Plant Archives Vol. 19, Supplement 2, 2019 pp. 111-117 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

EFFECT OF CALCIUM CARBIDE, HUMIC ACID AND NITROGEN APPLICATION ON GROWTH AND YIELD OF SUNFLOWER (*HELIANTHUS ANNUUS* L.)

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Abstract

A field experiment was conducted at Experimental Area in Research Station A in One of college of Agricultural Engineering sciences Fields' in University of Baghdad in Aljadriya, Baghdad –Iraq during Autumn season 2018, to evaluate the effect of calcium carbide, humic acid and nitrogen fertilizer application alone and in combination on growth and yield of sunflower "aqmar" ornamental hybrid. The experiment was laid out on Randomized Complete Block Design (RCBD) with sixteen treatments and three replications having three factors. Treatment plan was contain calcium carbide (0 and 60) kg CaC_2 ha^{-1}, humic acid (0 and 70) kg ha^{-1} and four levels of nitrogen fertilizer (0, 50, 100 and 150) kg N ha^{-1} in the presence of recommended doses of P and K fertilizer (35 kg P ha^{-1} and 66 kg K ha^{-1}). Maximum seeds yield and oil yield were recorded in the treatment $C_1H_1N_2$ (60 kg CaC_2 ha^{-1} + 70 kg humic acid ha^{-1} + 100 kg N ha^{-1}) which were (6.855 and 3.093) Mg ha^{-1} comparing with control $C_0H_0N_0$ treatment (3.548 and 1.719) Mg ha^{-1} with increasing rates (93.21% and 79.93%) respectively, Maximum dry vegetative and biological yield (12.433 and 20.579) Mg ha^{-1} were noticed in $C_1H_1N_3$ treatment with increasing rates (166.4% and 109.67%) comparing with control treatment $C_0H_0N_0$ which were (4.667 and 9.815) Mg ha^{-1} respectively, there are non-significant differences between $C_1H_1N_2$ and $C_1H_1N_3$ treatments . Maximum plant height in $C_0H_1N_3$ was 240 cm increasing rate 27.44% at control treatment $C_0H_0N_0$ (188.33 cm) and the lowest plant height was (175.83 cm) in $C_1H_0N_0$ treatment with decreasing rate (6.64%) comparing with control treatment $C_0H_0N_0$ which was (188.33 cm). maximum head diameter was (23.77 cm) in $C_1H_1N_3$ with increasing rate (55.06%) comparing with control treatment $C_0H_0N_0$ which was (15.33 cm), there are non-significant differences between $C_1H_1N_2$ and $C_1H_1N_3$ treatments in head diameter.

Keywords: calcium carbide, ethylene, nitrification inhibitor, humic acid, nitrogen fertilizer, Sunflower.

Introduction

Sunflower (*Helianthus annuus* L.) is an important oil seed crop which ranks 3rd after soybean and peanut along with other oil seed crops like (canola, and cotton) which contributes considerably to edible oil in the world (Thavaprakash *et al.,* 2002).

Sunflower seed oil is highly rich in unsaturated fatty acids [oleic acid (20%) and linoleic acid (70%)] required for cell structure. It is also light colored, delicious and easily digested. Sunflower oil catalyzes the intake of oil-soluble vitamins (A, D, E and K) in to body and plays a remedial role in cardiovascular and cholesterol diseases (Kolsarici *et al.*, 2005). According to FAO statistics, the share of sunflower in providing world oil demand is 7.3% (FAO, 2007). Calcium carbide is a potent source of the acetylene (nitrification inhibitor) and ethylene (plant hormone) gases when it react with water (Yaseen *et al.*, 2006). Calcium carbide affects plant growth through hormonal action of ethylene as well as improved nutrients use efficiency (NUE); however, the latter factor might be a relatively more contributing. When calcium carbide is applied to the soil, it reacts with soil water to release acetylene (C_2H_2). The acetylene reduced to ethylene (C_2H_4) by soil microorganisms with the help of enzyme (Nitrogenase). The ethylene (C_2H_4) enters the plant through roots. The acetylene (C_2H_2) is potent inhibitor of nitrification process and the ethylene (C_2H_4) affects physiological processes in plants (Khristeva, 1953; Freney *et al.*, 2000; Ramesh, and Kumar, 2006). Experiments have shown that humic acid improved production of sugar, protein and vitamins in plants that had a positive impact on various aspects of photosynthesis and increased yield and quality of the product (Sharif *et al.*, 2002). One study demonstrated that application of humic acid enhanced evaluations for oil content, seed weight and seed number per head in sunflower (Wisi and Hidari, (2013).

