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PHYSIOLOGICAL AND CHEMICAL RESPONSE OF SUNFLOWER TO SOME ORGANIC NITROGEN SOURCES AND CONVENTIONAL NITROGEN FERTILIZERS UNDER SANDY SOIL CONDITIONS

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ABSTRACT: Two sunflower (*Helianthas annus* L. cv. Vidoc hybrid) field experiments were performed in El-Khattara region (Sharkia Governorate, Egypt) during 2005 season to study the effect of organic- N sources and their combination as well as to compare the effect of organic sources and ammonium sulfate (A.S.) as a conventional fertilizer added individually or in combinations on growth, yield components, oil percentage as well as uptake of some macronutrients by plant grown on a sand soil. The organic sources were farmyard manure (FYM), chicken manure (Ch.M) and palma residues (Pa.R); Ch.M and (FYM + Ch.M of 1/1 ratio of added N) were superior to the other treatments and gave the highest yield, dry matter yield, NPK uptake by plant at all growth stages as well as seed yield at maturity stage. The promotive effect of the different organic sources of nitrogen on the yield and its components may follow the order; Ch.M> Pa.R> FYM. This was more emphasized when the materials were mixed with ammonium sulfate at the ratios of 3/1 and 1/1 organic source N / A.S-N. Uptake of N, P and K by sunflower plants was affected by the addition of different nitrogen sources and nitrogen addition treatments. The highest nutrient content and uptake by straw were obtained when treated with Ch.M followed by Pa.R at all growth stages, while it was Pa.R followed by Ch.M for seeds. The oil content was shown to respond to N supply but the changes in individual fatty acids were not statistically different.

Key words: Sunflower, sandy soil, organic manures, nitrogen sources, seed oil, fatty acids.

INTRODUCTION

Egypt's consumption of oil increased during the past years. According to EL-Fayoumy *et al.*, (1999) and FAO, (2006) Egypt production of edible oil represents only about 10% of the actual consumption. In 2005 the production average of sunflower was 39.000 tons, whereas the consumption amounted to 376.000 tons. Sunflower is one of the most widely cultivated oil crops in the world which is grown for edible oil. In 1998, the seed world production was 28.5 million and, as edible vegetable oil, only soybean and rapeseed canola oil production exceeded that of sunflower (FAO, 1999). Due to the sunflower ability to tolerate short periods of water deficit (Hattendorf *et al.*, 1988) the potential exists for it to become an important crop in semi-arid environments and wherever available irrigation water is limited.

The effect of sowing date and irrigation on seed yield of standard genotypes has been extensively studied (D'Amato and Giordano, 1992; Lanza *et al.*, 1992; Sarno *et al.*, 1992; Chiaranda and D'Andria, 1994; Dimic *et al.*, 1996), whereas the changes in oil recovery and fatty acid profile of sunflower due to fertilizing using different nitrogen sources have been poorly investigated. Therefore, more care should be given to this crop to improve the productivity to meet the shortage of vegetable oils. In Egypt, sunflower is adapted to wide types of soils and climate conditions. This wide adaptability enables sunflower to be grown under the low productive soils, particularly, in the newly reclaimed areas in Egypt.

The low fertility of desert soils quality particularly the sandy soil needs many efforts to improve their hydro-physical properties as well as their productivity. Thus, application of organic matter to such soils is needed. Organic materials contain significant amounts of macro-nutrients (i.e., N, P and K). Many organic materials contain other components that can contribute significantly to the increase in crop yields, including micro-nutrients.

Application of animal waste to soils is a common practice which when conducted judiciously can provide a cost-effective utilization strategy for recycling organic matter and essential plant nutrients as well as assist in solid waste disposal. The production benefits gained from animal sludge has been extensively documented (Adegbidi and Briggs, 2003; Yang *et al.*, 2004; Hiltbrunner *et al.*, 2005 and Zhou *et al.*, 2005).

Several experiments showed that nitrogen fertilizer increased seed yield of sunflower. Basha (2000) showed a significant response yield of sunflower to nitrogen levels and a highly significant increase in seed and oil yield. El-Zahar and El-Kafoury (1999) and El-Zahar *et al.*. (1999) reported that the highest seed and oil yields of Vidoc cultivar were obtained from the highest N-fertilizer of 60 kg N fed^{-1} and application of 20 kg N fed^{-1} gave the highest seed oil recovery. Lawlor (2002) stated that metabolic processes, based on protein, lead to increases in vegetative and reproductive growth and yield is totally dependent upon the adequate supply of nitrogen. Scheiner *et al.* (2002) pointed out that nitrogen fertilization affected the seed yield and number of seeds per head. Moreover, yield increased by 17% when N was added, regardless of the rate of application. Thomas *et al.* (2006) reported that using sludge-scrubber by-product mixture as a nitrogen fertilizer gave a significant increase in leaf area, dry shoot, root masses and seed yields for mature plants. Higher nitrogen concentration resulted in higher shoot dry matter production per plant and the effect was apparent from 29 days after sowing (Cechin and Fatima-Fumis, 2004). The differences in dry matter production were mainly attributed to the effect of nitrogen in leaf production and on individual leaf dry matter.

The purpose of the current investigation is to study the effects of some organic-N sources and their combinations as well as to compare the effect of organic sources and ammonium sulfate (A.S.) as a conventional fertilizer added individually or in combinations on growth, yield components, yield quality, oil as well as uptake of some macronutrients by plant grown on a sandy soil.

MATERIALS AND METHODS

Two field experiments were carried out during the season 2005 at El-Khattara region (El-Sharkia governorate, Egypt) to study the response of sunflower to some organic-N sources and their combination as well as some nitrogen sources and nitrogen addition treatments under sandy soil conditions. A representative soil sample (0 – 30 cm) was taken before planting to determine some physical and chemical properties (Table 1). Nitrogen sources used were: ammonium sulfate (A.S) and three organic sources which included farmyard manure (FYM), chicken manure (Ch.M) and palma residues (Pa.R) which is an agro-industrial wastes. Organic-N sources were applied at 119 kg N ha^{-1} according to the total nitrogen in each source. The chemical compositions of the organic sources are shown in Table 2.

Organic sources (FYM, Ch.M and Pa.R) were added and mixed thoroughly with soil two weeks before seeding. A randomized complete block experimental design with three replicates, having a plot area 4 X 2.5 m^2, was used. Each plot consisted of 8 rows 50 cm apart, two plants/hill and 20 cm between hills. Sunflower seeds (*Helianthas annus* L.) cv. Vidoc hybrid were sown after soil preparation. Seeding was carried on June 15th, 2005. The

Table 1. Physical and chemical properties of the soil of the experiment

Particle size distribution (%)				Textural class	OM ($g\ kg^{-1}$)	$CaCO_3$ ($g\ kg^{-1}$)
C. sand	F. sand	Silt	Clay			
57.44	34.67	5.92	1.97	sand	5.9	6.9

Φ pH	EC ($dS\ m^{-1}$)	§Cations ($cmol\ kg^{-1}$)				Anions ($cmol\ kg^{-1}$)			
		Ca^{+2}	Mg^{+2}	Na^{+1}	K^{+1}	CO_3^{-2}	HCO_3^{-1}	Cl^{-1}	SO_4^{-2}
8.00	0.52	1.2	0.7	1.4	1.6	0.0	1.8	1.5	1.6

Available nutrients ($mg\ kg^{-1}$)					
Macronutrients			Micronutrients		
N	P	K	Mn	Zn	Cu
17.5	5.16	23.2	2.30	0.68	0.43

Φ (1 : 2.5) soil : water suspension

§ Soluble cations and anions in (1: 2.5 w : v) soil: water extract.

