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Original Research Article

Estimation of Genetic Parameters of Oil Content of Sesame Cultivars

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Abstract: The field experiment was applied in College of Agriculture/ Wasit University, Wasit, Iraq. It is located at longitude = 33.5 = 50 = 45° east and latitude = 49.8 = 29 = 32° north for the season 2022. The aim of study was to evaluate and estimate the genetic factors of the oil content of the genotypes of sesame, as well as determining the best genotype in terms of growth characteristics, yield and oil percentage within the conditions of Wasit province. Sesame seeds (*Sesamum indicum* L) were planting in field on 6/15/2022 and harvested on 11/25/2022. The study was conducted on oil yield, percentage and components. The results has been found that the local cultivars were significantly superior in terms of total yield as they reached highest rates, which amounted (1195.33 kg/ ha, 170.40 kg/ ha). The Iranian genotypes has been recorded the lowest rates, and the lowest rates were for the characteristic of the total yield of the genotype (1), which gave an average (459.88 kg/ ha).

Keywords: Genetic Parameters, oil Content, Sesame, Cultivars, Genotypes.

INTRODUCTION

The sesame (*Sesamum indicum* L) is one of the important oil and food crops globally because its seeds contain a high percentage of oil, which ranged (45- 60%). It also contains a good percentage of protein estimated about (25%) and (15%) carbohydrates. In addition, to the presence of vitamins and elements of phosphorus and calcium, all of which are affected by the cultivar and environment (Amoo *et al*., 2017; Ashri & Singh, 2006). The sesame plant is a capsule filled with small seeds. Sesame varieties can be divided into two main groups: shaltering varieties, which fall off at maturity, and Shaltering Non Varieties.

Sesame has been known since long time ago. Many studies and historical references indicate that this plant moved from the continent of Africa to India and China, and its cultivation spread in southern Europe and North Africa and to the countries of the tropics, subtropics and temperate regions, all through the countries of the Middle East (Hil'tebrandt, 1935; Tashiro *et al*., 1990).

The problems that accompany the cultivation of sesame that accompany its production and lead to a decrease in yield in quantity and quality, including exposure to agricultural pests, foremost of which is infestation with many plant diseases such as charcoal rot, which is one of the most determining factors for its cultivation, as well as Fusarium wilt, which leads to loss of yield that may reach more than two-thirds of its production (Ziedan, 1993).

The oil of the sesame plant is extracted by pressing or cold pressing, and does not require additional processing. The color of the resulting oil depends on the color of the pressed sesame seed and on the degree of roasting or not. The oil contains a high percentage of fatty acids and antioxidant flavonoids; which contributes to the oil retaining its natural properties for a long time without oxidation, as the percentage of oil in the sesame crop is greatly affected by the genotype, the prevailing environmental conditions, agricultural processes, and the length of the cultivar's growth period (Nzikou *et al*., 2009). The sesame oil is one of the best types of oils worldwide. It is preceded only by olive oil, as it is characterized by a high percentage of unsaturated fatty acids, which often reaches 85% of the total other fatty acids, which leads to a high fluidity of the oil, in addition to its importance in lowering cholesterol in the blood. Sesame oil is characterized by its long-term retention of its taste and its non-oxidation.

It contains the antioxidants Sesamine, Sesamoline and Sesamole, which makes it more stable for stored. (Kalaiselvan *et al*., 2001) have been found that the percentage of oil gave a significant difference for non-local varieties (1,2) Where the percentage has been reached (33.33%, 30.27%). For the total oil yield of the local cultivars (14, 15), it was higher at a rate of (226.54, 243.82) kg/ha-1, due to the difference in the genetic structure of the plant. The percentage of oil in sesame ranges between (45-60%) and this percentage are affected by the variety, environmental conditions and agricultural processes (Duraisamy *et al*., 1999). (Al-Mohammadi & Almohammedi, 2022) have been found that the percentage of oil and the yield of oil according to the dates of planting, which may be attributed to the variation in temperature and photoperiod during the stage of seed formation and maturity. As for the planting distance, the oil content of sesame seeds and the oil yield increases by increasing the distance between the lines and reducing the plant density (Srinivas, 1991). (Hassan *et al*., 1977) have been reported that the oil content of sesame seeds increased with increasing soil moisture.