Nitrogen is one of the major nutrients that enhance the metabolic processes that based on protein, leads to increases in vegetative, reproductive growth and yield of the crop (Zubillaga *et al.*, 2002; Koutroubas *et al.*, 2008). Nitrogen is one of the most essential elements for plant especially sunflower, so it considers a limiting factor for their growth, because crops are demanded in such a large amount, the agricultural sector relies greatly on nitrogen and often inappropriate uses it, which threatens environment: air, water and soil quality (Xu, Fan and Miller, 2012). Nitrogen is main element for sunflower grain production and oil extraction (Abdel-Motagally and Osman, 2010; Rasool, Hassan and Jahangir, 2013). They were observed the effect of increasing nitrogen in soil by fertilization on several growth parameters (plant height, stem diameter, head diameter, 1000 seed weight, seed yield $plant^{-1}$, seed yield ha^{-1} and oil yield ha^{-1}) causing increasing in production. Nitrogen fertilization affects many important agronomical parameters such as leaf area, head diameter, seed weight and yield (Ali and Noorka, 2013). According to the dosage of nitrogen used, either decreases or increases in oil yield may be reported.

Materials and Methods

The experiment was conducted as factorial in a randomized complete block design with three replications, The field of study lies in the Researches Station A in One of fields of college Agricultural and Engineering Sciences, University of Baghdad in Aljadriya, Baghdad, Iraq during Autumn season 2018 to evaluate the effect of calcium carbide, humic acid and nitrogen application alone and in combination on growth and yield of sunflower "aqmar" ornamental hybrid the following treatments were tested with three replications:

T_1. $C_0H_0N_0$ = control (0 kg CaC_2 ha^{-1} + 0 kg Humic Acid ha^{-1} + 0 kg N ha^{-1}).
T_2. $C_0H_0N_1$ = 0 kg CaC_2 ha^{-1} + 0 kg Humic Acid ha^{-1} + 50 kg N ha^{-1}.
T_3. $C_0H_0N_2$ = 0 kg CaC_2 ha^{-1} + 0 kg Humic Acid ha^{-1} + 100 kg N ha^{-1}.

T_4. $C_0H_0N_3$ = 0 kg CaC_2 ha^{-1} + 0 kg Humic Acid ha^{-1} +150 kg N ha^{-1}.
T_5. $C_1H_0N_0$ = 60 kg CaC_2 ha^{-1} + 0 kg Humic Acid ha^{-1} + 0 kg N ha^{-1}.
T_6. $C_1H_0N_1$ = 60 kg CaC_2 ha^{-1} + 0 kg Humic Acid ha^{-1} + 50 kg N ha^{-1}.
T_7. $C_1H_0N_2$ = 60 kg CaC_2 ha^{-1} + 0 kg Humic Acid ha^{-1} + 100 kg N ha^{-1}.
T_8. $C_1H_0N_3$ = 60 kg CaC_2 ha^{-1} + 0 kg Humic Acid ha^{-1} + 150 kg N ha^{-1}.
T_9. $C_0H_1N_0$ = 0 kg CaC_2 ha^{-1} + 70 kg Humic Acid ha^{-1} + 0 kg N ha^{-1}.
T_{10}. $C_0H_1N_1$ = 0 kg CaC_2 ha^{-1} + 70 kg Humic Acid ha^{-1} + 50 kg N ha^{-1}.
T_{11}. $C_0H_1N_2$ = 0 kg CaC_2 ha^{-1} + 70 kg Humic Acid ha^{-1} + 100 kg N ha^{-1}.
T_{12}. $C_0H_1N_3$ = 0 kg CaC_2 ha^{-1} + 70 kg Humic Acid ha^{-1} + 150 kg N ha^{-1}.
T_{13}. $C_1H_1N_0$ = 60 kg CaC_2 ha^{-1} + 70 kg Humic Acid ha^{-1} + 0 kg N ha^{-1}.
T_{14}. $C_1H_1N_1$ = 60 kg CaC_2 ha^{-1} + 70 kg Humic Acid ha^{-1} + 50 kg N ha^{-1}.
T_{15}. $C_1H_1N_2$ = 60 kg CaC_2 ha^{-1} + 70 kg Humic Acid ha^{-1} + 100 kg N ha^{-1}.
T_{16}. $C_1H_1N_3$ = 60 kg CaC_2 ha^{-1} + 70 kg Humic Acid ha^{-1} + 150 kg N ha^{-1}.