Table 2. Chemical characteristics of the organic-N sources used in the current study

Characteristics	FYM	Pa.R	Ch.M
Total carbon ($g\ kg^{-1}$)	276	323	204
C/N ratio	19.7:1	12.9:1	8.7:1
Total macro nutrients ($g\ kg^{-1}$)			
N	14.0	25.0	23.5
P	2.10	3.70	5.80
K	3.30	19.1	10.5
Total micro nutrients ($mg\ kg^{-1}$)			
Fe	152	473	358
Mn	88	119	219
Zn	62	72	198

plants were thinned to a single plant per hill after 21 days from sowing. Phosphorus fertilizer was added to all plots before sowing at a rate of 31 kg P ha^{-1} as superphosphate (6.8 % P). Potassium sulphate (40 %, K) was applied as soil application at a rate of 99 kg K ha^{-1} in two equal splits, 30 and 45 days after sowing. Nitrogen was added at 119 kg N ha^{-1} according to the following treatments:

First Experiment

1- Control (without N); 2- FYM; 3- Ch.M; 4- Pa.R; 5- (FYM + Ch.M); 6- (FYM + Pa.R); 7- (Ch.M + Pa.R). Each of the following treatments receiving two sources of N (i.e. treatments 5 to 7) received the N as a ratio of 1/1 (i.e. 59.5 kg N ha^{-1} from each of the two concerned sources).

Second Experiment

1) Ammonium sulfate (A.S.)
2) FYM, 1/0 (119.0 kg N ha^{-1}); FYM / A.S 3/1 (89.25 kg N ha^{-1} as FYM + 29.75 kg N ha^{-1} as A.S.); FYM / A.S 1/1 (59.50 kg N ha^{-1} as FYM + 59.50 kg N ha^{-1} as A.S.) and FYM / A.S 1/3 (29.75 kg N ha^{-1} as FYM + 89.25 kg N ha^{-1} as A.S.).
3) Ch.M, 1/0 (119.0 kg N ha^{-1}); Ch.M / A.S 3/1 (89.25 kg N ha^{-1} as CH.M + 29.75 kg N ha^{-1} as A.S.); Ch.M / A.S 1/1 (59.50 kg N ha^{-1} as Ch.M + 59.50 kg N ha^{-1} as A.S.) and Ch.M / A.S 1/3 (29.75 kg N ha^{-1} as Ch.M + 89.25 kg N ha^{-1} as A.S.).
4) Pa.R, 1/0 (119.0 kg N ha^{-1}); Pa.R / A.S 3/1 (89.25 kg N ha^{-1} as Pa.R + 29.75 kg N ha^{-1} as A.S.); Pa.R / A.S 1/1 (59.50 kg N ha^{-1} as Pa.R + 59.50 kg N ha^{-1} as A.S.) and Pa.R / A.S 1/3 (29.75 kg N ha^{-1} as Pa.R + 89.25 kg N ha^{-1} as A.S.).

The experiment was executed in a factorial design comprising the two following factors: (1) Organic sources of N which included FYM (farmyard manure), Ch.M (chicken manure), and Pa.R (palma residues); (2) Ratio of organic-N / A.S (ammonium sulfate)-N which included ratios of 1/0 (i.e. no A.S addition), 3/1, 1/1 and 1/3. An extra treatment was done with N added as A.S only. Thus there were 12 treatments representing the different combinations of the two factors (3 organic sources X 4 different ratios) plus the A.S-N treatment.

Plant samples were taken at 45, 65 and 90 days after sowing (DAS) corresponding to vegetative, flowering and maturity stages, respectively. Dry matter yield (DW) as well as total contents of N, P and K in plant were measured.

At maturity, two rows of each plot were harvested, air dried, then straw yield, seed yield, seed oil percentage, oil yield and protein yield were calculated. In addition, representative ten plants were taken randomly from each plot to record the following characters: Head weight (g $plant^{-1}$), seed weight $head^{-1}$ (g), 100 seed weight (g), seed yield, straw yield, biological yield, crop index (Seed yield / straw yield) x 100, protein (%), protein yield, seed oil content (%) and oil yield were also determined = seed yield x oil percentage.

Methods of Analysis

Seed and straw samples were digested with concentrated acids. N determination was done by the Kjeldahl method; P and K were determined by digestion with a mixture of sulfuric and perchloric acids. The analysis of plants and soil were determined using the methods described by Black (1965) and Chapman and Pratt (1961). Available Fe, Mn and Zn were extracted by DTPA (Lindsay and Norvell, 1978) and determined using Inductively Coupled Plasma (ICP) Spectrometer model 400 (Soltanpour, 1985). Oil content was determined using Soxhlet method (AOAC, 1990). Protein percentage was calculated by multiplying the nitrogen percentage by the converting factor 6.25 (Hymowitz *et al.*, 1972).

Gas liquid chromatography analysis of fatty acid methyl esters was also done. Fatty acids were transesterified into methyl esters by heating in borontrifluoride (10% solution in methanol, Merck, Darmstadt, Germany) according to the procedure reported by Metcalfe *et al.*, (1966). Fatty acids methyl esters were identified on a Shimadzu GC-14A equipped with flame ionization detector and C-R4AX Chromatopac integrator (Kyoto, Japan). The flow rate of the carrier gas (helium) was 0.6 ml min^{-1} and the split value with a ratio of 1:40 was used. A sample of 1µL was injected on a 30 m X 0.25 mm X 0.2g film thickness Supelco SP M-2380 (Bellefonte, PA, USA) capillary column. The injector and detector temperature was set at 250°C. The initial column temperature was 100°C programmed by 5°C min^{-1} until 175°C and kept for 10 min at 175°C, then 8°C min^{-1} until 220°C and kept 10 min at 220°C. A comparison between the retention times of the samples with those of authentic standard mixture (Sigma, St. Louis, MO, USA; 99% purity specific for GLC), run on the same column under the same conditions, was made to facilitate identification. The quantification of each fatty acid was carried out by comparing the peak area of its methyl ester with that of methyl nonadecanoate without application of any correction factor.

The obtained data were subjected to the analysis of variance as described by Snedecor and Cochran (1967). Duncans multiple range test (Duncan, 1955) was used to compare among means.

RESULTS AND DISCUSSION

The data representing the effect of some organic manure (i.e. FYM, Ch.M and Pa.R) on sunflower yield, yield components and its chemical constituents are recorded in Tables 3a&3.b and Figs. 1&1.a.