Also, (Malik *et al*., 2003) have been indicated that increasing the number of irrigations increases the percentage of oil in sesame seeds, while (El-Metwally & Abdu-Hagaza, 1988) have been concluded that increasing the number of irrigation times leads to an increase in the percentage of oil and oil yield (kg/ h) of sesame plants. They did not find significant differences in the percentage of oil in sesame seeds between the irrigation treatments that used in their studies, while they noticed an increase in oil yield, and the reason for the increase in oil yield is attributed to the increase in seed yield (kg/ h). (Mitchell *et al*., 1974) has been also recorded that the oil content of sesame seeds was not affected significantly at the levels of fertilizer that used in his study, while they found a significant increase in the oil yield (kg/ h) when the levels of fertilizer added were increased. Likewise, nitrogen fertilization has an important role in increasing the percentage of oil and oil yield in seeds at the higher fertilizer levels and lowering it at the fertilizer level (zero), as it improves plant growth and increases its metabolic rate. It also increases the production and accumulation of dry matter in the plant, including carbohydrates, as these carbohydrates in the seeds are converted into fatty acids, causing an increase in the percentage of oil and oil yield in the seeds. The aim of the study was to assess and estimate the genetic factors of oil content for genotypes of sesame, as well as to determine the best genotype in terms of growth characteristics, yield and oil percentage under the conditions of Wasit Province.

MATERIALS AND METHODS

Field Experiment Location

The field experiment was applied at College of Agriculture, Wasit University, Wasit, Iraq at the research station of the College of Agriculture during the season (2022/2023).

The Physical and Chemical Characteristics of the Soil Samples

The chemical and physical analyzes of the soil were done by taking three random samples from the field soil (0-30 cm) and they were air-dried, then ground and sifted with a sieve with a diameter (2 mm). The experiment area was divided into three blocks, each block contains (15 experimental units) with dimensions (2×2m^2), each unit included (four lines of 2 m each line) and planting distances (20 cm) between the lines and between one plant and another (10 cm).

Table 1: Name of studied genotypes

No.	Genotype name	No.	Genotype name
1	Naz tak shakheh	8	Darab1
2	Dashtestan	9	TC-25
3	Dashtestan2	10	Yellow white
4	Mahali Mehran	11	Darab14
5	Nashekhifa	12	Oltan
6	Holeil	13	Darab2
7	Shevin	14	Red Iraqi
15	Iraqi White		

Planting operations were applied as well. The seeds of the plant were planting on 15, June (the spring season 2022) and as indicated in Table (2) that shown below in the climatic conditions of the region at the time of planting details of the planting season. The triple superphosphate fertilizer (46% P2O5) was added with an amount (80 kg P2O5 H^{-1}) with (40 kg N/H) in the form of urea fertilizer in one batch before planting and during plowing.

Table 2: details of the planting season for the samples according to the Kut station/ time of the experiment

Season	Month	Temperature °C	Humidity (%)	Brightness/h	Rainfall mm)	wind speed (m/s)
spring	June	41.3	39	12.6	0.0	2.5

Oil yield (kg/h): It was estimated by multiplying the percentage of oil by the seed yield (kg/h) (Figure 1).

Oil Ratio (%)

The oil ratio in seeds was estimated according to the official method of the American Oil Society (AOAC) (1980) using the (Soxhlet) equipment (Figure 1). Two methods were used for oil extraction, Soxhlet extraction, and cold pressing.

Soxhlet Extraction:

Thirty grams of sample were used for oil extraction with 250 ml of hexane during 5h. The solvent was removed from the extracted oil using a rotary evaporator (Buchi R-210) and residual solvent was excluded by oven at 50°C until constant weight.

Cold Pressing Extraction:

This is a common method, in which sesame oil can be extracted under low temperature conditions without any chemical solvents (Warra, 2011). The sesame seeds were milled and the oil was extracted using mechanical pressure. Oil was poured in glass bottles and protected against the light after they weretransported to laboratory and stored at 4°C. Moisture determination of sesame seeds and oil: The moisture content (H) was determined by drying samples (2 grams) powder or oil of sesame at 105°C until a constant weight was reached. Once the sample was poured in the cell of Lovibond, the color was determined while comparing it with color standard blades. Reading was done by regulation of two faces; the observation was conducted until the obtaining of the same color for both sides, then, reading on the board values of the yellow and red. The results were expressed by the number of yellow and red units necessary to obtain the corresponding color (Sudke and Sakarkar, 2013).

Statistical Analysis: The data were analyzed by using Tukey method and at 95.0%.

