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Effect of the preceding crop and organic or mineral fertilization on yield and oil components of sunflower

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ABSTRACT
A two-year field experiment was conducted in Etay El-Baroud Experimental Research Station, El-Beheira Governorate, Agricultural Research Center (ARC), Egypt, during 2018/2019 and 2019/2020 seasons to investigate the effects of preceded winter crops with organic (FYM) and mineral nitrogen (N) fertilizers on yield and its components, as well as seed quality of sunflower. This study included twelve combinations between three preceded winter crops (flax, wheat, and onion) and four fertilizer treatments (T1: (50% N + 50% farmyard manure, T2: 75% N + 25% farmyard manure, T3: 100% N and T4: 100% farmyard manure). A split-plot design with three replication was used. Three preceded winter crops were randomly assigned to the main plots, and four fertilizer treatments were allotted in sub plots. The preceding crops had a significant effect on most yield and yield components, the highest values (3.007 and 3.275 ton/ha) were obtained when sunflower grown after onion in the first and second seasons. Fertilizer treatments had a significant effect on number of seeds/head, 100-seed weight and seed yield/ha. The highest values (2.787 and 2.962 ton/ha) of seed yield of sunflower were obtained when the T1 treatment was applied at the first and second seasons. Growing sunflower after onion decreased percentage of two saturated fatty acids (palmitic acid and stearic acid), while increased the percentage of the 2 essential unsaturated fatty acids (oleic acid and linoleic acid), protein content and oil content, compared with sunflower grown after flax or wheat. The highest values of oleic acid (49.95 and 50.28%) and linoleic acid (35.81 and 37.86%) were observed by applying of T4 in both seasons. The highest palmitic acid values of (8.61 and 8.77%) and stearic acid (8.14 and 7.77%) were observed by fertilizing of T3 in both seasons, respectively. The fertilizer treatments of sunflower (T1 and T4) increased the percentage of unsaturated fatty acids/ saturated fatty acids%, while T3 decreased this percentage. Application of sunflower by 50% N + 50% FYM after onion uprooting can be recommended for increasing productivity and seed quality of sunflower.
Keywords: Flax, Wheat, Onion, Protein Seeds Percentage, Oil Percentage, Quality

INTRODUCTION
Sunflower (Helianthus annuus L.) is one of the most important oil crops and is considered the fourth most important crop in the world (FAOSTAT, 2019). In Egypt, the area devoted to sunflower in the crop structure is very limited. Where, sunflower area gained cultivation in 2019 was about 7 ha produced 21 tons with the average productivity of 3 ton he-1 (FAOSTAT, 2019).Therefore, increasing the cropped area of oil seed crops is an important target to reduce the gap between our production and consumption from edible oils (FAOSTAT, 2019) and (Alzamel *et al.*, 2022).

The sunflower crop is characterized by many advantages such as the short growth period, and it has a great ability to adapt on a wide range of different environmental conditions, the insensitivity to the photo period, there are many promising hybrids and varieties available from it, these varieties and hybrids showed high stability in area and productivity (Al-Aref *et al.*, 2011). Sunflower also has many other advantages such as high adaptability, ease of cultivation and growth in different conditions and soils, suitability for mechanization, and low labor needs (Al-Aref *et al.*, 2011).

Crop rotation and preceding short season crops is known as one of the main farming practices in the farming system. A well-planned rotation will reduce the spread of diseases, pests and weeds. It also provides many additional advantages such as increasing soil fertility, increasing the depth of the fertile layer, preventing erosion, and leads to the use of different layers of soil to the same extent. Therefore, it improves the chemical and physical composition of the soil and increases productivity of the crops (Kaya and Kolsarici, 2013). Due to the benefits and importance of the various rotation systems in which legumes participate, they are spread and applied in many countries with advanced agriculture (Kaya and Kolsarici, 2013).

The application and management of agricultural inputs is an imperative measure in improving production and profitability of any crop. In this direction, one of the most important and first major practices to modify plant growth and development, yield and quality is nitrogen fertilization. In context, onion, absorbs a high percentage of nitrogen and potassium its growth cycle and therefore needs fertilization with high levels of these elements (Negassa *et al.,* 2001;Najm *et al.,* 2013; Di Miceli *et al.,* 2022). Hence, the use of fertilizers is a very necessary and important practice to increase both yield and yield components, to ensure the optical and near qualities expected by consumers are maintained. The availability of plant nitrogen greatly affects the yield and quality (Negassa *et al.,* 2001;Najm *et al.,* 2013; Di Miceli *et al.,* 2022).

Mineral fertilizers play a major and important role in agricultural production in general and crops in particular. One of the most important mineral fertilizers in determining the growth and productivity of crops is nitrogen fertilizer; it is one of the components of proteins, enzymes and vitamins in plants. In addition, many genetic and structural compounds, amino acids and chlorophyll content in plant cells of necessary for biological yield synthesis (Siracusa *et al.,* 2013). However, increased N fertilization does not always increase yield, and may actually result in reduced growth and yield. Moreover, excessive use of N fertilizers leads to delayed ripening and sometimes lower yields (Tinna *et al.,*2020).

The tendency to use fertilization with farmyard manure increases due to the clarity of its importance and the benefits of fertilizing it year after year and because of the high cost of mineral fertilizers and their long-term harmful effect on the physical and chemical properties of the soil (Bocchi and Tano 1994; Najm *et al*., 2013). An experiment on the use of different fertilizer sources under an integrated nutrient management system in sunflower showed positive effects of nutrient integration (Bocchi and Tano 1994). Fertilization with farm manure improved soil fertility as well as providing and increasing the macronutrient and micronutrient content of the soil (Dogan *et al.,*2008; Di Miceli *et al.*, 2022).

One of the most important benefits of fertilizing with animal manure is that it leads to the addition and increase of organic matter in the soil, which in turn leads to a significant improvement in the chemical, physical and biological properties of the soil as well as works to reduce soil erosion and leads in addition to all of the above to increasing crop yields and improving its growth and quality (Petek *et al.*, 2012). Numerous studies and researches in different parts of the world have demonstrated the importance of organic fertilization. The use of 10 tons/ha and 20 tons/ha of farmyard manure led to a significant improvement in the productivity and quality of sunflower seeds (Scheiner *et al.,*2002; Elemike *et al.,*2019). In one of these studies, it was found that there was an improvement in the quality of the oil and an increase in the seed yield in sunflower by adding 10 tons per hectare of chicken manure, which is equivalent to 60 kg nitrogen / hectare. In contrast, the unfertilized experimental plots were significantly lower in growth, yield and dry matter compared to the plots to which organic fertilizer was added (Scheiner *et al.,*2002).

The main objectives of this study was to evaluate the effect of three preceding crops and different fertilizer sources of organic fertilizers (farmyard manure) and N mineral fertilizers on yield, yield components and quality traits of sunflower and the extent to which they improved yield, seed and oil quality.

MATERIALSAND METHODS

A two-year field experiment was conducted in Etay El-Baroud Experimental Research Station, El-Beheira Governorate, Agricultural Research Center (ARC), Egypt, during 2018/2019 and 2019/2020 seasons to investigate the effects of preceded flax, wheat, and onion with organic (FYM) and mineral nitrogen (N) fertilizers on yield and its components, as well as seed quality of sunflower. The treatments were the combination between three preceding winter crops (flax var. Sakha 1, wheat var. Sakha 94 and onion var. Giza 20, Red variety) and four fertilizer treatments (T1: 50% N + 50% FYM, T2: 75% N + 25% FYM, T3: 100% N and T4: 100% FYM. A split-plot design with three replications was used. Three preceded winter crops were randomly assigned to the plots, and four fertilizer treatments were allotted in sub plots.