Dry Matter at Vegetative and Flowering Stages

Data illustrated in Figure 1 show that dry matter yields in experiment 1 at vegetative and flowering stages were increased by application of different organic-N sources and their combinations compared with the control treatment. Abdel-Sabour *et al.* (1999) stated that the dry matter yield of leaves stems and flower at different growth stages were significantly increased by application of different types or rates of compost. This may be due to a decomposition of organic matter and release of nutrients in the available form. Also, improvement of soil physical, chemical and biological properties as well as nutritional status due to organic manures addition must have contributed to the higher yield. Tahoun *et al.* (2000) reported that adding organic matter and manure improved soil tilth, supplied appreciable amounts of P and K and small amounts of other elements in addition to N and increased the base-exchange capacity, the relative potential fertility and organic matter content of soil. These results are similar to results reported by Awad *et al.* (2003).

Data also in Figure 1.a show that addition of N as a mixture of organic source and the mineral source A.S significantly increased the dry matter yields at vegetative and flowering stages. This shows the positive effect of the mineral source A.S which would increase the decomposition of organic matter and thereby release the nutrients in available form. Moreover, it might be also the role of nitrogen in increasing photosynthetic activity efficiency which led to an enhancement vegetative growth, probably resulting from the increase in the activity of meristematic tissues due to the increase in the rate of cell division and elongation (Ibrahim *et al.,* 2003). El-Awag *et al.* (1996) found that application of urea may increase the decomposition of soil organic matter and thereby release the nutrients in available form. The increase in dry matter production at the different growth stages due to N application was reported by Legha et al. (1999); Awad *et al.* (2000) and Mostafa (2001). Organic matter FYM, Ch.M and Pa.R may have acted as chelating agents for nutrients. Such organic residues contain nutrients other than N (Table 2) which must have contributed to their superiority over the treatment which received the entire N rate as soluble A.S.

The positive effect of the FYM, Ch.M and Pa.R was most pronounced with the 3/1 and 1/1 ratios of organic source / A.S. The highest dry matter was observed from the Ch.M / A.S of 3/1 ratio at the vegetative and flowering stages. According to the above results, it could be concluded that the promotive effect of the different organic sources of nitrogen on the dry matter and straw yield may follow the order; Ch.M> Pa.R> FYM. This was more emphasized when the materials were mixed with A.S at the ratio of 3/1.

Yield and its Components

The data in Table 3.a reveal that sunflower yield and its components (i.e., head weight, seeds weight head^{-1}, seed yield, straw yield and crop index) were significantly increased due to the addition of organic-N sources individually or combined. The relative values of yields due to the N fertilization treatments of: FYM, Ch.M, Pa.R, (FYM+Ch.M), (FYM+Pa.R), and (Ch.M+Pa.R) to that regarding the non- fertilized were as follows: 142.0, 224.0, 217.5, 188.6, 154.4 and 175.1% , respectively for seed yield and 195.5, 327.7, 261.6,

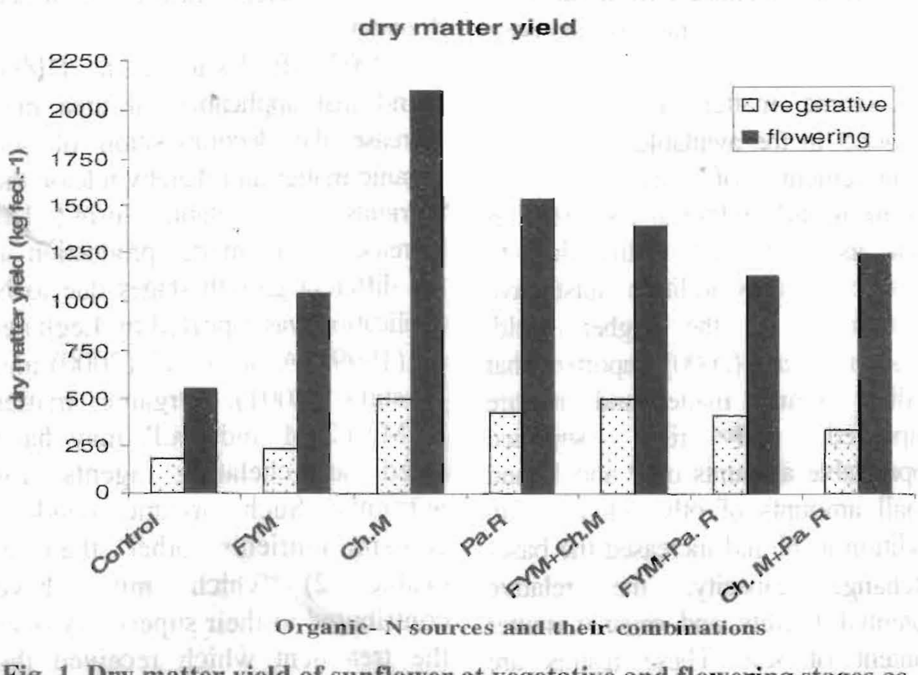


Fig. 1. Dry matter yield of sunflower at vegetative and flowering stages as affected by organic-N sources and their combinations (ratio of 1/1)

Note: FYM: farmyard manure; Ch.M: chicken manure; Pa.R: palma residues; mixture rate of N-application = 119 kg N ha^{-1}

