



## **Assessment of Some Physical and Chemical Characteristics in Three Sunflower Varieties**

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### **Abstract**

A field experiment was conducted in Kanipanka station, at a research center, which belongs to the Ministry of Agriculture and located about 36 Km south-east of Sulaimany, the planting was done in autumn at (July 01, 2012). A laboratory experiment was conducted to estimate some physical and chemical characteristics such as seed volume, true density, water absorption capacity, water absorption index, seed size, oil%, ash%, nitrogen%, potassium%, calcium% and protein% in different varieties of sunflower (Confute, Flame and Local). The results demonstrated the existence of significant differences (at  $P < 0.05$ ) among studied varieties for all physical and chemical characteristics except thousand seed weight. The results of physical properties exhibited that Local variety had maximum values of seed volume, seed size, water absorption capacity and water absorption index. Concerning the chemical properties of seeds, the results showed that Confute variety gave high amount of nitrogen, potassium, protein and oil. The correlation coefficients of some seed related traits showed that oil content of the seeds was significantly and negatively related to seed size, protein content and ash, but significant and positive relation observed between the oil content and the thousand seed weight.

### **Introduction**

The sunflower crop (*Helianthus annuus* L.) is one of the important oil crops that follow the (Compositae) or (Asteraceae) family and the seeds contain a high percentage of oil between (30–50%) by varieties, also rich in vitamins, especially vitamin B1 [1]. The sunflower is an annual crop that is propagated by seed only and can hybridize spontaneously, with several wild/weedy relative[2]Sunflower is shorter season than most crops, so it can be planted later or harvested earlier, helping spread out work[3] Generally, there are two types of sunflower which are sunflower non-oil and sunflower oil. Sunflower is a second most important source of vegetable oil in the world after soybeans [4].Therefore, dramatically it is used in human nutrition, due to reducing cholesterol in the blood [4, 5].Sunflower plants are used as green fodder in many industries, and in the industry of silage at the beginning flowers composition, as well as cake seeds to feed farm animals and especially, cattle. The seeds are used in human nutrition and birds. Additionally, plants are used as windbreakers in the fields and also can be used as medical and decoration plant. Furthermore, it attracts bees in its fields to produce good quality, honey [1, 3, 6, 7, 8, 9 and 10].

Sunflower is a strong component of oilseed and bio-fuel cropping systems, because it adapts well to various conditions and often requires fewer agricultural inputs than more common crops. Because the oil has several potential markets and the pressed meal can fill niche cattle markets, so sunflower is a good choice for growers at both small and large scales [11]. It is believed that Mexico and west of the southern region of the

(USA) are the first origin of the sunflower, were growing wild varieties up to the present time [1, 8 and 12]. Estimated global production (33.421) million tons for the year (2008–2009), and Russian is one of the largest producing areas of this crop where estimated production is approximately (7.4) million tons, their production cover about (22%) of global production (2.52) million tons [13]. The global production for oil sunflower is (11.674) million tons for the year (2008 - 2009), but the estimated global production is increased to (38.7) million tons for the year (2013–2014), meantime, it's estimated that the production of Russian also increased to (11.8) million tons[13].The cultivation of this crop was introduced to (Iraq) by agriculture institutions and departments, and numerous experiments proved the success of the crop deep in mix soils, good drainage and high acidity signals to slash the base (pH) in between (6.5-8) [1]. Maximum productivity of sunflower in Iraq was about 327.8 kg/acre for the year (1997) [14], but the biggest production of sunflower in Kurdistan region in Sulaimany city estimated (302.03) kg/acre for the year (2002). Erbil produced about: 287.92 kg/acre. Due to the broad range enjoyed by this crop, terms of probability and unsustainable growth in the sandy soils of good drainage and afford to different environments, where grows between latitudes (55) in the north and (40) to the south of the equator. Add to afford temperature (30-40) °C the plant sunflower of tropical crops and economically produced in worm area [1]. So the different region of Kurdistan is suitable for cultivation and the consequent economic benefits in terms of yield and increase in the exploitation of agricultural land, but the specialized area of land for cultivation, is not of desired economic level. So this study was conducted, in order to assess the physical and chemical characteristic in three varieties of sunflower to determine the best variety for oil content, in relation to increasing and improving the quantity and quality of oil for this crop.

## **Materials and Method**

This part of the study was conducted at laboratory of the photochemistry/Department of Field crops/Faculty of Agricultural Science/University of Sulaimani; and in Central research laboratory of Faculty and in Directorate of Agriculture Research in Bakrajo. While, the first part regarding planting of the three varieties was done in Kanipanka station research center.

The soil was plowed twice in opposite direction (tillage orthogonal) before planting with depth (30) cm, the soil was pulverized by cultivator and the field design was conducted by furrows machine. The Planting was done in autumn at (June 20, 2012) on furrow (4) m length and width lied between (75) cm and the distance between plants was (25) cm. The field was irrigated by traditional method. Randomized Complete Block Design with three replications was used.