RESULTS AND DISCUSSION

Oil Yield (Kg/ Ha)

Table (3) has been indicated that there are significant differences between the genotypes for the characteristic of total oil yield (kg/ ha). It is indicating the superiority of the genotypes (14 and 15) by giving them the highest rates of the trait, which amounted (262.548 kg/ ha – 243.827 kg/ ha) respectively, and this superiority is attributed to the total yield of seeds.

However, the genotypes (1, 5, 6, 8, 11 and 12) have been recorded the lowest rate. The reason is due to giving them the lowest rates in the characteristic of the total plant yield (Abdalsalam & Al-Shebani, 2010; Metwally *et al*., 2021). (Abdalsalam & Al-Shebani, 2010) has been indicated that increasing nitrogen rates by 0, 50 and 100 up to 150 kg N per hectare significantly increased growth of plant traits, yield/ha and yield components. The maximum value was (1.26) seeds yield ton/ha and oil percentage (51.7%) were obtained when sesame cv. Kod-94 was fertilized by 150 kg N/ha. While, the lowest values of these two characters were recorded in plots with zero nitrogen whatever the sesame cultivar grown was. The Data has showed clearly that the local cultivar was very susceptible to powdery mildew, while sesame cv. Kod-94 was very resistant as no symptoms of the disease was recorded at all growth stages and with all nitrogen fertilizer treatments.

Table 3: oil yield (kg/ ha) for genotypes

Genotype	Plant high (cm)	Branches no.	Fruit box/ plant	Plant yield (g/plant)	Total yield (kg/ha)	Oil yield (kg/ha)
1	110.733	12.400	163.467	20.900	459.800	153.267
2	124.100	11.733	161.200	31.667	696.667	210.898
3	110.867	13.983	160.533	29.867	657.067	177.596
4	125.067	14.017	155.433	32.200	708.400	202.340
5	122.733	12.967	157.000	33.600	739.200	184.800
6	101.100	15.083	151.600	31.533	693.733	182.958
7	111.067	14.933	156.500	37.800	831.600	218.852

Genotype	Plant high (cm)	Branches no.	Fruit box/ plant	Plant yield (g/plant)	Total yield (kg/ha)	Oil yield (kg/ha)
8	90.067	10.283	153.500	36.400	800.800	190.683
9	103.600	10.667	152.833	44.533	979.733	217.682
10	113.300	14.267	156.100	42.933	944.533	209.896
11	120.000	13.033	157.533	38.400	844.800	183.659
12	126.667	13.433	155.800	43.333	953.333	181.587
13	124.933	14.200	152.133	45.500	1001.000	212.929
14	138.200	19.067	122.833	54.333	1195.333	262.548
15	141.100	19.067	123.800	53.200	1170.400	243.827
Average	117.57	13.94	152.02	38.41	845.09	202.23
LSD	4.415	2.057	4.363	10.754	236.579	57.661

Table 4: The plant yield and the yield of oil of *Sesamum indicum*

Sources of variation	d.f	Plant high (cm	Branches no./ plant	Fruit boxes/plant	Plant yield (g/plant)	Total plant yield (kg/ha)	Oil yield (kg/ha)
Blocks	2	33.802	3.269	1.548	44.56	21567	637
Genetic Compositions	14	562.005*	18.942*	440.764*	244.98*	118568*	2296*
Experimental Error	28	6.970	1.512	6.804	41.34	20008	1189
Total	**44**						

The Specific Characteristics of the Plant
The Ratio of Oil

The analysis of variance (appendix 6) has been indicated that there are significant differences between the genotypes of the percentage of oil and its components. Table (4) has been recorded that the superiority of genotype (1) in the percentage of oil, it has gave the highest rate (33.33%), while genotype (12) gave the lowest rate of oil percentage (19.048%). This is due to the difference in the genetic nature and origin of the genotypes that used in the study. These results have been agreed with (Merry *et al*., 1999) and Al-Naqeeb, (2013).