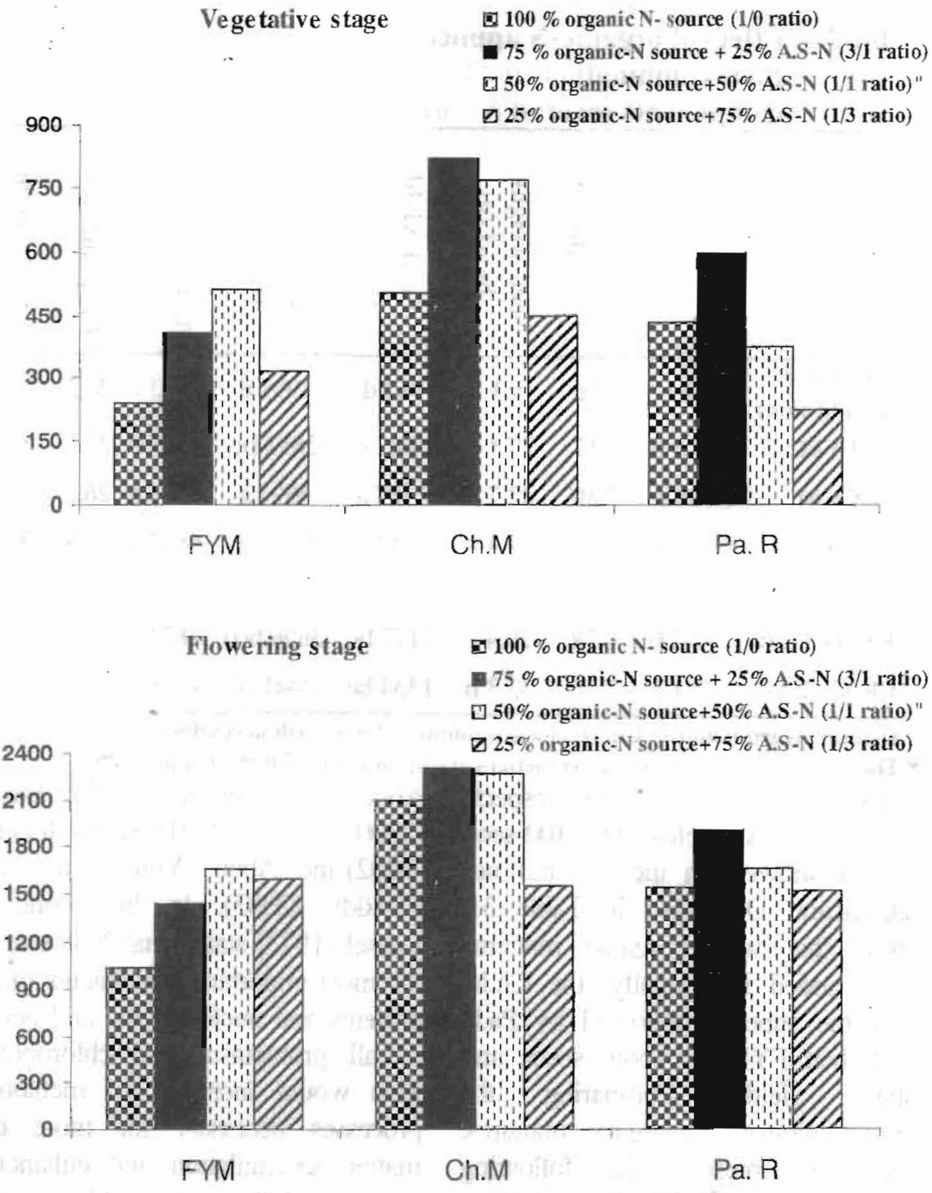


Fig. 1 a. Dry matter yield (kg fed.$^{-1}$) of sunflower vegetative and flowering stages as affected by addition of N as a mixture of organic source and A.S

*** (See notes of Figure 1 for designation of sources)**

Table 3 a. Effect of organic-N application as different sources and their combinations (of 1/1 ratio) on sunflower yield and its components (overall N rate: 119 kg N ha^{-1})

Nitrogen source	Head weight (g plant^{-1})	100 seed weight (g)	Seed weight / head (g)	Seed yield (Kg fed.$^{-1}$)	Straw yield (Kg fed.$^{-1}$)	Biological yield (Kg fed.$^{-1}$)	Crop index (CI)	Oil content (g kg^{-1} seed)
Control (no addition)	68.8 b*	5.76	19.1 d	762 d	1991 d	2753 c	38.3	351
FYM	73.6 b	7.17	27.1 c	1082 c	3892 bc	4947 b	27.8	365
Ch.M	108 a	7.80	42.7 a	1707 a	6524 a	8231 a	26.2	379
Pa.R	124 a	7.99	41.4 a	1657 a	5208 ab	6865 a	31.8	369
FYM+Ch.M	107 a	8.04	35.9 b	1437 ab	5376 ab	6813 a	26.7	383
FYM+ Pa.R	72.2 b	6.78	29.4 c	1177 bc	3696 bcd	4873 b	31.8	381
Ch.M+ Pa.R	72.1 b	7.26	33.3 b	1334 bc	3041 cd	4375 b	43.9	388

FYM: farmyard manure; Ch.M: chicken manure; Pa.R : palma residues

* The values followed by a different letters are significantly different at $p \leq 0.05$

270.0, 185.6 and 152.7%, respectively for straw yields. The 100-seed weight showed an increase but not significant. Data also in Table 3.a show that when organic manures were added individually, the Ch.M was the superior followed by Pa.R and then FYM for both seeds and straw yields. Comparing the combination of the organic manures, the data present the following descending order: (FYM + Ch.M) > (Ch.M + Pa.R) > (FYM + Pa.R) for seed yield and (FYM + Ch.M) > (FYM + Pa.R) > (Ch.M + Pa.R) for straw yield. These results are in full agreement with those obtained by Abdel-Sabour *et al.* (1999); Basha (2000); Ahmed (2001); Darwish *et al.* (2002) and Abou -Youssef and El-Eweddy (2003). In this concern, Russel (1973) stated that N is one of the most important constituents of all proteins and nucleic acids and hence of all protoplasm and chlorophyll. This would increase the metabolic processes necessary for more dry matter accumulation and enhancing the grain hilling rate, which would finally increase the amount of protein in grain, thus more crop yield with good quality of grains. Faiyad (1999) suggested that the increasing effect of organic manures may be due to the ability of organic matter in rendering soil nutrients more available and chelation of these elements by humic substances.

As for the addition of N as a mixture of organic source and A.S., data in Table 3.b reveal that, head weight, 100-seed weight and seed weight head^{-1} of sunflower were highest under the treatment of Ch.M / A.S ratio of 1/1. These results are similar to those obtained by Basha (2000), Abou Youssef and El-Eweddy (2003), Solaiman and Hassan (2004) and Shaban and Helmy (2006). These results may be due to the increase in growth characters as shown in Table 3.b and the photosynthetic pigments by the application of N fertilizer and consequently more dry matter accumulation in the head and seeds. Also, this is a reflection of the low organic matter and soluble nitrogen in the soil of the experimental site as shown in Table 1. In this respect, addition of nitrogen sources and increasing nitrogen level increased sunflower yield per plant as reported by Nel *et al.* (2000); Murad *et al.* (2000); Salehi and Bahrani (2000); Nawar and El-Kafoury (2001); Gajendra and Giri (2001) and Scheiner *et al.* (2002). The current results are similar to those obtained by Ibrahim *et al.* (2003) who found that head diameter, head dry weight, number of seeds/head and 100-seeds weight as well as seed, straw and biological yield were increased significantly as the nitrogen level was increased from 0 to 30 and 60 kg fed^{-1} in the two seasons.

The highest straw yield and biological yield (9324 and 11236 kg fed.$^{-1}$, respectively) were obtained due to the addition of Pa.R / A.S of 3/1 ratio. Seed yield obtained under the application of Ch.M / A.S of 1/1 ratio. This high seed yield is associated with highest values of 100-seed weight, head weight and number of seeds/head. It seems, that nitrogen encouraged the accumulation of dry matter during the seed filling period of sunflower These findings conform with those obtained by Zubillaga *et al.* (2002).

According to the above results, it could be concluded that the promotive effect of the different organic sources of nitrogen on the yield and its components may follow the order; Ch.M> Pa.R> FYM. This was more emphasized when the materials were combined with ammonium sulfate at the ratio of 3/1 and 1/1.

Crop Index (Seed/Straw Ratio)

The data in Table 3.a reveal that application of organic manures decreased crop index compared with the control treatment. This resulted from the high relative increase in straw yield than

Table 3 b. Effect of organic nitrogen source applied singly or in combination with ammonium sulphate (A.S) at different ratios to sunflower on its yield and yield components

