1.43	1.54
	H1 L3	16.78	20.02	18.40	1.38	1.49	1.44
	H4 L4	17.05	26.15	21.60	1.35	1.80	1.57
	H18 L54	18.45	16.15	17.30	1.38	1.36	1.37
	Crawford	22.52	23.78	23.15	1.70	1.65	1.67
	Giza 111	15.47	18.75	17.11	1.18	1.48	1.33
Jone 15th	H6 L198-Misr 6	14.35	24.62	19.48	1.07	1.72	1.39
	H10 L288-Misr 10	14.65	14.43	14.54	1.20	1.15	1.18
	H1 L3	12.82	15.83	14.33	0.95	1.35	1.15
	H4 L4	13.72	17.10	15.41	1.06	1.50	1.28
	H18 L54	14.03	19.50	16.77	0.99	1.49	1.24
	Crawford	15.32	21.17	18.24	1.06	1.47	1.27
	Giza 111	11.40	16.18	13.79	0.97	1.35	1.16
LSD at 0.05		2.24	2.69	1.744	0.24	0.16	0139

Conclusion

The choice of the new released cultivars from the new genotypes used in this study aim at assisting farmers to reach the maximum yield with least costs. From the results obtained in this study, it was found that sowing soybean cultivar Giza-111 on May 15th led to obtaining the highest values of yield and its components. These findings highlight the importance of selecting appropriate genotypes and optimal sowing dates for maximizing soybean productivity in different agro-climatic zones. Early sowing of high-performing genotypes, particularly Crawford and H4 L4, are recommended to enhance yield potential under Egyptian conditions. There were some points must be put in mind when we grow soybean for specific purposes such as seed oil and protein production, it is preferred to sow proper soybean cultivars in a proper time according to the cultivation area and the purpose of production.

Consent for publication:
All authors declare their consent for publication.

Author contribution:
The manuscript was edited and revised by all authors.

Conflicts of Interest:
The author declares no conflict of interest.

Acknowledgments
The author wishes express appreciation and gratitude are due to Prof. Dr. Sayed Ahmed Safina Professor of Agric. Agronomy Dept., Fac. of Agric., Cairo University for his valuable supervision, helpful suggestions and constructive criticism in the progress of the present work.
Sincerest thanks are due to Prof. Dr. Hashem Mohamed Abdel-Latif Professor of Agric. Agronomy Dept., Fac. of Agric., Cairo University for his valuable supervision and truthful support.
The author is deeply indebted and grateful to Prof. Dr. Mostafa Mohamed Soliman Chief Research of Legume Crops, FCRI, Agric. Res. Center, Egypt. for his unlimited help, valuable supervision, kind guidance and valuable advice throughout the course of the present investigation and also many thanks for his revision of this manuscript.
Many thanks are also due to all of the staff members in Agric. Agronomy Department, Faculty

of Agriculture, Cairo Universityfor their valuable help.
Sincerest thanks are also due to all of the workers in National Legume Crops Research Program, Agricultural Research Center for their **valuable assistance and truthful support.**

References

Ali, O.A.M. and Abdel-Aal, M.S.M. (2021) Importance of some soil amendments on improving growth, productivity and quality of soybean grown under different irrigation intervals. *Egyp. J. Agron.*, *43*(1), 13-27.

Amoanimaa-Dede, H., Su, C., Yeboah, A., Zhou, H., Zheng, D. and Zhu, H. (2022) Growth regulators promote soybean productivity: a review. *PeerJ*, *10*, p.e12556

Anjum, K., Waseem, M., Anwar, S., Sarfraz, Q., Ali, Q., Khaliq, G. and Abass, H.T. (2023) Influence of Different Planting Dates on the Quantitative and Qualitative Traits of Soybean (Glycine max L.) under Coastal Environments. J. Agri. Res., 8(3) 000313, pp.1-11.

Ball, R.A., Purcell, L.C. and Vories, E.D. (2000) short – season soybean yield compensation in response to population and water regime. *Crop Sci*., 40,1070-1078.

Bastidas, A. M.; Setiyono, T. D.; Dobermann, A.; Cassman, K. G.; Elmore, R. W.; Graef, G. L.; Specht, J. E. (2008) Soybean sowing date: The vegetative, reproductive, and agronomic impacts. *Crop Sci.*, 48, 727-740.

Boquet, D.J. and Clawson, E.L. (2007) Planting dates for soybean varieties in North Louisiana. *Louisiana Agriculture Magazine .LSUA, center.com*

Cai, Y., Chen, L., Zhang, Y., Yuan, S., Su, Q., Sun, S., Wu, C., Yao, W., Han, T. and Hou, W. (2020) Target base editing in soybean using a modified CRISPR/Cas9 system. *Plant Biot. J.,* 18(10), p.1996.