The Surface Soil from 0-30 cm depth samples was collected from the research area, mixed and sent to the Laboratory to make tests for it table (1).

Table 1 : Shows some of Chemical and Physical properties of the Soil used in the Experiment which measured according to standard methods used in (Page *et al*., 1982)

Characteristics		Value	Unit
Hydrogen Potential (pH)		7.45	
Electric Conductivity (EC)		1.92	dSm^{-1}
NH_4^+ - N		20.72	mg kg^{-1} Soil
NO_3^- - N		26.51	mg kg^{-1} Soil
Available Phosphorus		8.1	mg kg^{-1} Soil
Available Potassium		185.0	mg kg^{-1} Soil
Gypsum		1.75	g kg^{-1}
Minerals of Carbonate		225	g kg^{-1}
Organic matter		10.5	g kg^{-1}Soil
Cations	Ca^{+2}	11.2	mmole L^{-1}
	Mg^{+2}	7.1	mmole L^{-1}
	K^{+1}	2.3	mmole L^{-1}
	Na^{+1}	10.5	mmole L^{-1}
Anions	SO_4^{-1}	5.2	mmole L^{-1}
	Cl^{-1}	21.3	mmole L^{-1}
	HCO_3^{-1}	3.05	mmole L^{-1}
	CO_3^{-2}	Nill	mmole L^{-1}
CEC		19.5	$cmole_c$ kg^{-1}
Soil		g kg^{-1}	Soil texture Class
Sand		352.0	Silty Loam
Silt		523.0	
Clay		125.0	
Bulk Density		1.45	mega g m^{-3}

Results

1. Height of Plant

Table (2) indicated the statistical results of calcium carbide application alone which was decreased significantly in height of plant (211.16 cm) in C_1 treatment with decreasing percent (4.10%) with the treatment C_0 which was (220.18 cm). humic acid application was increased in height of plant (226.24 cm) in H_1 treatment with increasing percent (10.31%) comparing with treatment H_0 (205.10 cm) ,while the nitrogen fertilizer application was increased significantly in height of plant the highest value was (229.70 cm) in N_3 treatment which was higher than the lowest value (200.33 cm) by (14.66%).

The double interference between calcium carbide and humic acid was increased significantly in height of plant, the highest value was (226.79 cm) in C_0H_1 treatment comparing with control C_0H_0 which was (213.58 cm) with increasing rate (6.19%), while the lowest value was (196.62 cm) in C_1H_0 with reducing rate (7.94%) comparing with control treatment which was (213.58 cm). the double interference between calcium carbide and nitrogen fertilizer had different interaction between increasing and decreasing in height of plant, the highest value was (236.66 cm) in C_0N_3 treatment with increasing rate (17.02%) comparing with control treatment C_0N_0 which was (202.24 cm), while the lowest value was (198.41 cm) in C_1N_0 with non-significant decreasing rate (1.89%) comparing with control treatment C_0N_0 which was (202.24 cm), the double interference between humic acid and nitrogen fertilizer was increased significantly in height of plant, the highest value was (236.50 cm) in H_1N_3 treatment with increasing rate (29.89%) comparing with control treatment H_0N_0 which was (182.08 cm).