	Nitrogen source [Φ] (S)	Ratio of N- addition of organic source /A.S(R) 1/0	3/1	1/1	1/3	Mean
Head weight ($g\ plant^{-1}$)	FYM	83.8	110	154	149	124
	Ch.M	108	142	167	136	138
	Pa.R	118	163	146	124	138
	Mean	103	138	156	136	
	LSD at 0.05	(R): 15.46		N (S): 13.39		R S: **
Seed weight / head (g)	FYM	27.1	30.5	42.1	35.4	33.8
	Ch.M	42.7	45.2	48.4	29.8	41.5
	Pa.R	41.4	47.9	47.8	35.7	43.2
	Mean	37.1	41.2	46.1	33.6	
	LSD at 0.05	(R): 1.455		(S): 1.259		R S: **
100 seed weight (g)	FYM	7.17	7.45	7.53	7.32	7.37
	Ch.M	7.80	7.60	8.48	7.52	7.85
	Pa.R	7.99	7.99	7.78	8.21	7.99
	Mean	7.65	7.68	7.93	7.68	
	LSD at 0.05	(R): ns		(S): ns		R S: ns
Straw yield ($kg\ fed.^{-1}$)	FYM	3892	4799	7840	7336	5967
	Ch.M	6524	8176	9072	7644	7854
	Pa.R	5208	9324	8148	6076	7189
	Mean	5208	7433	8353	7019	
	LSD at 0.05	(R): 1171.5		(S): 1014.5		R S: *
Seeds yield ($kg\ fed.^{-1}$)	FYM	1082	1221	1685	1414	1351
	Ch.M	1707	1807	1937	1193	1661
	Pa.R	1657	1912	1918	1429	1729
	Mean	1482	1647	1847	1345	
	LSD at 0.05	(R): 128.4		(S): 111.2		R S: **
Crop index (CI)	FYM	27.8	25.4	21.5	19.3	23.5
	Ch.M	26.2	22.1	21.4	15.6	21.3
	Pa.R	31.2	20.5	23.5	23.5	24.7
	Mean	28.4	22.7	22.1	19.5	
Oil content ($g\ kg^{-1}$ seed)	FYM	365	369	375	363	368
	Ch.M	379	385	399	372	384
	Pa.R	369	371	378	368	372
	Mean	371	375	384	368	

Yield for all N as ammonium sulfate were 92.9, 37.2 and 7.96 for head weight, seed weight $head^{-1}$ and 100 seed weight, respectively as well as 4144 and 1487 for straw yield and seeds yield, respectively. Crop index for all N as ammonium sulfate was 35.9%. [Φ] See footnotes of Table 3 a. for codes of N-sources that of seed yield. Regarding the combined effect of the organic sources, data show that the combination of organic sources also decreased crop index except when Ch.M was combined with Pa.R which showed the highest ratio as a result of low relative increase of straw. These results are similar to the results obtained by Geweifel *et al.* (1997). As for the addition of N at different ratios of source / A.S, data in Table 3.b show the order; 1/0> 3/1> 1/1> 1/3. Hence, the increase in ammonium sulfate addition the decrease was in crop index.

Seed Protein Parameters

Data illustrated in Figure 2 demonstrate that application of different organic sources and their combinations significantly increased the protein yield. The individual effect of organic sources showed a descending increases in the order of, Pa.R> Ch.M> FYM. Regarding the effect of the combinations between the organic–N sources, the treatments followed the order of, FYM + Ch.M> Ch.M + Pa.R> FYM + Pa.R.

Data in Figure 2.a illustrate that addition of N as a mixture of organic source and A.S significantly increased protein yield. Scheiner *et al.* (2002) reported that nitrogen fertilization increased seed protein content. The individual effect of organic sources showed a descending increases in the order of Ch.M> Pa.R> FYM. This was more emphasized when the materials were mixed with ammonium sulfate at the ratio of 1/1.

Oil Recovery and Fatty Acid Composition

Results of oil recovery presented in Table 3.a and 3.b demonstrate that application of nitrogen increased the oil recovery. The effect of organic sources individually showed the following order Ch.M> Pa.R> FYM. Concerning the effect of organic–N in combined sources, the treatments followed the order (Ch.M + Pa.R) > (FYM + Ch.M) > (FYM + Pa.R). On the other hand, addition of N as a mixture of organic sources and A.S. remarkably increased oil content. The effect of adding organic sources individually showed the order of Ch.M> Pa.R> FYM. This was markedly noted at the ratio of 1/1.

The changes in fatty acid relative distribution of sunflower upon fertilizing using different nitrogen sources have been poorly studied. The relative distribution of fatty acids is an important attribute particularly for marketing and processing. In particular, the fatty acid composition is known to differ between cultivars and with environmental conditions (Connor and Sadras,1992) and (Salera and Baldini, 1998). Genotype and temperature during oil formation exert the major effect on the proportions of oleic and linoleic acids, whereas the effect of N supply is

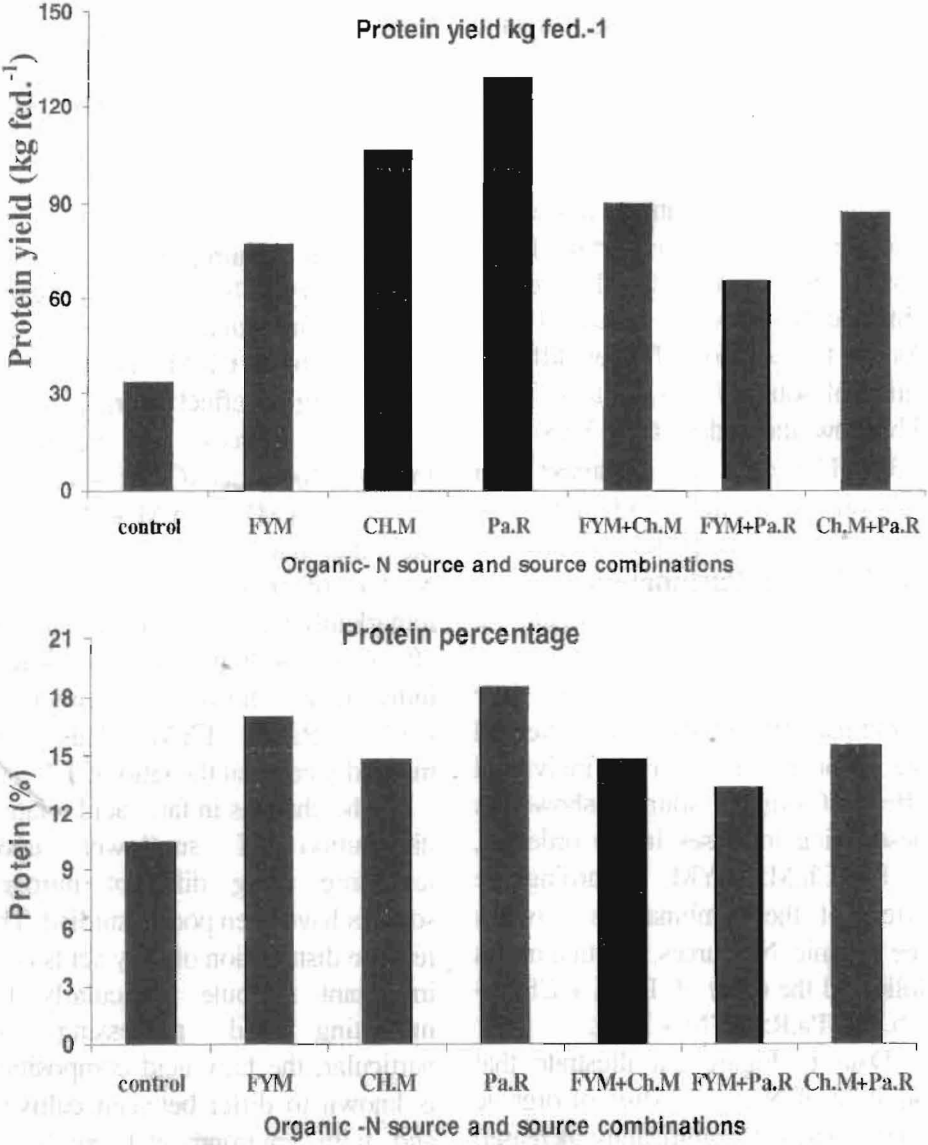
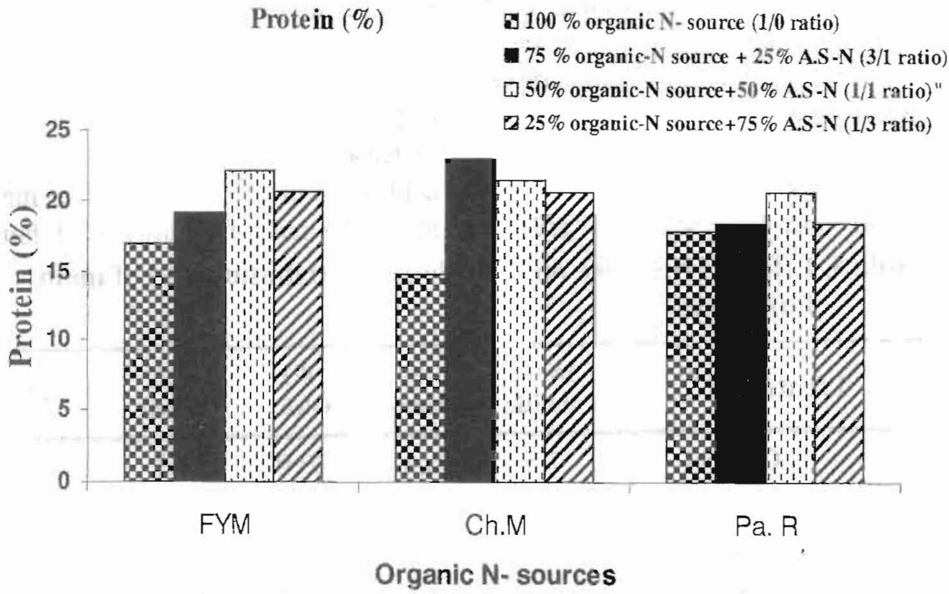