The area of sub-plot was 10.80 m2, 6 ridges (60cm width), and 3.60 m x 3 m long. All preceding winter crops were given their convention cultural practices.

Soil samples were taken at a depth of 30 cm. **Table (1)** shows the mechanical analysis and chemical properties of the soil and the nutrients available in the soil.

Table 1. Properties of Physical and chemical of experimental site during 2018/2019 and 2019/2020 seasons before growing preceding crops.

Soil properties	Soil texture	Sand%	Silt%	Clay%	PH	Organic matter%	Available N (ppm)	Available P (ppm)	Available K (ppm)	EC (m mhos) cm-1 (1;5)
2019	Clay	7.08	32.53	61.39	7.71	2.10	17.06	10.3	220.87	1.5
2020	Clay	7.09	33.05	59.95	7.79	2.14	16.64	11.2	301.01	1.6

After harvesting of preceding winter crops, soil samples were collected depending on the preceding crops, on 30 cm depth, it was prepared for some physical and chemical characteristics of soil as shown in **(Table 2)**, which were measured at the laboratory of Soil and Water Science Department, (ARC). Nitrate N using Kjeldahl method described by Jakson (1958), available phosphorus according to Olsen *et al.* (1954), available potassium was analyzed in flame photo metrically determined as described by Volk and Truog (1934).

Table 2. Physical and chemical properties of the Soil of the Experiment Site after harvesting winter crops.

Soil variable	Flax		Wheat		Onion	
	2019	**2020**	**2019**	**2020**	**2019**	**2020**
PH	7.93	7.85	7.80	7.79	7.71	7.72
Organic matter (%)	1.98	1.99	2.02	2.05	3.23	3.45
Available N (%)	0.041	0.043	0.050	.051	0.093	0.095
Available P (mg/kg))	2.01	1.99	2.11	2.09	2.87	2.89
Available K (mmol/L)	0.419	0.423	0.513	0.515	0.697	0.701

Table (3) illustrated the physical and chemical characteristics of farmyard manure. Besides, provides information about the availability nutrients of farmyard manure (FYM).

Table 3. Chemical analysis of farm-yard manure fertilizer sample.

Mg (%)	Fe (%)	Zn (%)	Cu (%)	PH	Organic (carbon%)	Total K (%)	Total P (%)	Total N (%)
0.0266	0.0744	0.0109	0.0025	8.89	29.55	3.05	0.77	1.49

Table 4. Meteorological records during 2019 and 2020 seasons.

Meteorological records	**HC Air temperature (C0)**				**HC Relative humidity (%)**	
Season	**2019**	**2020**	**2019**	**2020**	**2018**	**2019**
Month	Minimum		Maximum			
May	22.0	17.1	40.9	38.0	62.1	65.0
June	20.3	20.5	40.8	40.2	71.8	73.0
July	20.5	19.1	35.9	37.3	79.0	74.8
August	20.0	17.4	35.4	36.7	77.3	72.2
September	19.0	17.0	32.4	35.7	73.2	68.5

Meteorological records of Central Laboratory for Agriculture Climate (Source: Etay El-Baroud Research Station) El-Beheira Governorate The Agriculture Research Center, Egypt, 2019 and 2020.

Mineral nitrogen (N) was used from urea (46% N), where the recommended dose was 72 kg N /ha for sunflower equal 156 kg urea was added in two equal doses, the first dose after thinning the plants and before the first irrigation, while the second dose was added before the second irrigating.

Organic fertilizer was added from farmyard manure (FYM)), according to the recommendation of Agricultural Research Center (ARC). Applying 48 m3/ha farmyard manure (FYR) equal 72 kg N/ha.

The preceding winter crops were planted at 20th and 15th Nov. for flax and wheat, while onion was transplanted at 20th and 15th Dec. as well as their harvested in the first May in both seasons.

Studied traits:

1- Seed yield and yield components:

At harvest, five plants were randomly chosen from each sub-plot to determine; plant height (cm), number of leafs /plant, head diameter (cm), number of seeds/head, seed weight/head (g), and 100-seeds weight (g). Seed yield/ha(ton) was determined from seed weight of each sub-plot and converted toon/ha.

2- Chemical composition of sunflower seeds (quality traits):

Sample of sunflower seeds was taken and dried to 70^{o}$_{C}$ unit constant weight to estimate the percentage of: Protein percentage (%): content of nitrogen was determined using modified Micro-Kjeldahl method.

- Crude protein content (%) was calculated by multiplying nitrogen content by 6.25, according to the method described by Association of Official Analytical Chemists (A.O.A.C., 1988).

- Oil percentage (%): The percentage of oil in seeds was determined by extraction with a Soxhlet apparatus according to the method described by Association of Official Analytical Chemists (A.O.A.C., 1990).

- Fatty acid methyl esters (FAMEs) were synthesized and determined, following the procedure provided by (A.O.A.C., 1990). Fatty acids percentage in oil, including oleic acid percent, linoleic acid percent, palmitic acid percent, stearic acid percent, and unsaturated / saturated fatty acids percent. For each treatment, three aliquots of 0.2 g of lipid extract were esterified with 10 mL of a methanolic NaOH solution by refluxing the mixture for 10 min at 85°C. The samples were boiled for 2 minutes after the addition of the internal standard (0.1mL of 2 g/L, C17:0) and 4.4mL of BF3-etherate. Hexane was used to extract the FAMEs from a salt-saturated mixture (3.0 mL). Anhydride Na2SO4 was added and centrifuged to dry FAMEs (7min, 2500 rpm, Kubota, 6900 Japan). The top portion was poured into a certain cell. By using a GC (UnicamPu 4550, UK) equipped with a capillary column (FFAP, 25 m, 0.25mm, or 0.22 m film thickness), the esters were separated. A carrier gas of helium was employed with an inlet pressure of 1.2 kg/cm2. Injection port and detector (FID) temperatures were kept at 200 and 240 °C, respectively, and the temperature programming for the column was carried out as follows: 170 °C for 4 minutes, followed by 180 °C at 31 °C/min, and finally 190 °C at 11 °C/min (25 min). All samples were tested in duplicate, and the peaks were identified based on their retention periods using genuine reference fatty acids methyl esters.

Statistical analysis:

The least significant difference (L.S.D.) at the 5% probability level was used for the comparison between the treatments. CoStat V 6.4 (2005) program was used to estimate analysis of variance (ANOVA).

RESULTS

Seeds yield and yield components:

The preceded winter crops:

The preceded winter crops affected significantly plant height, meanwhile number of leaves /plant was not affected in both seasons **Table (5**). Higher values of plant height was obtained for sunflower sowing after wheat harvest. Sowing sunflower after onion uprooting came in the 2nd rank for plant height. Flax is a crop that produces oil and fiber.

The preceded winter crops had significant effects on seed yield and its components in both seasons **Table (5**). Higher head diameter was obtained by growing sunflower after onion uprooting, meanwhile the converse was true by growing sunflower after flax harvest. The preceded winter crops had significant effect on number of seeds/head, weight of 100-seed, weight of seed /head and seed yield /ha in the two studied seasons. Sunflower plants grown after onion uprooting were superior compared with after flax or wheat for these traits. The highest values were 18.27 and 18.28 cm for head diameter, 940.95 and 923.07 seed for number of seeds/head, 7.63 and 8.45g for 100-seed weight, 66.88 and 71.16 g for weight of seeds/head and 3.007 and 3.275 ton for seed yield/ha at the first and second seasons, respectively, as shown in (**Table 5, and Figure 1**). While sowing sunflower after flax was recorded the lowest values, where16.63 and 17.18cm for head diameter, 777.46 and 750.37 seed for number of seeds/ head, 7.00 and 7.60 g for 100-seed weight, 53.93 and 59.77 g for weight of seeds /head and 2.424 and 2.407 ton for seed yield /ha in the first and second seasons, respectively, as shown in (**Table 5 and Figure 1**). The results indicated that, the increases in seed yield / ha was obtained from growing sunflower after onion uprooting were 19.39 and 15.56% in the first and second seasons over yields obtained than those growing after flax and wheat. The increases in seed yield / ha from growing sunflower after onion uprooting were 26.50, 17.77% in the first and second seasons over yields obtained than those growing after flax and wheat, respectively.