The triple interference among calcium carbide, humic acid and nitrogen fertilizer was increased significantly in height of plant, the highest value was (240.0 cm) in $C_0H_1N_3$ with increasing rate (27.44%) comparing with control treatment $C_0H_0N_0$ which was (188.33 cm) while the lowest value was (175.83 cm) with significantly decreasing rate (6.64%) comparing with control treatment $C_0H_0N_0$ which was (188.33 cm).

2. Yield of Seeds

Table (3) indicated the statistical results of addition of carbide calcium alone which was increased significantly in seeds yield (5.444 Mg ha^{-1}) in C_1 compared with control C_0 (4.480 Mg ha^{-1}) with rate of increasing (21.52%), Humic acid application alone was increased in seeds yield significantly (5.668 Mg ha^{-1}) in H_1 with increasing percent (33.18%) comparing with H_0 (4.256 Mg ha^{-1}). Nitrogen fertilizer application was increased significantly in seeds yield, the maximum yield (5.394 Mg ha^{-1}) in N_3 without significant different with N_2 comparing with N_0 (4.394 Mg ha^{-1}) with increasing percent (22.76%).

The interference between calcium carbide and humic acid was increased significantly in seeds yield; the maximum yield (6.377 Mg ha^{-1}) in C_1H_1 with increasing rate (59.43%) comparing with control C_0H_0 (4.000 Mg ha^{-1}).The interaction between calcium carbide and nitrogen fertilizer was increased significantly in seeds yield; the maximum yield (5.887 Mg ha^{-1}) in C_1N_2 with increasing percent (53.07%) comparing with C_0N_0 (3.846 Mg ha^{-1}). The interaction between Humic acid and nitrogen fertilizer was increased significantly, the maximum yield (6.153 Mg ha^{-1}) in H_1N_3 with increasing percent (63.12%) comparing with H_0N_0 (3.772 Mg ha^{-1}), there are not significant different between H_1N_3 and H_1N_2.

The triple interference between calcium carbide, humic acid and nitrogen fertilizer application was increased significantly in seeds yield, the maximum seeds yield (6.855 Mg ha^{-1}) in $C_1H_1N_2$ with increasing percent (93.21%) comparing with $C_0H_0N_0$ (3.548 Mg ha^{-1}).

3. Dry Vegetative Weight

Table (4) showed the statistical results of dry vegetative weight, calcium carbide application was increased significantly in dry weight (9.453 Mg ha^{-1}) in C_1 compared with control C_0 (7.499 Mg ha^{-1}) with increasing percent (26.06%), Humic acid application alone was increased in dry weight significantly (10.027 Mg ha^{-1}) in H_1 with increasing percent (44.79%) comparing with H_0 (6.925 Mg ha^{-1}) . Nitrogen fertilizer application was increased significantly in dry weight, the maximum (10.025 Mg ha^{-1}) in $N_3$with increasing percent (68.57%) comparing with N_0 (5.947 Mg ha^{-1}).

The interaction between calcium carbide and humic acid was increased significantly in dry weight; the maximum weight (11.003 Mg ha^{-1}) in C_1H_1 with increasing percent (85.02%) comparing with control C_0H_0 (5.947 Mg ha^{-1}). The interaction between calcium carbide and nitrogen fertilizer was increased significantly in dry weight; the maximum weight (10.890 Mg ha^{-1}) in C_1N_3 with increasing percent (94.46%) comparing with C_0N_0 (5.600 Mg ha^{-1}). The interaction between Humic acid and nitrogen fertilizer was increased significantly, the maximum dry weight (11.577 Mg ha^{-1}) in H_1N_3 with increasing percent (137.87%) comparing with H_0N_0 (4.867 Mg ha^{-1}).