Fig. 2. Protein percentage and protein yield (kg fed.$^{-1}$) as affected by organic-N sources and its combinations
(See notes of Fig. 1. for designation of sources, N rate and source combinations)



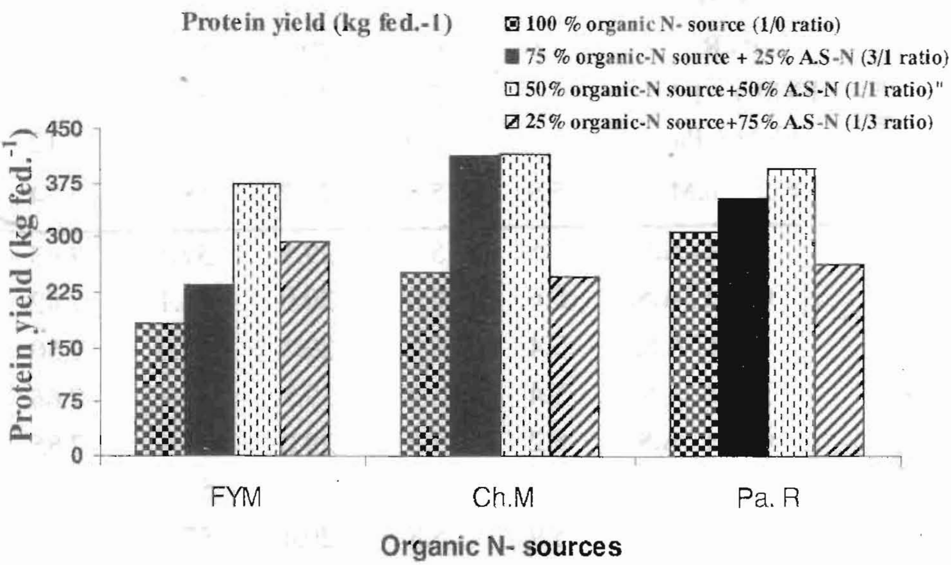


Fig. 2 a. Protein percentage and protein yield (kg fed.$^{-1}$) as affected by organic-N source and its mixtures with A.S

(See notes of Fig. 1. for designation of sources, N rate and source combinations)

small and depends on timing of N application (steer and Seiler, 1990).

With regard to fatty acid composition (Table 4), slight differences were evident between the two experiments, with a slight decrease in palmitic, stearic and linoleic acids and an increase in oleic acid when organic nitrogen sources were applied. Therefore, it seems that application of organic fertilizers resulted in an increase in total unsaturated fatty acids over the control. N source may affect the rate of hydrolysis of fatty

Table 4. Effect of N source on the relative distribution (%) of main fatty acids

		Treatment Φ	16:0 Palmitic	18:0 Stearic	18:1 Oleic	18:2 Linoleic	TU/TS [b]
A.S and organic source of N ξ (singly and combinations)		Control	7.5	6.4	20.0	63.3	5.99
		A.S	7.7	6.2	19.9	63.2	5.97
		FYM	5.8	6.0	29.2	57.0	7.30
		Ch.M	5.7	6.1	29.1	57.1	7.30
		Pa.R	5.9	6.0	29.0	57.2	7.24
		FYM + Ch.M	5.8	5.9	29.5	57.1	7.40
		FYM + Pa	6.1	6.0	28.9	57.3	7.12
		Pa + Ch.M	5.9	5.9	28.7	58.0	7.34
Ratio of source –N / A.S- N	(1: 1)	FYM / A.S.	5.5	5.9	29.5	57.5	7.63
		Ch.M / A.S.	5.6	6.0	30.0	56.1	7.42
		Pa R / A.S.	5.4	6.1	29.3	57.0	7.50
	(1: 3)	FYM / A.S.	5.4	5.9	29.5	57.1	7.66
		Ch.M / A.S.	5.2	5.8	29.0	57.4	7.85
		Pa R / A.S.	5.8	6.0	29.7	57.3	7.37
	(3: 1)	FYM / A.S.	5.9	5.8	29.4	57.1	7.39
		Ch.M / A.S.	5.7	6.1	29.3	57.3	7.33
		Pa R / A.S.	5.5	6.1	29.5	57.2	7.47

[b] TU/TS ratio = (total unsaturated fatty acids) / (total saturated fatty acids).

Φ see footnotes of Table 3. for codes of N-sources/ A.S : ammonium sulphate N-rate :119 kg N ha^{-1} for all treatments receiving N.

ξ: organic source combinations are 1/1

acid complexes or their transport from the proplastid to the cytosolic compartment. From the nutritional point of view, a diet rich in mono-unsaturated fatty acids has been suggested to reduce cholesterol in blood plasma, in that it lowers low density lipoprotein but not high density lipoprotein (Delpanque, 2000) and, thus, the risk of coronary heart disease (Grundy, 1986).