Divito, G.A., Echeverría, H.E., Andrade, F.H. and Sadras, V.O. (2016) Soybean shows an attenuated nitrogen dilution curve irrespective of maturity group and sowing date. *Field Crops Rese.*, 186, 1-9.

Egli, D.B., and Bruening, W.P. (2000) Potential of early-maturing soybean cultivars in late plantings. *Agron. J.*, 92(3), 532-537.

Ewais, N.A. (2021) Studies on the best time for cultivation and production of vegetable soybean under Egyptian condition . Egypt. J. Appl. Sci., 36 (5-6),100-113.

Fordoński, G., Okorski, A., Olszewski, J., Dąbrowska, J. and Pszczółkowska, A. (2023) The effect of sowing date on the growth and yield of soybeans cultivated in north-eastern poland. *Agriculture*, *13*(12), p.2199.

Hassan, M. Z., AL-Assily, K. A., Mohamed, M. S. A. and Sharaf, A. W. (2002) Performance of some soybean cultivars under different sowing dates at the newly reclaimed lands of east Owinat and Kharga. *Arab Univ. J. Agric. Sci.,* 10 (1),173-179.

Hu, M. and Wiatrak, P. (2012) Effect of planting date on soybean growth yield and grain quality: Review. *Agron. J*., 104, 785-790.

Ibrahim, S.E. (2012) Agronomic studies on irrigated soybeans in central Sudan: II. Effect of sowing date on grain yield and yield components. *Inte. J. Agri. Sci*., (9),766-773.

Izgı, M.N. (2023) Field performance of some soybean [*Glycine max* (L.) Merr.] cultivars sown on different dates. *Türkiye Tarımsal Araştırmalar Dergisi*, 10 (1), 27-37.

Jackson, M.L. (1967) Soil chemical analysis. Prentice-Hall of India pp.144- 197.

Kandil, A.A., Sharief, A.E., Morsy, A.R. and El–Sayed, A.I.M. (2013) Influence of planting date on some genotypes of soybean growth, yield and seed quality. *J. Biol. Sci*., 13, 146-151.

Kang, B.K., Kim, H.T., Choi, M.S., Koo, S.C., Seo, J.H., Kim, H.S., Shin, S.O., Yun, H.T., Oh, I.S., Kulkarni, K.P. and Lee, J.D. (2017) Genetic and environmental variation of first pod height in soybean [*Glycine max* (L.) Merr.]. *Plant Breed. Biotechnol*, *5*(1), 36-44.

Kawasaki, Y., Yamazaki, R. and Katayama, K. (2018) Effects of late sowing on soybean yields and yield components in southwestern Japan. *Plant Prod. Sci.*, 21, 339-348.

Khalil, N.A., Darwish, D.S., Safina, S.A. and Ferozy, S.A. (2011). Effect of environmental conditions on the productivity of soybean in Egypt. *Egypt. J. Plant Breed*, *15*(3), 33-43.

Khan A.Z. Shah P, Khalil S. K. and Ahmed B., (2004) Yield of soybean cultivars as affected by planting date under Peshawar valley Conditions. *The Nucleus,* 41,93-95.

Liu, X., Jin, J., Wang, G. and Herbert, S. (2008) Soybean yield physiology and development of high-yielding practices in Northeast China. *Field Crops Research*, 105(3), 157-171.

Maamoun, H.A. and Abd El Gawad, A.M. (2013) Effect of salicylic acid, biofertilization and sowing dates on peanut (*Arachis hypogaea* L.) yield under semi-arid conditions. *Egypt J Agron*, *35*(1), 37-64.

Mandi´c, V., Bijeli´c, Z., Krnjaja, V., Simi´c, A., Ruži´c-Musli´c, D., Dragiˇcevi´c, V. and Petriˇcevi´c, V. (2017) The rainfall use efficiency and soybean grain yield under rainfed conditions in Vojvodina. *Biotechnol*. *Anim. Husb*., 33, 475-486.

Mandić, V., Đorđević, S., Đorđević, N., Bijelić, Z., Krnjaja, V., Petričević, M. and Brankov, M. (2020). Genotype and sowing time effects on soybean yield and quality. *Agriculture*, 10(11), p.502.

Mayers, J., Lawn, R. and Byth, D. (1991) Agronomic studies on soybean (*Glycine max* (L.) Merrill) in the dry season of the tropics. II. Interaction of sowing date and sowing density. *Australian J. Agric. Rese.*, 42(7), 1093-1107.

Moosavi, S.S., Seyed, M.J.M., Ali, A.I., Ali, M.K and Babak, S.M., (2011) Study of effect of planting date on vegetative traits, reproductive traits and grain yield of soybean cultivars in cold region of Ardabil (Iran). *African J. Agric. Rese*., 6(21), 4879-4883.