Table 5. Effect of the preceded winter crops on yield and its components of sunflower during 2019 and 2020 seasons.

Treatments	Plant height (cm)		No. of leaves/plant		Head diameter (cm)		No. of seeds/head		100-seed weight (g)		Seed weight /head		Seed yield /ha (ton)	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
After Flax	171.42b	172.04 b	22.75 ab	23.13ab	16.63c	17.18b	777.46c	780.37 b	7.00b	7.60b	53.93 c	59.77 c	2.424 c	2.407 c
After Wheat	186.29a	185.46 a	22.89 a	23.40a	17.08b	17.46b	846.52b	791.90 b	6.93b	7.84b	56.78 b	61.86 b	2.539 b	2.693 b
After Onion	184.75a	183.17 a	22.98 a	23.21ab	18.27a	18.28a	940.95a	923.07 a	7.63a	8.45a	66.88 a	71.16 a	3.007	3.275 a
L.S.D. at 5%	6.11	8.09	Ns	Ns	0.22	0.54	39.57	42.92	0.41	0.34	1.87	1.83	0.085	0.151

L.S.D.: least significant differences at 5% of probability, ns: non-significant differences. Alphabetic letters different represent the significant differences among the treatments at p < 0.05, according to Duncan's test.

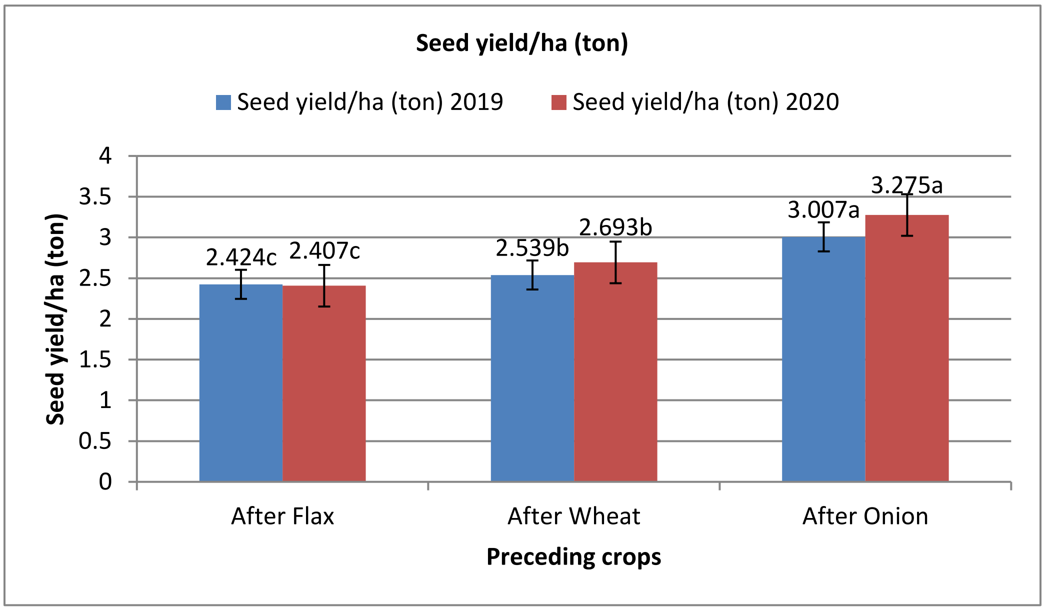

Fig. 1. The effect of preceding crops on seeds yield/ha (ton) of sunflower during 2019 and 2020 seasons. Alphabetic letters different represent the significant differences among the treatments at p < 0.05, according to Duncan's test. Bars represent the standard error.

Fertilizer treatments:

Fertilizer treatments had significant effects on plant height, while no significant effect was found on number of leaves /plant in both seasons (Table 6). Data in Table 6, obtained that applying of 75% mineral fertilizer of N resulted the tallest plants (182.50 and 183.22 cm) while applying of 100% FYM (T4) recoded the shortest plants (177.00 and 178.37 cm) in both seasons, respectively.

Fertilizer treatments had significant effects on yield and its components **Table (6)**. Seed yield/ha, seeds weight/ head and number of seed/ head, were significantly affected by fertilizer treatments in both seasons, while head diameter and 100-seed weight were significantly affected by fertilizer treatments in 2020 season only as shown in **Table (6).** Results showed that the highest values of head diameter and number of seeds/head were obtained when sunflower was fertilized of 100% FYM (T4) in both seasons. The treatment 100% FYM (T4) achieved the highest value of seed yield/ha (2.829 ton) by increasing percentage of 19.55% compared with 100% N (T3) in the first season. Meanwhile no differences significant were obtained between the treatments T1, and T4 at the 5% degree of probability for seed yield/ha in first season **(Table 6 and Figure 2).** There were no significant differences among treatments with regard to 100-seed weight in the first season. While, in the second season, 100-seed weight was significantly affected by fertilizer treatments, the highest 100-seed weight (8.18g) was obtained when sunflower was fertilized of 50% N +50% FYM (T1), while, the lowest values of 100-seed weight (7.80g) was recorded when sunflower was fertilized of 100% FYM (T4) **(Table 6)**. It is an established fact in many previous studies that organic fertilizer contains all micro and macro elements, these studies found a significant and positive response on the characteristics of stem height, seed yield, head diameter and growth components.

Table 6. Effect of fertilizer treatments on yield and its components of sunflower during 2019 and 2020 seasons.

Treatments	Plant height (cm)		No. of leaves/plant		Head diameter (cm)		No. of seeds/head		100-seed weight (g)		Seeds weight /head (g)		Seed yield/ha (ton)	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
T1 (50%N+50%FYM)	182.0a	179.5ab	22.79ab	22.96ab	17.20ab	17.58b	859.19b	823.35b	7.31a	8.18a	59.52b	65.72a	2.787a	2.962a
T2 (75%N+25%FYM)	182.5a	183.2a	22.84ab	23.30a	17.25ab	17.51b	848.37b	818.72b	7.34a	7.88b	58.30b	64.18a	2.731b	2.837b
T3 (100% N)	181.8a	179.8ab	23.21a	23.49a	17.26ab	17.28c	804.69c	789.20c	7.21a	7.99ab	56.44c	61.60b	2.276c	2.513c
T4 (100% FYM)	177.0b	178.4b	22.64b	23.26a	17.60a	18.17a	907.65a	895.85a	6.94ab	7.80b	62.52a	65.55a	2.829a	2.849b
L.S.D. at 5%	4.2	4.5	ns	Ns	ns	0.26	23.27	35.33	Ns	0.22	1.38	1.63	0.067	0.105
Interaction	Ns	ns	ns	Ns	ns	0.37	33.17	50.50	0.24	0.32	1.98	2.34	0.096	0.151

L.S.D.: least significant differences at 5% of probability, ns: non-significant differences. Alphabetic letters different represent the significant differences among the treatments at $p < 0.05$, according to Duncan's test.Bars represent the standard error.