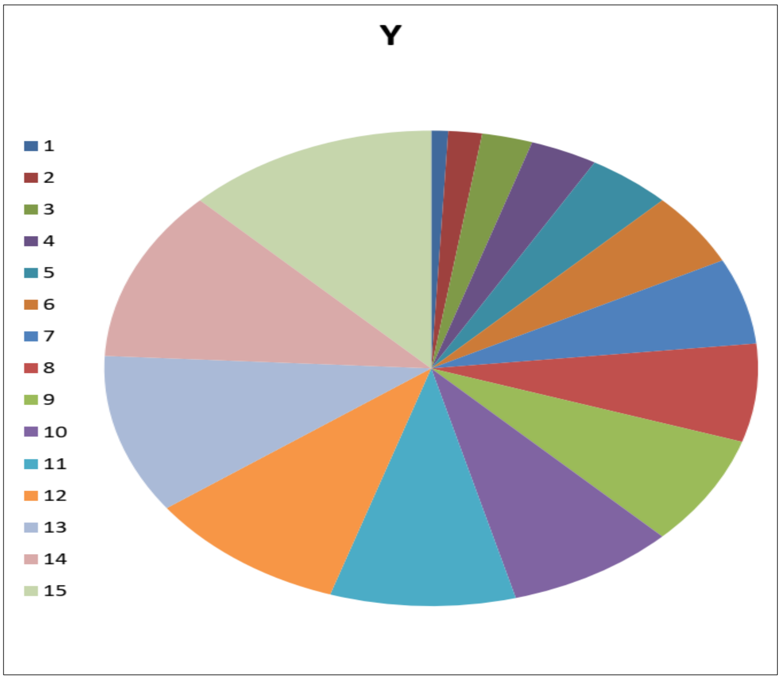

Figure 1: Oil ratio of genotypes

The genotype (1) has been excelled in all components of the oil. It has been recorded the highest rate for the characteristics of (triglycerides, free fatty acids, binary glycerides, lecithin, serine phospholipids, ethanophospholipids, palmitic, stearic, oleic, linoleic), which recorded (2.168%, 8.667 %, 23.400%, 5.800%, 8.733%, 4.000%, 2.000%, 16.667%, 16.833% and 16.833%)

respectively. However, the genotype (12) has been gave the lowest rates for the characteristics of the components of the oil, which reaching (19.048%, 1.126%, 3.048%, 10.571%, 2.476%, 3.429%, 1.695%, 676%, 6.857%, 7.619% and 7.619%) respectively. It is noting that there were no significant differences in the rates of genotype (12) with genotype (15) for the characteristics of triglycerides, serine phospholipids, ethanophospholipids, stearic, oleic, and linoleic (Figure 1).

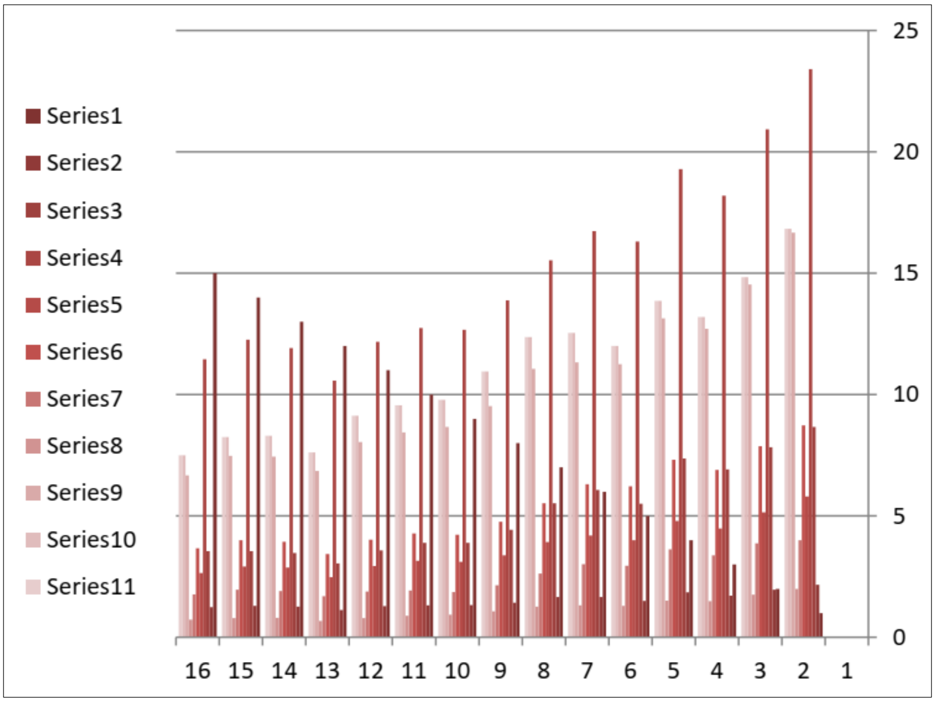

Figure 2: Oil components of plant yield for genotypes

CONCLUSIONS

The study concludes that the total oil yield is a natural reflection of the total yield. The genotype (1) has been superioritied in the percentage of oil and its components to the oil. Iraqi cultivars have been recorded the lowest in the percentage of oil, which was reflected in the other components of the oil.