The triple interaction between calcium carbide, humic acid and nitrogen fertilizer application was increased significantly in dry vegetative weight, the maximum weight (12.433 Mg ha^{-1}) in $C_1H_1N_3$ with increasing percent (166.4%) comparing with $C_0H_0N_0$ (4.667 Mg ha^{-1}). There are non-significant differences between $C_1H_1N_2$ and $C_1H_1N_3$ treatments.

4. Biological Yield

Table (5) showed the statistical results of Biological yield, calcium carbide application was increased significantly in Biological yield (16.422 Mg ha^{-1}) in C_1 compared with control C_0 (13.579 Mg ha^{-1}) with increasing percent (20.94%), Humic acid application alone was increased in Biological yield significantly (17.220 Mg ha^{-1}) in H_1 with increasing percent (34.73%) comparing with H_0 (12.781 Mg ha^{-1}). Nitrogen fertilizer application was increased significantly in Biological Yield, the maximum (16.969 Mg ha^{-1}) in N_3 with increasing percent (42.12%) comparing with N_0 (11.940 Mg ha^{-1}).

The double interference between calcium carbide and humic acid was increased significantly in Biological yield; the maximum (18.829 Mg ha^{-1}) in C_1H_1 with increasing percent (63.06%) comparing with control C_0H_0 (11.547 Mg ha^{-1}). The interaction between calcium carbide and nitrogen fertilizer was increased significantly in Biological yield; the maximum (18.165 Mg ha^{-1}) in C_1N_3 with increasing percent (64.46%) comparing with C_0N_0 (11.045 Mg ha^{-1}). The interaction between Humic acid and nitrogen fertilizer was increased significantly, the maximum Biological yield (19.230 Mg ha^{-1}) in H_1N_3 with increasing percent (87.81%) comparing with H_0N_0 (10.239 Mg ha^{-1}), there are not significant different between H_1N_3 and H_1N_2

The triple interference between calcium carbide, humic acid and nitrogen fertilizer application was increased significantly in Biological yield, the maximum value (20.579 Mg ha^{-1}) in $C_1H_1N_3$ with increasing percent (109.67%) comparing with $C_0H_0N_0$ (9.815 Mg ha^{-1}). There are non-significant differences between $C_1H_1N_2$ and $C_1H_1N_3$ treatments.

5. Diameter of Head (cm)

Table (6) indicated the statistical results of carbide calcium application alone which was increased significantly in head diameter (21.14 cm) in C_1 treatment which was higher than control treatment C_0 (18.74 cm) by (12.81%). Humic acid application was increased in diameter of head (21.71 cm) in H_1 treatment with increasing rate (19.84%) comparing with control treatment H_0 (18.17 cm). the levels of nitrogen fertilizer application was increased in diameter of head of sunflower, the highest value was (20.83 cm) in N_3 treatment which was higher than the lowest value (18.88 cm) in control treatment N_0 by (10.33%), there are non-significant differences between N_2 and N_3 treatments.

The double interference between calcium carbide and humic acid was increased significantly in diameter of head, the highest value of head diameter was (22.75 cm) in C_1H_1treatment which was higher than the lowest value (16.81 cm) in control treatment C_0H_0 by (35.34%). The double interference between calcium carbide and levels of nitrogen fertilizer application was increased in diameter of head significantly, the highest value of head diameter was (22.05 cm) in C_1N_3 treatment with increasing rate (24.79%) comparing with control treatment C_0N_0 which was (17.67 cm) there are non-significant differences between C_1N_2 and C_1N_3. the double interference between humic acid and levels of nitrogen fertilizer application was increased significantly in diameter of head, the highest value was (22.49) in H_1N_3 treatment with increasing rate (31.29%) comparing with control treatment H_0N_0 which was (17.13 cm), there are non-significant differences between H_1N_2 and H_1N_3 treatments.