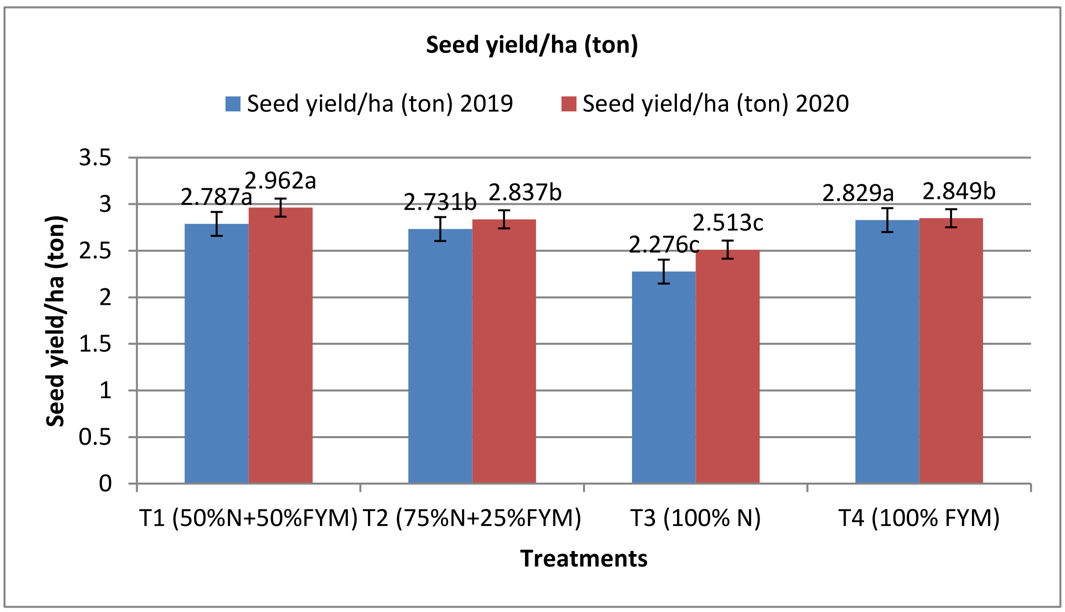

Fig. 2. The effect of fertilizer treatments on seeds yield/ha (ton) of sunflower during 2019 and 2020 seasons. Alphabetic letters different represent the significant differences among the treatments at $p < 0.05$, according to Duncan's test. Bars represent the standard error.

The interaction between the preceded winter crops and fertilizer treatments:

The data in **(Table 7)** shows the interaction between previous crops and fertilizer treatments on number of seeds/head, 100-seed weight, seed weight/head and seed yield / ha of sunflower in 2019 and 2020 seasons. From this data it is clear that there the interaction had significant on head diameter in the second season. The highest values for head diameter and number of seeds/ head were obtained by sowing sunflowers after onions uprooting and applying of 100% FYM (T4), while the lowest values of these characters by sowing sunflowers after flax and applying of 100% N (T3). The highest value of 100-seed weight (8.23 g) was obtained when sunflower was grown after onion uprooting and fertilizer of 75% N + 25% FYM (T2) in the first season. While, in the second season the highest value of 100-seed weight (8.50 g) was resulted when sunflower was fertilized of 100% N (T3). Whereas the lowest 100-seed weight (6.67 and 6.90 g) were obtained when sunflower was grown after flax and fertilizing of 100% FYM (T4) in the first and second seasons, respectively, Table 7. Concerning to seed weight / head and seed yield / ha, the highest values (70.39g and 3.226 ton) were resulted when sunflower was grown after onion uprooting with treatment of 100% FYM (T4) for these characters in the first season, while in the second season, the highest values (72.72g and3.548 ton) were recorded by fertilizing of 50% N + 50% FYM (T1) with the same cultivation of the sunflower after onion for these traits. Whereas, the lowest values (52.39 and 58.39g as well as 2.081 and 2.045 ton) were recorded when growing sunflower after flax and application of 100% N (T3) for these characters in both seasons, respectively.

Table 7. Effect of the interaction between the preceded winter crops and fertilizer treatments on yield and its components of sunflower during 2019and 2020 seasons.

Treatments		Head diameter(cm)	Number of seeds hesd^{-1}		100-seed weight (g)		Seed weight head^{-1}(g)		Seed yield ha^{-1}(ton)	
		2020	2019	2020	2019	2020	2019	2020	2019	2020
	T1 (50%N+50%FYM)	17.15ef	760.41j	755.68j	7.18c	8.00bc	53.67i	60.37g	2.531d	2.608efg
	T2 (75%N+25%FYM)	17.13ef	753.07k	743.34k	7.07cd	7.70d	53.01j	59.06h	2.522d	2.540fg
After flax	T3 (100% N)	17.01f	746.37i	733.89i	7.09cd	7.78cd	52.39k	58.39i	2.081f	2.045h
	T4 (100% FYM)	17.39d	849.97h	888.55d	6.67e	6.90e	56.66f	61.26f	2.560d	2.423g
	T1 (50%N+50%FYM)	17.30de	869.27f	779.19h	7.08cd	8.12b	56.22fg	64.07d	2.635cd	2.731de
After wheat	T2 (75%N+25%FYM)	17.27de	863.57g	783.18g	6.68e	7.55d	55.89g	62.25e	2.592cd	2.703ef
	T3 (100% N)	17.08f	773.02i	770.60i	7.03cd	7.68d	55.00h	58.95hi	2.228e	2.446g
	T4 (100% FYM)	18.17b	880.21e	834.60f	6.94d	8.01bc	60.00e	64.17d	2.701c	2.890cd
	T1 (50%N+50%FYM)	18.31b	947.90b	935.17ab	7.56b	8.42a	68.67b	72.72a	3.196a	3.548a
After onion	T2 (75%N+25%FYM)	18.13b	928.46c	929.65c	8.23a	8.39a	66.01c	71.23b	3.078b	3.269b
	T3 (100% N)	17.74c	894.68d	863.10e	7.52b	8.50a	61.94d	67.47c	2.520d	3.047c
	T4 (100% FYM)	18.95a	992.77a	964.38a	7.22c	8.48a	70.89a	71.22b	3.226a	3.234b
L.S.D. at %		0.37	33.17	50.50	0.24	0.32	1.98	2.34	0.096	0.151

L.S.D.: least significant differences at 5% of probability. Alphabetic letters different represent the significant differences among the treatments at $p < 0.05$, according to Duncan's test.

Quality attributes of sunflower:
Effect of the preceded winter crops:
Protein% and oil% in seeds:

The preceded winter crops had significant effects on protein percentage and oil percentage in sunflower seeds in both seasons (**Table 8 and Figure 3**). The highest protein % (16.98 and 17.02%) in seeds and oil % (30.94 and 32.49%) in seeds were obtained when sunflower was grown after onion uprooting in the two studied seasons, respectively. While the lowest protein % (14.17 and 15.14%) in seeds, and oil% (28.45 and 30.12%) in seeds were obtained when sunflower was grown after flax in the first and second seasons, respectively.

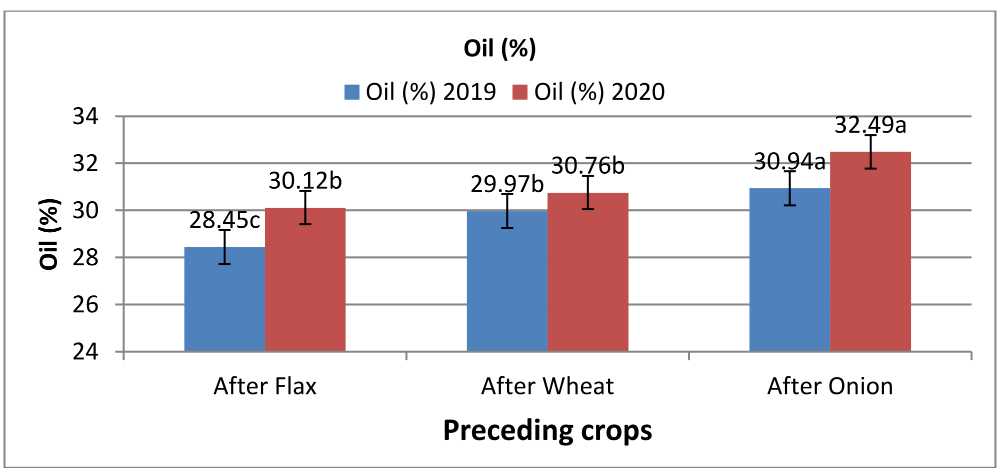

Fig. 3. Effect of preceding crops on oil (%) of sunflower during 2019 and 2020 seasons. Alphabetic letters different represent the significant differences among the treatments at $p < 0.05$, according to Duncan's test. Bars represent the standard error.