Sunflower varieties Flame, Confute and local variety were harvested at in the area (Kanipanka) nearby (Saisadq) town. Kanipanka location lies at the rain line that has an average precipitation of (637) mm/year [15]. The seed was air-dried at room temperature and prepared for Soxhelt extraction.

### ***Physical properties of seeds***

The seed volume, seed size, true density, water absorption capacity by Mohsenin [16] and water absorption index by (Williams and Singh [17]).

#### ***Seed volume (Hector/liter)***

To determine the seed volume, 100 seeds were selected randomly from each replicate and were spilled into a calibrated cylinder containing a certain amount of water so that this amount of water covers the entire surface of the seed. For each replication, two readings (water volume and water volume with hundreds of seeds inside it) were done, and then the numerical differences between the two readings were divided into 100 [16].

#### ***Seed size (g)***

To measure the seed size, 15 seeds of the sunflower seeds from each variety were taken randomly in three replicates. Geometrical dimensions of the seeds were measured with a digital Vernier calliper (Mitutoyo, Japan). The mean values of the replicates were calculated by [16].

**True density (g/cm<sup>3</sup>)**

To measure true density, seed weight was divided by its volume and it was expressed based on g/ml.

**Water absorption capacity of seed (g)**

To calculate the water absorption capacity, 100 seeds of each replication were weighted and then were pour into a flask containing water and were put at temperature of 22 °C for 12 hours until they were completely soaked and swollen, then surface water of turgidity seeds were removed by absorbent paper and were weighted again in this ease.

**Water absorption index (g)**

Was obtained by dividing the water absorption capacity on the main seed size (g)

**Sample preparation and seed oil extraction**

Three samples of each varieties of Local, Flame and Confute were taken and (5) grams of each dried sample, ground to powder with electric blender, the oil extracted according to the procedure shown by [18]. The oil extracted with 150 ml of (Hexane) for four hrs. The collected solvent was air-evaporated by keeping the opened tubes for 24 hours in the fume cupboard. The oil samples were then weighed and stored in plastic tubes in dry place [19]. The oil samples kept in refrigerator for further analysis, the oil content was calculated as follows:

$$\text{Oil\%} = [(W2-W1) \times 100] / S$$

W1 = weight of empty flask (g), W2 = weight of flask and extracted oil (g) and S= sample

Oil% in seeds = weight of oil ÷ weight of dry sample x 100 [19]

**Determination of nitrogen content**

The content of nitrogen was measured by Kjeldahl apparatus (BUYCHI) using chemical material H<sub>2</sub>SO<sub>4</sub> (98%) and H<sub>2</sub>O<sub>2</sub> (50%) and NaOH (50%). Nitrogen content was calculated as N% by :( Sample titer-Blank) x N - H<sub>2</sub>SO<sub>4</sub> x 14 /Weight x 100 [20]

**Determination of phosphorus content**

Phosphorous content was determined by Spectrophotometer UV – VIS –RS apparatus with mark Labored, using chemical material [(NH<sub>4</sub>)<sub>6</sub>Mo<sub>7</sub>O<sub>24</sub>.4H<sub>2</sub>O] and Phosphorous was calculated as P% by = ppm P (From Standard Curve) x R /Wt. (g) x 100 / 10000 [20]

**Determination of potassium content**

The content of potassium was quantified by Flame photometer apparatus with mark JENWAY using Chemical material H<sub>2</sub>SO<sub>4</sub> (98%) and H<sub>2</sub>O<sub>2</sub> (50%) and KCL and K% was calculated as K% by: PPM-K = (PPM in extract – Blank) x A / wt. [20] We calculated also protein percentage by (N% x 6.25) in Lab of the Central Research laboratory of Directorate of Agriculture Research in Bakrajo.

**Statistical analysis:** Analysis of variance (ANOVA) used as a general test, Duncan multiple ranges for comparison between means and correlation coefficients between some traits were performed using XLSTAT V7.5 [21]

**Results and Discussion**

**Physical properties of seeds**

As shown in Table (1), significant values were found among sunflower varieties for seed volume. The results of physical properties were presented in Table (2). The values of seed volume were ranged from 0.087 to 0.35. The highest seed volume was recorded by Local varieties while the minimum seed volume was registered by Confute. There were significant differences observed among three varieties (Table 1). The seed true density values were 29.257, 57.107 and 115.740 for varieties Local, Flame and Confute, respectively (Table 2). Water absorption capacity demonstrated that the differences among varieties were significantly different at p ≤ 0.05 and the highest value was obtained from Local variety (0.175), whereas the minimum was showed by Confute (0.029) followed by Flame which was not significantly different (Table 2). The seed size was significantly different at p ≤ 0.05. The highest value of seed size was recorded by Local variety with 1.842 and the lowest value was recorded by Confute variety with 0.723 which followed

by Flame variety (0.992). The water absorption index displayed significant differences at  $p \leq 0.05$  (Table 2). The local variety showed higher value of water absorption index compared to other varieties. In general, these results were in accordance with results of other researchers by [22, 23 and 24].