The triple interference among calcium carbide, humic acid and nitrogen fertilizer was increased significantly in diameter of head, the highest value was (23.77 cm) in $C_1H_1N_3$ treatment with increasing rate (55.06%) comparing with control treatment $C_0H_0N_0$ (15.33 cm), there are non-significant differences between $C_1H_1N_2$ and $C_1H_1N_3$ treatments.

6. Yield of Oil

Table (7) was showed the statistical results of effect of calcium carbide, humic acid and nitrogen fertilizer application on yield of oil, calcium carbide application was increased in yield of oil (2.465 Mg ha^{-1}) in C_1 treatment with increasing rate (18.45%) comparing with control treatment C_0 which was (2.081 Mg ha^{-1}), humic acid was increased in yield of oil (2.592 Mg ha^{-1}) in H_1 treatment with increasing rate (32.72%) comparing with control treatment H_0 which was (1.953 Mg ha^{-1}), while the levels of nitrogen fertilizer application were increased in yield of oil, the highest value was (2.423 Mg ha^{-1}) in N_2 treatment which was higher than control treatment N_0 which was (2.089 Mg ha^{-1}) by (15.99%).

The double interference between calcium carbide and humic acid was increased in yield of oil, the highest value was (2.887 Mg ha^{-1}) in C_1H_1 by (23.23%) comparing with control treatment C_0H_0 which was (1.864 Mg ha^{-1}).The double interference between calcium carbide and the levels of nitrogen fertilizer application was increased in yield of oil, the highest value was (2.662 Mg ha^{-1}) in C_1N_2 treatment which was higher than control treatment C_0N_0 (1.853 Mg ha^{-1}) by (43.66%). The double interference between humic acid and the levels of nitrogen fertilizer application was increased in yield of oil, The highest value was (2.778 Mg ha^{-1}) in H_1N_2 treatment which was higher than control treatment H_0N_0 (1.800 Mg ha^{-1}) by (54.33%).

The triple interference among calcium carbide, humic acid and levels of nitrogen fertilizer application was increased in yield of oil, The highest value was (3.093 Mg ha^{-1}) in $C_1H_1N_2$ treatment which was increased (79.93%) comparing with control treatment $C_0H_0N_0$ which was (1.719 Mg ha^{-1}).

Table 2: Effect of calcium carbide, humic acid and nitrogen fertilizer application on height of plant (cm).

Humic Acid Levels	Calcium Carbide Levels	Nitrogen Levels				Effect Mean H*C
		N_0	N_1	N_2	N_3	
H_0	C_0	188.33	207.00	225.66	233.33	213.58
	C_1	175.83	191.33	206.83	212.50	196.62
H_1	C_0	216.16	219.66	231.33	240.00	226.79
	C_1	221.00	219.83	229.00	233.00	225.70
L.S.D. 0.05		11.94				5.97
						Mean C
N*C	C_0	202.24	213.33	228.50	236.66	220.18
	C_1	198.41	205.58	217.91	222.75	211.16
L.S.D. 0.05		8.44				4.22
						Mean H
N*H	H_0	182.08	199.16	216.25	222.91	205.10
	H_1	218.58	219.75	230.16	236.50	226.24
L.S.D. 0.05		8.44				4.22
						Mean N
N		200.33	209.45	223.20	229.70	215.67
L.S.D. 0.05		5.97				

Table 3 : Effect of Calcium Carbide, Humic Acid and Nitrogen Application of Seeds Yield (Mg ha^{-1})

Humic Acid Levels	Calcium Carbide Levels	Nitrogen Levels				Effect Mean H*C
		N_0	N_1	N_2	N_3	
H_0	C_0	3.548	3.867	4.121	4.465	4.000
	C_1	3.995	4.326	4.919	4.803	4.511
H_1	C_0	4.143	4.775	5.360	5.560	4.960
	C_1	5.888	6.017	6.855	6.746	6.377
L.S.D. 0.05		0.290				0.145
						Mean C
N*C	C_0	3.846	4.321	4.741	5.013	4.480
	C_1	4.942	5.172	5.887	5.775	5.444
L.S.D. 0.05		0.205				0.103
						Mean H
N*H	H_0	3.772	4.097	4.520	4.634	4.256
	H_1	5.016	5.396	6.108	6.153	5.668
L.S.D. 0.05		0.205				0.103
						Mean N
N		4.394	4.746	5.314	5.394	4.962
L.S.D. 0.05		0.145				