Table 8. Effect of the preceded winter crops on quality traits of sunflower during 2019 and 2020 seasons.

Treatments	Protein%		Oil%		Oleic acid (%)		Linoleic acid (%)		Palmitic acid (%)		Stearic acid (%)		Unsaturated/ saturated fatty acids (%)	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
After Flax	14.17b	15.14b	28.45c	30.12b	44.30c	44.32c	33.03b	32.98c	8.85a	9.04a	7.56a	7.36a	4.76c	4.79c
After Wheat	14.69b	15.39b	29.97b	30.76b	49.07b	48.25b	33.05b	34.22b	8.38b	8.47b	7.26b	7.21a	5.28b	5.31b
After Onion	16.98a	17.02a	30.94a	32.49a	49.78a	48.82a	35.16a	36.29a	7.75c	7.85c	6.11c	6.40b	6.18a	6.03a
L.S.D. at 5%	0.93	0.36	0.83	0.67	0.38	0.57	0.92	0.46	0.14	0.18	0.33	0.33	0.35	0.16

L.S.D.: least significant differences at 5% of probability. Alphabetic letters different represent the significant differences among the treatments at $p < 0.05$, according to Duncan's test.

Oleic acids% and linoleic acid% in oil:

The preceded winter crops had significant effects on oleic acid% and linoleic acid% in sunflower oil in both seasons **(Table 8).** The highest values of oleic acid% (49.78 and 48.82%) and linoleic acid% (35.16 and 36.29%) were recorded when sunflower was grown after onion uprooting, while the lowest values (44.30 and 44. 32%) and (33.04 and 32.98%) was resulted when sunflower was grown after flax in the first and second seasons, respectively. Sowing sunflower after onion uprooting increased oleic acid and linoleic acid in oil by 11.01 and 9.22% as well as 6.06 and 9.12% compared to sowing sunflower after flax in both seasons, respectively.

Palmitic acids% and stearic acid% in oil:

The preceded winter crops had a significant effect on the percentage of palmitic acid and stearic acid in sunflower oil in both seasons **(Table 8).** The highest values of palmitic acid % (8.85 and 9.04%) and stearic acid % (7.56 and 7.36%) were recorded when sunflower was grown after flax in the two studied seasons, respectively, whereas the lowest values (7.75 and 7.85%) for palmitic acid %, and (6.11 and 6.40%) stearic acid % were resulted when sunflower was grown after onion uprooting in the first and second seasons, respectively. In general, a very large decrease in yield and a significant decrease in quality occurs for most crops when sowing and growing on flax residue.

The ratio of fatty acids unsaturated/ fatty acids saturated% in oil:

The data in **(Table 8)** revealed the ratio of fatty acids unsaturated/ fatty acids saturated% in oil, the highest unsaturated / saturated % in oil (6.18 and 6.03%) were obtained when sunflower was grown after onion uprooting, while the lowest unsaturated/saturated fatty acids % in oil (4.76 and 4.79%) were recorded when sunflower was grown after flax harvest in 2019 and 2020 seasons, respectively. It is very interesting for all producers to increase global production and profitability of sunflower, and to increase production of oils containing unsaturated fatty acids to preserve human health.

Fertilizer treatments:

Protein% and oil% in seeds:

Fertilizer treatments had significant effects on protein% and oil% in sunflower seeds in 2019 and 2020 seasons **(Table 9).** Protein% increased from 15.26 and 15.47% by application of 50%N+50% FYM (T1) to 16.21 and 17.13% by application of 100% N (T3), while decreased to 14.35 and 14.80% by application of 100% FYM (T4) in the two studied seasons, respectively. Oil% was increased to (34.06 and 33.58%) by using treatment of 100% FYM (T4), on the other hand, oil % in seed was decreased from 30.77 and 31.02% by using of 50% N +50% FYM (T1) to 26.56 and 28.86% by using of 100% N (T3), compared to 100% N (T3, as control treatment) which gave the lowest values of seed oil content **Table (9) and Figure (4).**

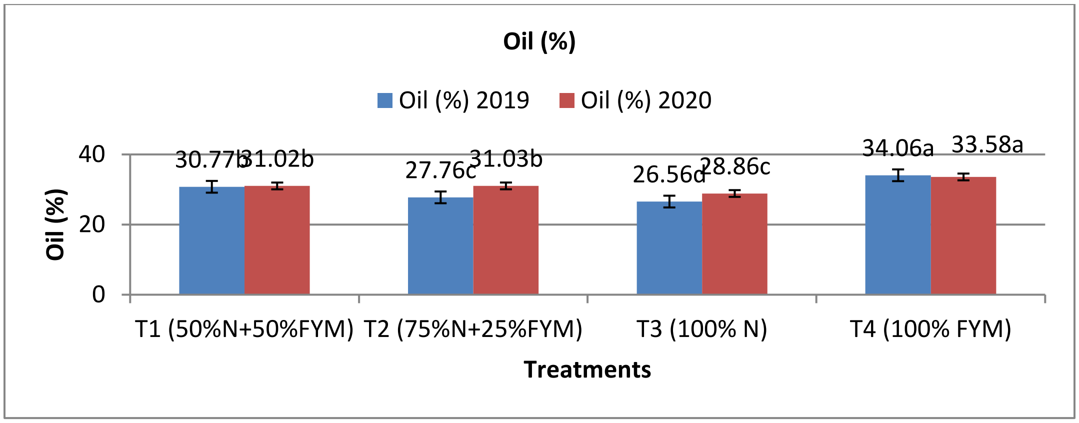

Fig. 4. Effect of fertilizer treatments on oil (%) of sunflower during 2019 and 2020 seasons. Alphabetic letters different represent the significant differences among the treatments at p < 0.05, according to Duncan's test. Bars represent the standard error.

Oleic acids% and linoleic acid% in oil:

Fertilizer treatments had significant effects on oleic acid % and linoleic acid % in sunflower oil in both seasons **(Table 9)**. The highest values (49.95 and 50.28% as well as 35.81 and 37.86%) were obtained by fertilization of 100% farmyard (T4), whereas the lowest values (45.99 and 44.14% as well as 29.31 and 30.46%) by fertilization of 100% N mineral (T3, as control treatment) in the first and second seasons, respectively.

Palmitic acids% and stearic acid% in oil:

Fertilizer treatments had significant effect on palmitic and stearicacids percentage in both seasons as shown in **Table (9).**Palmitic and stearic acids in oil of sunflower were taken the opposite trend compared with oleic acid and linoleic acid in sunflower oil, Therefore the highest values for palmitic and stearic acids (8.61 and 8.77% as well as 8.14 and 7.77%) were recorded by applying of 100% mineral N (T3), while the lowest values for palmitic and stearic acids in sunflower oil (8.26 and 8.25% as well as 6.23 and 6.33%) were resulted by applying of 100% farmyard manure (T4) in the first and second seasons, respectively.