Macronutrients Uptake

Nitrogen uptake

It is clear from the data in Table 5 that Ch.M was superior for increasing the uptake of N in straw at all growth stages compared to the other treatments. The superiority of Ch.M over all the organic manures for N uptake can be attributed to its narrow C/N ratio which would lead to rapid mineralization and decomposition in soil. Cordovil et al. (2001) reported that incorporation of organic wastes always led to an increase of potentially available N in the soil. These results are in agreements with those obtained by Tahoun et al. (2000) and Solaiman and Hassan (2004). Data also reveale an ascending increase in N uptake in the order of Ch.M> Pa.R> FYM for straw at all growth stages and in the order of Pa.R> Ch.M> FYM for seeds. As for the effect of adding mixtures of organic–N sources, data show that it followed the same trend of that observed with dry matter yield. The treatment of (FYM + Ch.M) was superior to the other treatments at all growth stages and gave the highest straw yield at all growth stages as well as seed yield at maturity stage.

Regarding the addition of N as a mixture of organic source + A.S, data in Table 6 revealed an ascending increases in N uptake in the order of Ch.M> Pa.R> FYM for straw and seeds. This was more emphasized when the materials were mixed with A.S at the ratio of 3/1 and 1/1. Highest straw yield was observed from the addition of Ch.M / A.S ratio of 3/1 at vegetative and maturity stages, while at flowering stage it was due to Ch.M / A.S ratio of 1/1. Highest seed yield was obtained due to the Ch.M / A.S ratio of 1/1.

Phosphorus uptake

Data in Table 5 show that phosphorus uptake was increased significantly due to addition of N. This may be due to the benefits of organic matter supply to the soil on the basis of anion replacement or competition between humate and phosphate ions on the active sites of adsorbing surfaces of soil colloids. Solving action of humic substances on insoluble phosphates leading to the formation of fulvic acid metal phosphates could be suggested in this respect. Products of organic decay such as organic acids and humus are thought to be effective in forming complexes with iron and aluminum compounds which contribute in P fixation in soils (El-Sherbieny *et al.*, 2003). Data also reveale an ascending increases in P uptake in the order of Ch.M> Pa.R> FYM for the effect of individual application of organic sources. Regarding to the effect of adding mixtures of organic–N sources, data show that treatment of (FYM + Ch.M) was superior to the other treatments at all growth stages.

As for, the mixture of organic source + A.S, it was observed from the data shown in Table 7 that the increases in P uptake followed the order of Ch.M> Pa.R> FYM for straw at vegetative and flowering stages while it was in the order of Pa.R> Ch.M> FYM for straw and seeds at maturity stage. This was more emphasized when the materials were mixed with A.S at the ratio of 3/1 and 1/1.

Potassium uptake

Data presented in Table 5 indicate that K-uptake was significantly increased due to the addition of nitrogen as organic sources. This was true at all growth stages. Such positive response reflects the different characteristics of the added organic manures (their chemical composition and nutritional status), hence the rate of decomposition and the differences in the subsequent release of included nutrients. Also the production of organic and inorganic acids during the degradation of such organic materials (as well as humates) as a result of the microorganisms activities must have contributed in a decrease in soil pH which would reduce K fixation and producing more chelating ions, leading to an increase in available forms of elements in the rhizosphere zone. However, organic manure addition to soil would result in creating favorable soil physical conditions (such as structure), which must have affected the solubility and availability of nutrients and thus uptake of nutrients (Rabie *et al.*, 1997). These results are in agreement with those obtained by El-Sherbieny et al., (1999) and Mohamed (2002). As for the combined effect of organic-N sources, data show that it followed the same trend observed with P uptake. Hence, the treatments of (Ch.M) and (FYM + Ch.M) were superior to the other treatments at all growth stages as well as at seed yield at maturity stage.

Based on the foregoing results, it can be concluded that the highest values of sunflower yield, yield quality and its components as well as N, P and K uptake were obtained with the plants supplied with Ch.M or (FYM + Ch.M) which were superior to the other treatments.

Regarding to the addition of organic sources mixed with A.S, data in Table 8 indicate that K uptake was significantly increased due to addition of organic sources. Data also reveal

Table 5. N, P and K uptake (Kg fed.$^{-1}$) in sunflower as affected by organic sources of N and their combinations

Nitrogen treatment	N uptake				P uptake				K uptake			
	Vegetative	Flowering	Maturity		Vegetative	Flowering	Maturity		Vegetative	Flowering	Maturity	
			Straw	Seeds			Straw	Seeds			Straw	Seeds
Control	2.06 c*	8.58	28.3 c	12.6 c	1.83 e	4.32 d	5.33 b	11.1 d	1.97 e	5.12 d	19.3 b	13.1 c
FYM	5.06 bc	23.2	69.1 c	29.4 b	2.80 de	10.8 c	30.3 a	20.1 c	4.03 d	10.5 c	42.3 ab	20.9 b
Ch.M	14.3 a	49.5	148 ab	40.4 ab	6.15 a	22.9 a	30.6 a	28.9 a	8.35 a	23.7 a	70.8 a	30.4 a
Pa.R	13.7 a	41.6	85.9 bc	47.7 a	4.44 bc	15.8 b	25.4 a	26.2 ab	6.22 bc	15.5 b	57.7 a	30.1 a
FYM + Ch.M	11.8 ab	34.5	192 a	34.0 ab	5.62 ab	14.2 bc	33.8 a	25.2 ab	7.62 ab	16.3 b	67.7 a	29.2 a
FYM + Pa.R	9.30 abc	26.7	83.1 bc	25.1 bc	4.37 bc	9.95 c	18.2 ab	19.9 c	5.06 cd	12.7 bc	40.9 ab	23.3ab
Ch.M + Pa.R	9.61 abc	32.3	52.6 c	33.1 ab	3.50 cd	11.0 c	15.7 ab	23.3 bc	4.26 d	13.7 bc	37.3 ab	27.1ab

(See footnotes of Tables 3.a and 4; treatments followed by similar letters are not statistically different)
* The values followed by a different letters are significantly different at $p \leq 0.05$

Table 6. N uptake (kg fed.$^{-1}$) of sunflower as affected by organic nitrogen sources of N and their ratios with A.S-N (N-rate 119 kg N ha^{-1})

Nitrogen Φ source (S)	Ratio of N-addition of organic source /A.S (R)									
	1/0	3/1	1/1	1/3	Mean	1/0	3/1	1/1	1/3	Mean
	Vegetative stage					Flowering stage				
FYM	5.06	17.8	18.7	11.8	13.3	23.2	54.3	33.3	54.7	41.4
Ch.M	14.3	24.1	20.8	14.4	18.4	49.5	67.8	72.3	64.8	63.6
PA.R	13.7	16.2	12.8	7.48	12.5	41.6	49.5	57.0	28.6	44.2
Mean	11.0	19.4	17.4	11.2		38.1	57.2	54.2	49.4	
LSD at 0.05	R: 1.202	S: 1.041		RS: ns		R: ns	S: 15.86		RS: ns	
	Maturity stage									
	Straw					Seeds				
FYM	69.1	102	139	156	117	29.4	37.6	59.8	46.8	43.4
Ch.M	147	213	172	136	167	40.4	66.3	66.5	39.5	53.2
PA.R	86.2	177	174	144	145	47.7	56.7	63.3	42.3	52.5
Mean	101	164	162	145		39.2	53.5	63.2	42.9	
LSD at 0.05	R: ns		S: ns	RS: ns		R: 11.91		S: ns	RS: ns	

N uptake for all N as ammonium sulfate were 7.17, 31.1, 63.7 and 58.1 (kg fed.$^{-1}$) at vegetative, flowering, straw and seeds yield, respectively.