Table 4 : Effect of Calcium Carbide, Humic Acid and Nitrogen Application of Dry Vegetative Weight (Mg ha^{-1})

Humic Acid Levels	Calcium Carbide Levels	Nitrogen Levels				Effect Mean H*C
		N_0	N_1	N_2	N_3	
H_0	C_0	4.667	5.253	6.267	7.600	5.947
	C_1	5.067	8.133	9.067	9.347	7.904
H_1	C_0	6.533	8.813	10.137	10.720	9.051
	C_1	7.520	11.790	12.267	12.433	11.003
L.S.D. 0.05		0.210				0.105
						Mean C
N*C	C_0	5.600	7.033	8.202	9.160	7.499
	C_1	6.294	9.962	10.667	10.890	9.453
L.S.D. 0.05		0.148				0.074
						Mean H
N*H	H_0	4.867	6.693	7.667	8.474	6.925
	H_1	7.03	10.302	11.202	11.577	10.027
L.S.D. 0.05		0.148				0.074
						Mean N
N		5.947	8.497	9.435	10.025	8.476
L.S.D. 0.05		0.105				

Table 5: Effect Calcium Carbide, Humic Acid and Nitrogen Application of Biological Yield (Mg ha^{-1})

Humic Acid Levels	Calcium Carbide Levels	Nitrogen Levels				Effect Mean H*C
		N_0	N_1	N_2	N_3	
H_0	C_0	9.815	10.720	11.988	13.665	11.547
	C_1	10.662	14.059	15.586	15.750	14.014
H_1	C_0	12.276	15.188	17.097	17.880	15.610
	C_1	15.008	19.407	20.322	20.579	18.829
L.S.D. 0.05		0.3784				0.1892
						Mean. C
N*C	C_0	11.045	12.954	14.543	15.773	13.579
	C_1	12.835	16.733	17.954	18.165	16.422
L.S.D. 0.05		0.2675				0.1338
						Mean. H
N*H	H_0	10.239	12.390	13.787	14.708	12.781
	H_1	13.642	17.298	18.710	19.230	17.220
L.S.D. 0.05		0.2675				0.1338
						Mean. N
N		11.940	14.844	16.248	16.969	15.000
L.S.D. 0.05		0.1892				

Table 6 : Effect of calcium carbide, humic acid and nitrogen fertilizer application of Diameter of Head (cm)

Humic Acid Levels	Calcium Carbide Levels	Nitrogen Levels				Effect Mean H*C
		N_0	N_1	N_2	N_3	
H_0	C_0	15.33	16.57	17.34	18.01	16.81
	C_1	18.92	19.00	19.83	20.33	19.52
H_1	C_0	20.01	20.55	20.91	21.21	20.67
	C_1	21.24	22.33	23.67	23.77	22.75
L.S.D. 0.05		1.06				0.53
						Mean. C
N*C	C_0	17.67	18.56	19.13	19.61	18.74
	C_1	20.08	20.67	21.75	22.05	21.14
L.S.D. 0.05		0.75				0.37
						Mean H
N*H	H_0	17.13	17.79	18.59	19.17	18.17
	H_1	20.63	21.44	22.29	22.49	21.71
L.S.D. 0.05		0.75				0.37
						Mean N
N		18.88	19.61	20.44	20.83	19.94
L.S.D. 0.05		0.53				

Table 7 : Effect of calcium carbide, humic acid and nitrogen fertilizer application on yield of oil (Mg ha^{-1})