Table 9. Effect of different fertilizer treatments on quality traits of sunflower during 2019 and 2020 seasons.

Treatments	Protein%		Oil%		Oleic acid (%)		Linoleic acid (%)		Palmitic acid (%)		Stearic acid (%)		Unsaturated/ Saturated fatty acids (%)	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
T1 (50%N+50%FYM)	15.26b	15.47c	30.77b	31.02b	47.74b	47.26b	35.35a	36.19b	8.02c	8.20ab	6.30c	6.52c	5.85a	5.72b
T2 (75%N+25%FYM)	15.30b	16.00b	27.76c	31.03b	47.20b	46.84b	34.52b	33.45c	8.42ab	8.59a	7.23b	7.34b	5.29b	5.11c
T3 (100% N)	16.21a	17.13a	26.56d	28.86c	45.99c	44.14c	29.31c	30.46d	8.61a	8.77a	8.14a	7.77a	4.53c	4.56d
T4 (100% FYM)	14.35c	14.80c	34.06a	33.58a	49.95a	50.28a	35.81a	37.86a	8.26b	8.25ab	6.23c	6.33c	5.97a	6.12a
L.S.D. at 5%	0.53	0.70	0.63	0.65	0.82	0.89	0.68	0.63	0.24	0.28	0.20	0.21	0.19	0.21
Interaction	0.76	Ns	Ns	ns	ns	1.27	0.97	0.91	0.34	ns	0.28	0.30	ns	ns

L.S.D.: least significant differences at 5% of probability, ns: non-significant differences. Alphabetic letters different represent the significant differences among the treatments at p < 0.05, according to Duncan's test.

Fatty acids unsaturated/ fatty acids saturated% in oil:

The results in **(Table 9),** showed that maximum mean values for the ratio of unsaturated/ saturated acids % (5.85 and 5.72%) were obtained by applying of 50% FYM + 50% N (T1) and (5.97 and 6.12%) were obtained by applying of 100% FYM (T4), in both seasons respectively, while no differences in unsaturated acid/saturated acid ratio were observed between different combinations of organic 50% FYM + 50% N (T1) and 100% FYM (T4) in the first season **(Table 9).** While the minimum values (4.53 and 4.56%) were observed by adding of 100% N (T3). The maximum mean values for the ratio of unsaturated/ saturated acids % (5.85 and 5.72%) were obtained by applying of 100% FYM (T4), in both seasons respectively, while no significances differences in unsaturated acid/saturated acid ratio were found between combinations of organic 50% FYM + 50% mineral N (T1) and 100% FYM (T4) in the first season (Table, 9). While the minimum values (4.53 and 4.56%) were observed by adding of 100% N (T3).

The interaction between the preceded winter crops and fertilizer treatments:

Protein% in sunflower seeds:

Data in **Table (10)** showed that, protein% was significantly affected by interaction in 2019 season only, the highest value (18.58%) were obtained when grown sunflower after onion uprooting and addition of 100% mineral N (T3), while protein% fell to the lowest percentage when sowing sunflower after wheat then flax, and adding of 100% FYM (T4). The percentage of protein in seeds is related to the percentage of available nitrogen, especially sowing sunflower after onions.

Fatty acids% in oil:

Data in Table (10) showed that, oleic acid% was significantly affected by interaction between the preceded winter crops and different fertilizer treatments during in 2020 season, while Linoleic acid% was significantly affected by interaction in both seasons. Plamiteic acid% was significantly affected by interaction in 2019 season, but stearic acid% was affected significantly by interaction in 2019 and 2020 seasons. The highest oleic acid (51.57%) in oil was resulted by fertilization of 100% FYM (T4) and sowing sunflower after onion, followed by sowing sunflower after wheat under the same fertilizer treatment (T4), Linoleic acid% was took the same direction, where the highest values (37.25 and 38.20%) in oil were resulted by applying of 100% FYM (T4) and sowing sunflower after onion uprooting, followed by sowing sunflower after wheat under the same fertilizer treatment (T4) in both seasons, respectively. While saturated fatty acid (Palmiteic acid% and stearic acid%) were took the opposite trend compared with oleic acid and linoleic acid in sunflower oil, therefore the highest plamiteic acid% (9.23%) in oil was resulted by applying of 100% N (T3) and sowing sunflower after flax. Also the highest stearic acid% (8.65%) in oil was resulted by applying of 100% N (T3) and sowing sunflower after flax in the first season, while in the second season the highest value (8.10) in oil when sowing sunflower after flax and applying of 75% N + 25% FYM (T2). Followed by sowing sunflower after wheat under the same fertilizer treatment (T3), the minimum palmiteic acid and stearic acid% (7.58% for plamiteic acid in 2019 season, 5.48 and 5.81% for stearic acid in both seasons) in oil were recorded by adding of 100% FYM (T4) and sowing sunflower after onion uprooting.

Table 10. Effect of interaction between preceding crops and fertilizer treatments on sunflower oil quality during 2019 and 2020 seasons.

Treatments		Protein (%) in seeds	Oleic acid (%) in oil	Linoleic acid%		Plamiteic acid (%)	Stearic acid (%) in oil	
		2019	2020	2019	2020	2019	2019	2020
After flax	T1 (50%N+50%FYM)	14.29fg	45.94e	35.48d	33.46e	8.73bc	6.87e	6.83c
	T2 (75%N+25%FYM)	14.19gh	44.12f	33.74f	32.60f	8.89b	7.98b	8.10a
	T3 (100% N)	14.39f	39.33g	27.20i	28.49i	9.23a	8.65a	7.67b
	T4 (100% FYM)	13.82h	47.88c	35.75cd	37.33c	8.55c	6.75e	6.84c
After wheat	T1 (50%N+50%FYM)	15.09e	47.51c	33.93f	37.45bc	7.69e	6.39f	6.97c
	T2 (75%N+25%FYM)	14.59f	47.76c	33.94f	31.90g	8.68bc	7.69c	7.45b
	T3 (100% N)	15.67d	46.33e	29.86h	29.45h	8.51c	8.47a	8.06a
	T4 (100% FYM)	13.40hi	51.38a	34.43e	38.06a	8.64c	6.47f	6.34d
After onion	T1 (50%N+50%FYM)	16..39c	48.32b	36.65b	37.65b	7.63e	5.65h	5.75e
	T2 (75%N+25%FYM)	17.12b	48.64b	35.88c	35.85d	7.69e	6.02g	6.47d
	T3 (100% N)	18.58a	46.77d	30.88g	33.43e	8.08d	7.29d	7.57b
	T4 (100% FYM)	15.84d	51.57a	37.25a	38.20a	7.58e	5.48h	5.81e
L.S.D. at 5%		0.76	1.27	0.97	91	0.34	0.28	0.30

L.S.D.: least significant differences at 5% of probability. Alphabetic letters different represent the significant differences among the treatments at p < 0.05, according to Duncan's test.

DISCUSSIONS

The most important outcomes of following two-, three-year or longer agricultural rotations is improved physical, chemical, and biological soil quality, improved water conservation and timing of land preparation, and improved energy conservation. So it needs fertile soil rich in nutrients. The information and experience of crop producers over more than 2000 years has informed our current understanding of the "most well-known" crop rotation systems, and discussion of these other mechanisms (such as changes in soil structure, changes in root biology, and allelopathy) that may fully assist In explaining the benefits of crop rotation and rotation (Kirkegaard *et al.*, 2008).