Morsy, A.R., Abdel-Rahman, R.A., Fares, W.M., ELHosary, A.A.A., Ibrahim, M.A., EL-Noby, M. A. and Abou-Zied, A.A. (2017) Interpretation of genotype x environment interaction for soybean variety trials using different stability procedures. *Egypt. J. Plant Breed*, *21*(5), 536-553.

Morsy, A.R., Mohamed, E.N. and Abou-Sin, T.M. (2016) Seed yield and seed quality of some soybean genotypes as influenced by planting date. *J. Plant Prod*., 7 (11), 1165-1171.

Ngalamu, T., Ashraf, M. and Meseka, S. (2013) Soybean (*Glycine max* L.) genotype and environment interaction effect on yield and other related traits. *Am. J. Exp. Agric*., 3, 977-987.

Nico, M., Miralles, D.J. and Kantolic, A.G. (2019) Natural post-flowering photoperiod and photoperiod sensitivity: Roles in yield-determining processes in soybean. *Field Crops Rese*., 231, 141-152.

Park, K. Y., Oh, S. K., Jeong, B. C., Rho, S. P. and Hong, E. H. (1987) Effects of planting dates on dry matter production and ecological characteristics of soybeans (*Glycine max* (L.) Merr.) in southern region of Korea. *Korean J. Crop Sci.*, 32(4), 409-416.

Rowntree, S.C., Suhre, J.J., Weidenbenner, N.H., Wilson, E.W., Davis, V.M., Naeve, S.L., Casteel, S.N., Diers, B.W., Esker, P.D. and Specht, J.E. (2013) Genetic gain× management interactions in soybean: I. Planting date. *Crop Science*, 53(3), 1128-1138.

Sadek, M.S.E., Abd El-Ghany, H.M., Abd, M.A. and Moula, E. (2011) Stability Performance of Some New Yellow Maize Genotypes Across Four Locations. *Egypt. J. Agron.*, *33*(2), 179-188.

Setiyono, T., Weiss, A., Specht, J., Bastidas, A., Cassman, K.G. and Dobermann, A. (2007) Understanding and modeling the effect of temperature and daylength on soybean phenology under high-yield conditions. *Field Crops Research*, 100(2-3), 257-271.

Setiyono, T.D., Weiss, A., Specht, J., Bastidas, A.M. and Cassman, K.G. (2006) Dobermann, A. Understanding and modeling the effect of temperature and day length on soybean phenology under high-yield conditions. *Field Crop. Res*., 100, 257-271.

Shapiro, S.S. and Wilk, M.B. (1965) Analysis of variance test for normality (complete samples). *Biometrika*, 52 (3/4), 591–611.

Snedecor, G.W. and Cochran, W.G. (1994) Statistical Methods. 8th Edn IOWA State University Press. *Ames, Iowa, USA*.

Sudarić, A., Kočar, M.M., Duvnjak, T., Zdunić, Z. and Kulundžić, A.M. (2019) Improving seed quality of soybean suitable for growing in Europe. In *Soybean for human consumption and animal feed*. IntechOpen.

Suo, R., Wang, M. and Zhao, T., (2024) Contribution of Photosynthetic, Root and Phenotypic Traits to Soybean Plant Height. *Sustainability*, *16* (7), p.2886

Tyagi, S.D., Khan, M.H. and Silva, J. (2011) Yield stability of some soybean genotypes across diverse environments. *Intern. J. Plant Breed.*, 5(1), 37-41

USDA (2025) United States department of agriculture foreign agricultural Service circular series WAP. 02-25 February 2025. P. (22)

Vidić, M., Hrustić, M., Miladinović, J., Đukić, V., Đorđević, V. and Popović, V. (2010) Latest NS varieties of soybean. *Ratarstvo i povrtarstvo/Field and Veg. Crops Res.*, *47*(1), 347-355.

Yang, Q., Lin, G., Lv, H., Wang, C., Yang, Y. and Liao, H. (2021) Environmental and genetic regulation of plant height in soybean. *BMC plant biology*, *21*, 1-15.

Zhang, J., Song, Q., Cregan, P.B., Nelson, R.L., Wang, X., Wu, J. and Jiang, G.L. (2015) Genome-wide association study for flowering time, maturity dates and plant height in early maturing soybean (*Glycine max*) germplasm. *BMC genomics*, *16*, 1-11.

Zhang, Q.Y., Gao, Q.L., Herbert, S.J., Li, Y.S. and Hashemi, A.M. (2010) Influence of sowing date on phenological stages, seed growth and marketable yield of four vegetable soybean cultivars in North-eastern USA. *African J. Agric. Rese.*, *5*(18), 2556-2562.