Φ see footnotes of Table 3.a

Table 7. P uptake (kg fed.$^{-1}$) of sunflower as affected by organic nitrogen sources of N and their ratios with A.S-N (N-rate 119 kg N ha^{-1})

Nitrogen Φ sources (S)	Ratio of N-addition of organic source /A.S (R)									
	1/0	3/1	1/1	1/3	Mean	1/0	3/1	1/1	1/3	Mean
	Vegetative stage					Flowering stage				
FYM	2.80	4.89	5.74	3.27	4.18	10.8	11.8	18.5	15.2	14.1
Ch.M	6.15	10.0	8.95	4.81	7.48	22.9	22.5	27.2	13.7	21.6
PA.R	4.44	6.32	3.83	2.20	4.20	15.8	18.4	15.6	17.8	16.9
Mean	4.46	7.07	6.17	3.43		16.5	17.6	20.4	15.6	
LSD at 0.05	R: 1.202		S: 1.041	RS: ns		R: ns	S: 3.228		RS: *	
	Maturity stage									
	Straw					Seeds				
FYM	29.4	17.3	33.2	33.9	28.5	20.1	18.7	29.6	21.5	22.5
Ch.M	29.7	38.7	32.0	41.4	35.5	28.9	26.8	28.4	18.8	25.7
PA.R	25.4	41.7	56.6	23.0	36.7	26.2	33.3	31.8	21.6	28.2
Mean	28.2	32.6	40.6	32.8		25.1	26.3	29.9	20.6	
LSD at 0.05	R: 8.405		S: ns	RS: **		R: 2.380		S: 2.061	RS: **	

P uptake for all N as ammonium sulfate were 3.77, 10.1, 26.9 and 22.1 (kg fed.$^{-1}$) at vegetative, flowering, straw and seeds yield, respectively.

Φ see footnotes of Table 3.a

Table 8. K uptake (kg fed.$^{-1}$) of sunflower as affected by organic nitrogen sources of N and their ratios with A.S-N (N-rate 119 kg N ha^{-1})

Nitrogen [Φ] sources (S)	Ratio of N-addition of organic source /A.S (R)									
	1/0	3/1	1/1	1/3	Mean	1/0	3/1	1/1	1/3	Mean
	Vegetative stage					Flowering stage				
FYM	4.03	7.73	8.61	5.67	6.51	10.5	15.5	17.2	19.0	15.6
Ch.M	8.35	11.8	16.4	6.17	10.7	23.7	26.5	27.7	18.8	24.2
PA.R	6.22	14.3	5.95	3.95	7.61	15.5	21.4	18.5	17.4	18.2
Mean	6.20	11.3	10.3	5.26		16.6	21.1	21.1	18.4	
LSD at 0.05	R: 1.396		S: 1.209		RXS: **	R: 3.469		S: 3.004		RXS: *
	Maturity stage									
	Straw					Seeds				
FYM	44.1	56.7	110	91.7	75.6	20.9	21.4	38.6	28.7	27.4
Ch.M	69.4	101	114	87.8	93.1	30.2	33.9	37.3	24.9	31.6
PA.R	56.3	107	95.0	85.4	85.9	30.1	40.0	45.8	32.0	37.0
Mean	56.6	88.2	106	88.3		27.1	31.8	40.6	28.5	
LSD at 0.05	R: 20.62		S: ns		RXS: ns	R: 3.917		S: 3.392		RXS: *

K uptake for all N as ammonium sulfate were 3.62, 10.9, 47.6 and 27.1 (kg fed.$^{-1}$) at vegetative, flowering, straw and seeds yield, respectively.

Φ see footnotes of Tables 3.a

ascending increases in K uptake in the order of Ch.M> Pa.R> FYM for straw at all growth stages while it was in the order of Pa.R> Ch.M> FYM for seeds. This was more emphasized when the materials were mixed with A.S at the ratio of 1/1.

CONCLUSION

Increasing the productivity of sunflower crop with good seed quality under sandy soil conditions of Egypt was achieved not only by using high rates of N-mineral fertilizers, but also by better management of its application to the soil through a moderate level of 59.5 kg N ha^{-1} and manuring the soil with matured organic materials such as Co.M, FYM and T.R. On the other hand, such management will decrease the enormous consumption of chemical N-fertilizers and meanwhile will minimize health and environmental risks which are prospectively fulfilled.

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الاستجابة الفسيولوجية و الكيميائية لنبات دوار الشمس لبعض مصادر التسميد النيتروجيني العضوي و التقليدي تحت ظروف الأراضي الرملية

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أجريت تجربتان حقليتان بمنطقة الخطارة محافظة الشرقية خلال موسم 2005 لدراسة تأثير استخدام بعض المصادر النيتروجينية العضوية وتداخلاتها وكذلك تأثير أضافة تلك المصادر بمفردها أو عند خلطها مع سلفات الأمونيوم على النمو ، محصول المادة الجافة ، مكونات المحصول ، جودة البذور لنبات دوار الشمس (صنف فيدوك) وامتصاصها لبعض العناصر الكبرى وقد أتضح من النتائج ان :

1) أعلي القيم لمحصول المادة الجافة للقش و الحبوب لنبات دوار الشمس وكذا أمتصاص عناصر النيتروجين و الفسفور و البوتاسيوم بواسطة النبات قد تم التحصل عليها نتيجة معاملة الإضافة مخلفات الدواجن و معاملة الأضافة (مخلفات الدواجن + السماد البلدى). ويمكن القول بأن ترتيب المصادر المستخدمة من حيث تأثيرها علي المحصول ومكوناتة يمكن أن تتبع الترتيب التالي مخلفات الدواجن > مخلفات الخروع > السماد البلدي وكان هذا التأثير أكثر وضوحاً و قوة عندما تم خلط هذة المخلفات مع سلفات الأمونيوم بمعدل (75% من المصدر العضوي / 25% سلفات أمونيوم) و (50% من المصدر العضوي / 50% سلفات أمونيوم).
2) كانت أعلي قيم النيتروجين و الفسفور و البوتاسيوم الممتص بواسطة القش قد تحصل عليها نتيجة لأستخدام مخلفات الدواجن يليها استخدام مخلفات الخروع بينما بالنسبة للحبوب فقد تم التحصل عليها نيتجة أستخدام مخلفات الخروع يليها مخلفات الدواجن وذلك خلال جميع مراحل النمو.
3) أدى أستخدام تلك المخلفات إلي التأثير علي كمية الزيت المنتجة تأثيرا واضحا بينما لم يظهر اثر استخدام تلك المعاملات المختلفة علي نسب الأحماض الدهنية بالبذور.

يمكن من النتائج السابقة التوصية (باستخدام التسميد العضوي خاصة مخلفات الدواجن مع ربع أو نصف الكمية الموصي بها من التسميد النيتروجيني المعدني لنبات دوار الشمس بنجاح) للحصول علي أعلي محصول و أعلي تركيز من العناصر الممتصة بواسطة النبات وهو ما يعد أفضل من حيث تقليل التكاليف و المحافظة علي البيئة من التلوث الناتج عن استخدام الأسمدة المعدنية.