This study deals with the effect of some preceding crops i.e. flax, wheat and onion, organic and nitrogen mineral fertilizers treatments on yield, protein and oil percentage in seeds as well as chemical composition of oil of sunflower. The highest plant was obtained for sunflower growing after wheat, followed by growing sunflower after onion. Meanwhile, number of leaves/plant not significant differences between growing sunflower after wheat and growing sunflower after onion for this character (**Table 5**). Flax is a crop that produces oil and fiber, so it needs fertile soil rich in nutrients. So, it stresses the soil and thus affects the subsequent crop. Yield and yield components of sugar beet decreased by intercropping with flax (Grande *et al.,* 2005). So, it stresses the soil and thus affects the subsequent crop. Yield and yield components of sugar beet decreased by intercropping with flax (Zen El-Dein, 2015). On the level of 9-year average results, there were no significant differences in the growth and yield of sunflower preceded by wheat, corn and sugar beet (Crnobarac *et al.,* 2010).

The preceding winter crops had significant effect on yield and its components in both seasons **Table (5) and Fig (1)**. The highest head diameter was resulted when planted sunflower after onion, whereas the lowest head diameter was recorded when planted sunflower after flax. The preceding crops had significant effect on number of seeds / head, weight of 100-seed, weight of seeds / head and seed yield /ha in the two studied seasons. Sunflower plants grown after onion were superior compared with after flax or wheat for these traits. These results may be due to cultivation of onions a led to increasing availability of soil contents of fertility and nutrients. Also, onions are characterized by a short growing season that leads to the comfort of the soil and its lack of stress. It also secretes substances that lead to resistance to diseases and insects, the use of crop rotations that differ in the nature of their growth and the growth of their roots and are suitable for the high fertility found in the soil of onions (Crnobarac *et al.,* 2000; Beattie, 2020). After planting flax there is usually a transfer of nutrients and moisture down to the soil depth of 70 cm causing stress on the next crop. After planting flax, some limited residues of straw and flax waste are left and this causes many problems in the soil and for the next crop (Growing Flax in Canda, 2019).

Fertilizer treatments had significant effect on plant height, while no significant effect was observed on number of leaves /plant in both seasons (**Table, 6).** This may be due to, number of leaves/ plant is a geneticist character, low-impact of environmental factors. Fertilizer treatments are equal in the amount of nitrogen available to plants. Manure and inorganic fertilizer effects on sunflower growth, and seed yield was not changed significantly by any of the treatments (De Lucas, *et al.,* 2008). Significantly increased growth, seedling vitality, and cold germination test performance, due to the addition of high nitrogen rate, and foliar spraying of three concentrations of potassium (Sawan *et al.,* 2009). Fertilizer treatments had significant effects on yield and its components **(Table 6 and Fig 2**). 100% FYM (T4) recorded the highest values of head diameter, number of seeds/head and seed yield/ha. It is an established fact in many previous studies that organic fertilizer contains all micro and macro elements. The soil physical composition is improved by using FYM, which increases the availability of organic carbon, N, P, Zn, K, Ca, and Mn in the soil (Azarmi *et al.,* 2008). The organic fertilizer treatments to sunflower showed a significant effect on the seeds weight/plant and they attributed the increase in these traits to the increase in the shelling percentage and seed index (Al-Aref *et al*., 2011 ; Alzammel *et al.,* 2022). Some previous studies have determined that, nitrogen from organic sources is uptake and absorbed by plants faster than nitrogen from inorganic sources. This is because the third step of the mechanism of nitrogen uptake and assimilation in plants is the assimilation of inorganic nitrogen into organic nitrogen (Nasim, 2010). In addition, organic fertilization had a significant effect on sunflower growth, where the field fertilized with organic fertilizer was significantly superior to the field that was not fertilized organically (Rasool *et al.,* 2013). The use of increasing doses of nitrogen led to a significant decrease in the dry matter percentage; It also led to a reduction in the absorption of calcium, which is an essential component of the cellular structure, and thus can reduce the stiffness of the various organs of the plant (Sharma *et al.,* 2008; Singh *et al.,* 2011; Di Miceli *et al.,* 2022). The use of organic fertilizer works to dismantle the soil granules and increase its fertility, in addition to that the fertilization with organic fertilizer works to equalize the pH of the soil, all of which led to an increase in the yield and its components in sunflower. Mixing organic fertilizer and mineral nitrogen at a ratio of 25 + 25 kg/ha resulted in obtaining the highest yield of sunflower, (Sharma *et al.,* 2008). The highest yield of sunflower was also obtained by applying the treatment 50:75: 50 metal NPK + 8 tons of poultry manure per fed (Munir *et al.,* 2007).

Sunflowers planted with the previous crops are affected, whether they are stressful to the soil or those that need high fertility and fertilization **Table (7).** It was found that sunflowers grown after potatoes, which were fertilized with NPK at 150% of the recommended rate, or fertilized with organic fertilizer such as FYM + N, require only half of the rate. NPK recommended for maximum productivity Planting sunflower after onion uprooting resulted to yield increase and can improve the quality and of the storage in terms of flavor and physical properties, because of the residual effect of onions and the natural nutrients that are slowly added to the plant (Seiler, 1986; Wagner, 2011; Buriro *et al.,*2015; Tae-Won *et al.,* 2017; Khodae-Joghan *et al.,*2018; Saleem *et al.,* 2020).

Planting sunflower after onion crop resulted to yield increase and can improve the quality and of the storage in terms of flavor and physical properties, because of the residual effect of onions and the natural nutrients**.** Data in **Table (8) and Fig (3)** showed that protein percentage and oil percentage in sunflower seeds were increased significantly affected by preceding crops in the two seasons. The root systems of each species differ structurally, for example rapeseed requires less water than grain, and tracking crops appear to be very efficient in terms of soil resource use. Furthermore, the seeds of a crop may be a nutrient-rich crop left after harvest, and the use of the remaining nutrients by a subsequent crop can improve its yield and the profitability of the system. Planting sunflower after onion uprooting resulted to yield increase and can improve the quality and of the storage in terms of flavor and physical properties, because of the residual effect of onions and the natural nutrients that are slowly added to the plant ((Thomas, 2008; Alzammel *et al.,* 2022). Furthermore, the seeds of a crop may be a nutrient-rich crop left after harvest, and the use of the remaining nutrients by a subsequent crop can improve its yield and the profitability of the system (Thomas, 2008).

Sowing sunflower after onion increased oleic acid and linoleic acid in oil. These results may be due to onion are not depleted of soil nutrients and produce environmentally friendly substances. The leftover residue after harvesting onions is a natural and environmentally friendly material that is very beneficial for subsequent cultivations (Seiler, 2007; Sharma *et al.* 2008; Buriro *et al.,* 2015;).

The data recorded that the previous crops had a significant effect in both seasons on the percentage of palmitic acid and stearic acid in sunflower oil, while the Linoleic acid took the opposite direction of the previous characteristics in the two studied seasons. This might be due to excretion or presence of some substances that inhibit germination and decrease of growth, addition to increase of the major plant pathogens that affect crop productivity and secrete substances that increase pollution after flax. This topic still needs more research and future studies in order to better understand this phenomenon associated with flax to overcome it and to increase the efficiency of pollutant removal (Seiler**,** 2007**).** It is very interesting for all producers to increase global production and profitability of sunflower, and to increase production of oils containing unsaturated fatty acids to preserve human health, Table 8. Agricultural policies such as crop succession must be followed after vegetable crops and legume crops. Hence, the cultivating people after onions (Buriro *et al.,* 2015; Tae-Won *et al.,* 2017).

The addition of organic fertilizer with the 50% of the recommended dose of mineral or inorganic fertilizers led to an increase in the percentage of protein and oil percentage in sunflower seeds (**Table, 9 and Figure 4**). Nitrogen fertilization is one of the most effective agricultural methods yield and quality of agricultural products; Providing optimal amounts of nitrogen for each type of crop is important for meeting the nutritional needs of the crop and maximizing production and quality (Montagu and Goh, 1990; Seiler**,** 2007; Rasool *et al.***,** 2013**;**). In this direction, fertilization with poultry dung manure, followed by goat/sheep manure resulted increase of the oil content of sunflower seeds compared to the rest of the treatments (Seiler, 1986; Akbari *et al.,* 2011; Saleem *et al.,*2020;).