Table (1) Analysis of variance for different studied characteristics represented by Mean Squares

S.O.V	d.f.	Seed volume	Seed true density	Water absorption capacity	Seed size	Water absorption index	Thousand seed weight
<b>Block</b>	2	0.005	48.56	0.000212	0.09	0.000436	95276.44
<b>Varieties</b>	2	0.054*	5846.456*	0.0204*	1.0239*	0.00345*	299739.788 <sup>ns</sup>
<b>Error</b>	4	0.002	44.196	0.000014	0.070	0.00022	81392.369

F(2, 4)<sub>0.05</sub> = 6.944, (\*) Significant, (ns) Non significant

Table (1) Continued

S.O.V	d.f.	N content (%)	P content (ppm)	K content (%)	Protein content (%)	Oil content (%)	Ash content (%)
<b>Block</b>	2	0.112	11.36	0.0125	0.099	5.112	0.0106
<b>Varieties</b>	2	0.522*	418.193*	0.039*	18.721*	100.271*	0.455*
<b>Error</b>	4	0.016	8.979	0.0043	0.191	4.970	0.0013

F(2, 4)<sub>0.05</sub> = 6.944, (\*) Significant, (ns) Non significant

Table (2) Means of some physical characteristics of sunflower seeds varieties

Varieties	Seed volume (Hector/liter)	Seed true density(g/cm <sup>3</sup> )	Water absorption capacity (g)	Seed size (g)	Water absorption index (g)	Thousand seed weight (g)
<b>Confute</b>	0.087c	115.740a	0.029b	0.723b	0.041b	745.917a
<b>Flame</b>	0.177b	57.107b	0.035b	0.992b	0.036b	462.188ab
<b>Local</b>	0.350a	29.257c	0.175a	1.842a	0.097a	114.804b

Means followed by the same letters within each column are not significantly different at 0.05 levels.

### Chemical composition of seeds

It was also noticed that nitrogen content was proved to be significantly different Table (1). The contents of nitrogen were aligned from 2.953 to 3.71. The large amount of nitrogen was found by Flame while the less amount of nitrogen was shared by Local variety Table (3). Regarding the content of phosphors, the phosphors content was varied significantly from 60.134 to 83.108 Table (3). Confute was superior in phosphors content compare to the rest of varieties Table (3). Potassium content showed significant variation among three varieties. The potassium content was diverged from 0.628 for Flame to 0.843 for Local. Significant differences were determined among sunflower varieties for content of oil, protein, and ash Table (1). It is evident from Table (3) that Flame had maximum oil content (34.450%), whereas Local variety had the lowest oil content (24.103%). Significant divergence was exhibited among three varieties for ash content (Table 1). High ash content was obtained by local variety (2.883%), while Confute had minimum value of ash content (2.133%). Similar results were obtained by Ingale and Shrivastava [25].

Table (3) Means of some chemical contents of Sunflower seed varieties

Varieties	N content (%)	P content (ppm)	K content (%)	Protein content (%)	Oil content (%)	Ash content (%)
<b>Confute</b>	3.636a	83.108a	0.671b	22.245a	33.746a	2.133c
<b>Flame</b>	3.710a	76.350b	0.628b	22.685a	34.450a	2.692b
<b>Local</b>	2.953b	60.134c	0.843a	18.155b	24.103b	2.883a

Means followed by the same letters within each column are not significantly different at 0.05 levels.

### Relationship among studied traits

The correlation coefficients of the most important related, physical and chemical traits showed in table 4. The oil content was negatively and highly significantly  $p < 0.01$  affected by both seed size and protein content, their correlation coefficients ( $r$ ) were -0.96 and -0.95 respectively and also a negative and significant  $p < 0.05$  correlation coefficient observed with -0.65 between oil and ash contents. Whereas the oil content shows highly significant and positive correlation coefficient  $P < 0.01$  when plotted against the thousand seed weight which was 0.86.

Table (4) Correlation coefficient between some studied traits of sunflower varieties.

Parameters	SS	TSW	Protein%	Oil%	Ash%
SS	1.00				
TSW	-0.97**	1.00			
Protein%	-0.95**	0.85**	1.00		
Oil%	-0.96**	0.86**	-0.95**	1.00	
Ash%	0.84**	-0.94**	-0.63*	-0.65*	1.00

SS: Seed size, TSW: Thousand seeds weight, PC: Protein content %, OC: Oil content% and AC: Ash content%,  $r(7)_{0.05}=0.67$ ,  $r(7)_{0.01}=0.75$ .

### Conclusion

The analysis of variance demonstrated the existence of significant differences (at  $P < 0.05$ ) among studied varieties for all physical and chemical characteristics except thousand seeds weight. The results of physical properties showed that Local variety had highest values of seed volume, seed size, water absorption capacity and water absorption index. Regarding the chemical properties of seeds, the results stated that Confute variety gave high amount of nitrogen, phosphor, protein and oil.

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