REFERENCES

- Abdalsalam, A., & Al-Shebani, Y. (2010). Phenological and productivity characteristics of sesame (Sesamum indicum L.) as affected by nitrogen rates under Sana'a conditions. *Journal of Plant Production*, *1*(2), 251-264.
- Al-Mohammadi, M. A. F., & Almohammedi, A. N. A. (2022). Effect of Organic and Phosphate Fertilizers on Yield Traits of Several Sesame Cultivars, Sesamum Indicum L. *Global Journal of Plant Science*, *7*(2), 35-42.
- Al-Naqeeb, M. (2013). Effect of iron and manganese on growth and yield of cotton. *Iraqi Journal of Agricultural Sciences*, *44*(5), 568-576.
- Amoo, S., Okorogbona, A., Du Plooy, C., & Venter, S. (2017). Sesamum indicum. In *Medicinal spices and vegetables from Africa* (pp. 549-579). Elsevier.
- Ashri, A., & Singh, R. (2006). Sesame (Sesamum indicum L.). *Genetic Resources, Chromosome Engineering, and Crop Improvement (Singh RJ, ed.)*, *4*, 231-289.
- Duraisamy, K., Kathiresan, G., & Balasubramanian, A. (1999). *Effect of irrigation frequency and coir pith application in sesame (Sesamum indicum)*.
- El-Metwally, E., & Abdu-Hagaza, N. (1988). Effect of nitrogen fertilization and plant spacing on seed yield of sesamie (Sesamum indicum, L.)[Egypt]. *Journal of Agricultural Sciences, Mansoura Univ.(Egypt)*.
- Hassan, H., El Shafey, Y., & Dodo, M. (1977). Some physiological studies on sesame plant (Sesamum indicum L.) in relation to its water requirements. 1. Growth and seed yield [Egypt]. *Bulletin of Faculty of Agriculture, University of Cairo*.
- Hil'tebrandt, V. (1935). Sesame (Sesamum indicum L. *Sesame (Sesamum indicum L.*
- Kalaiselvan, P., Subrahmaniyan, K., & Balasubramanian, T. (2001). Effect of nitrogen on the growth and yield of sesame–A review. *Agricultural Reviews*, *22*(2), 137-140.
- Malik, M. A., Saleem, M. F., Cheema, M. A., & Ahmed, S. (2003). Influence of different nitrogen levels on productivity of sesame (Sesamum indicum L.) under varying planting patterns. *International Journal of Agriculture and Biology*, *5*(4), 490-492.

- Merry, L., Graham, R., & Schachtman, D. (1999). Triticum Tauschii—A Potential Source of Genes for the Improvement of Zinc Efficiency in Bread Wheat. In *Plant Nutrition—Molecular Biology and Genetics* (pp. 235-244). Springer.
- Mitchell, G., Bingham, F., & Yermanos, D. (1974). Growth, mineral composition and seed characteristics of sesame as affected by nitrogen, phosphorus, and potassium nutrition. *Soil Science Society of America Journal*, *38*(6), 925-931.
- Nzikou, J., Matos, L., Bouanga-Kalou, G., Ndangui, C., Pambou-Tobi, N., Kimbonguila, A., Silou, T., Linder, M., & Desobry, S. (2009). Chemical composition on the seeds and oil of sesame (Sesamum indicum L.) grown in Congo-Brazzaville. *Advance Journal of Food Science and Technology*, *1*(1), 6-11.
- Srinivas, T. (1991). *Evaluation of Modified Bulk Breeding Proceedire in Sesame (Sesamum Indicum L.)* ANGRAU ACH: Genetics and Plant Breeding].
- Tashiro, T., Fukuda, Y., Osawa, T., & Namiki, M. (1990). Oil and minor components of sesame (Sesamum indicum L.) strains. *Journal of the American Oil Chemists' Society*, *67*(8), 508-511.
- Ziedan, E. (1993). *Studies on Fusarium wilt diseases of sesame (Sesamum indicum) in AREM Sc* thesis, Faculty of Agric. Ain Shams Univ].