Organic fertilization (municipal) increased unsaturated fatty acids (oleic acid and linoleic acid) in sunflower oil and reduced pollution from mineral fertilizers and is environmentally friendly, thus reducing blood pressure and atherosclerosis. The integrated fertilization with FYM + N improved soil fertility and increased its content of NPK, and also led to an increase in the soil organic carbon content compared to the recommended dose of NPK fertilizer only (Anderson and Beardall 1999; Buriro *et al*., 2015; Saleem *et al.,* 2020;)**.** Mineral fertilization increased palmitic and stearic acids in sunflower oil and increased pollution, in addition to its high costs for farms. Fertilization with varying rates of farmyard manure and nitrogen fertilizers had a clear effect on the percentage of palmitic acid and the percentage of fatty acids, Table (9). Palmitic and stearic acids in the oil of sunflower were taken the opposite trend compared with oleic acid and linoleic acid in sunflower oil. Mineral fertilization increased palmitic and stearic acids in sunflower oil and increased pollution, in addition to its high costs for farms. The nitrogen supply rates affect the formation of fatty acids in sunflower oil (Steer and Seilor, 1990; Saleem *et al.,* 2020).

The results of Table 9, showed the effect of different rates of farmyard manure (FYM) with N fertilizer on unsaturated /saturated fatty acids % in oil of sunflower. Fats are divided into saturated and unsaturated fats, saturated fats increase blood cholesterol levels, while unsaturated fats show the opposite trend; they are mostly from plant sources. The most common saturated fatty acid found in vegetable fats has 16 or 18 carbon atoms. Accordingly, the low saturated fatty acid content is desirable for edible uses. Typically, only palmitic acid (C16) and stearic acid (C18) are present in significant quantities, but saturated fatty acids collectively account for only 20% of the total fatty acid content of most plants, while those with one or more double bonds (unsaturated fatty acids) account for the remaining 80%. In the chemical composition of the oil in many of the fatty seeds, oleic [18:1 (9°C)] and linoleic [18:2 (9°C, 12°C)] acids often account for more than 70% of the fatty acid content. (90% in sunflowers) (Khaliq *et al*., 2008; Akbari *et al*., 2011). Alzamel *et al.* (2022) found that the amount of oil was affected and increased significantly, as well as unsaturated fatty acids, to a large extent by the source of organic nitrogen during the period of oil accumulation and seed ripening.

Data in **Table (10)** showed that, Unsaturated fatty acids (oleic acid and linoleic acid) and saturated fatty acids (plamiteic and stearic acid) were significantly affected by interaction between the preceded winter crops and different fertilizer treatments. The highest oleic acid and Linoleic acid% in oil was resulted by fertilization of 100% FYM (T4) and sowing sunflower after onion uprooting. The minimum palmiteic acid and stearic acid% were obtained by adding of 100% FYM (T4) and sowing sunflower after onion uprooting. Onions are carbonate substances and other substances, working on disease and insects, in addition to the remaining effect to increases the soil properties, reduces pollution, and increases quality. Similar results were finding by (Beattie, 2020; Crnobarac *et al.,* 2000). Significant decrease in oleic fatty acid content occurs with increasing nitrogen fertilization. Oleic acid and linoleic acid content were negatively correlated with both stearic acid and palmitic acid (Boydak *et al*., 2010; Li *et al.,* 2017).

CONCLUSION

The preceding crops are one of the main agricultural practices in the farming system. Which works to reduce the spread of diseases, pests, and weeds if it is well planned and provides many additional benefits such as increasing soil fertility and leads to the use of different layers of soil to the same extent. From the obtained results, it could be concluded that sowing sunflower after onion uprooting and fertilized by 50% N with 50% farmyard manure equal 36 kg N + 24 m3 FYM/ ha produced the highest values of seed yield, protein percentage and oil percentage of sunflower, as well as improved of chemical composition and nutritional value of oil of sunflower. Whereas, decrease saturated fatty acids (palmitic and stearic) and conversely resulted in a significant increase in linoleic and oleic acids (unsaturated fatty acids) compared to plants application of 100% mineral nitrogen. It is further noted that the nitrogen fertilizers should not be applied alone, rather in combination with FYM and onion as preceding crop.

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تأثير المحصول السابق والتسميد العضوي أو المعدني على المحصول ومكونات زيت عباد الشمس

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أجريت تجربة ميدانية لمدةعامين في محطة بحوث إيتاى البارود بمحافظة البحيرة مركزالبحوث الزراعية ، مصر، خلال موسمي 2019/2018 و2020/2019 لبحث تأثيربعض المحاصيل الشتوية السابقة مع أربعة مصادرمختلفة للأسمدة العضوية من روث المزرعة (FYM) والأسمدة المعدنية (N)، على المحصول ومكوناته وصفات الجودة لزهرة الشمس. هذه الدراسة تضمنت 12 معاملة بين ثلاثة محاصيل شتوية سابقة (الكتان,القمح والبصل) واربع معاملات للأسمدة كالاتي:

(T1: (50% N + 50% farmyard manure, T2: 75% N + 25% farmyard manure, T3: 100% N and T4: 100% farmyard manure).

بتصميم قطع منشقة مرة واحدة في ثلاث مكررات. المحاصيل السابقة وزعت عشوائيا في القطع الرئيسية, ومعاملات التسميد في القطع المنشقة. كان للمحاصيل السابقة تأثيرا معنويا على المحصول ومكوناته، حيث تم الحصول على أعلى القيم 3.007 و 3.275 طن / هكتار عند زراعة عباد الشمس بعد البصل في الموسمين الأول والثاني. كان لمعاملات الأسمدة تأثيرا معنويا على عدد البذور / القرص, ووزن 100 بذرة ومحصول البذور / هكتار. تم الحصول على أعلى قيم 2.787 و 2.962 طن / هكتار من محصول بذور دوارالشمس عند تطبيق معاملة السماد T1 في الموسمين الأول والثاني. أدى نمو دوارالشمس بعد البصل إلى انخفاض نسبة الأحماض الدهنية المشبعة (حمض البالمتيك وحمض الاستيارك)، بينما زادت نسبة الأحماض الدهنية غير المشبعة الاساسية (حمض الأوليك وحمض اللينوليك) ومحتوى البروتين ومحتوى الزيت، مقارنة بدوار الشمس المزروع بعد الكتان أوالقمح. ووجد ,أعلى قيم لحمض الأوليك (49.95 و 50.28٪) وحمض اللينوليك (35.81 و 37.86٪) بمعاملة السماد T4 في كلا الموسمين. سجلت أعلى قيم لحمض البالمتيك (8.61 و 8.77٪) وحمض الاستيارك (8.14 و 7.77٪) بمعاملة السماد(T3) في كلا الموسمين على التوالي. أدت معاملاتين السمادT1) و (T4إلى زيادة نسبة الأحماض الدهنية غير المشبعة / الأحماض الدهنية المشبعة ٪، بينما خفضت المعاملة السمادية (T3) نسبة الأحماض الدهنية غير المشبعة / الأحماض الدهنية المشبعة ٪في الزيت. من هنا تكون الزراعة بعد البصل كمحصول سابق مع التسميد بالأسمدة النيتروجينية وروث المزرعة(T1) إلى زيادة كلا من محصول البذور وجودة الزيت لدوار الشمس.

الكلمات المفتاحية: كتان ، قمح ، بصل ، البروتين ، نسبة الزيت ، الجودة