Humic Acid Levels	Calcium Carbide Levels	Nitrogen Levels				Effect Mean H*C
		N_0	N_1	N_2	N_3	
H_0	C_0	1.719	1.860	1.905	1.973	1.864
	C_1	1.882	1.992	2.231	2.065	2.043
H_1	C_0	1.987	2.285	2.463	2.453	2.297
	C_1	2.766	2.753	3.093	2.935	2.887
L.S.D. 0.05		0.144				0.072
						Mean C
N*C	C_0	1.853	2.072	2.184	2.213	2.081
	C_1	2.324	2.372	2.662	2.500	2.465
L.S.D. 0.05		0.102				0.051
						Mean H
N*H	H_0	1.800	1.926	2.068	2.019	1.953
	H_1	2.377	2.519	2.778	2.694	2.592
L.S.D. 0.05		0.102				0.051
						Mean N
N		2.089	2.222	2.423	2.357	2.273
L.S.D. 0.05		0.072				

Discussions

The result was indicated the effect of calcium carbide was decreased significantly on height of plant, that return to effect of calcium carbide when reacts with water released acetylene (C_2H_2) and ethylene (C_2H_4), Ethylene was decreased the plant height by inhibits the movement of Auxin in stem tissue, possibly reducing the ability of Auxin to promote stem elongation (Morgan and Gusman, 1966). Vertical reduction of plant height causes increase in horizontal expansion of plant by decreasing the intermodal distance. Calcium carbide produced acetylene which reduced the nitrification process increased the efficiency of nitrogen use and ethylene triggered the adventitious root formation, ethylene enhanced the root formation which was responsible for the better nutrient uptake and hence enhanced the vegetative growth (Seenewera *et al*., 2003). This may be reason for increasing yield of seeds table (3), dry vegetative weight table (4), biological yield table (5), head diameter table (6) and yield of oil table (7). (Keerthisinghe *et al*., 1996) and ultimately increases the vegetative growth like dry vegetative weight table (4), biological yield table (5), head diameter table (6), yield of seeds table (3) and yield of oil table (7) (Kashif *et al*., 2008) this result deals with (Yaseen *et al*., 2009; Abbasi *et al*., 2009; Mahmood *et al*., 2010).

Humic acid application was increased in plant height because humic acid is proposed to modify soil structure, aeration, ability of soil to keep water and increase nutrient absorption, these reasons were increased in plant height table (2). Humic acid application is containing abundant nutrients improves soil fertility and increase the availability of nutrients to plants and thus it influences plant growth and yield and it is naturally occurring polymeric organic compound, humic acid has natural potential resources, that can be utilized to enhance plant growth like in tables (2, 3, 4, 5, 6, 7) (Sharif *et al*., 2002). Humic Acid application significantly increased photosynthetic efficiency and chlorophyll contents of plants (Russo and Berlyn, 1990) humic acid was increased the permeability of cells membrane especially the root cells, that increases root absorption to the nutrient and that leads to increase plant height table (2), yield of seeds table (3), dry vegetative weight table (4), biological yield table (5), head diameter table (6) and yield of oil table (7).

Nitrogen fertilizer application was increased plant height table (2), nitrogen fertilizer is related to carbohydrate utilization, when nitrogen supplies are adequate and conditions are favorable for growth, proteins are formed from the manufactured carbohydrates, less carbohydrates is thus deposited in the vegetative protein, that leads to more protoplasm is formed and because the protoplasm is highly hydrated, so there is more succulent plant results. (Marshner, 1995; Tisdale *et al*., 2003) therefore increase in crop growth is relate in line with increase in nitrogen fertilizer application. the nitrogen application was enhanced the activity of photosynthesis and that increased the leaf area and root activity, these reasons made plant to increase nutrient absorption all that leads to significant increasing in plant height table (2), yield of seeds table (3), dry vegetative weight table (4), biological yield table (5), head diameter table (6) and yield of oil table (7) (Tisdale *et al*., 2003).

Conclusion

Calcium carbide application enhanced the growth, yield and oil yield in sunflower and it was increased from nitrogen use efficiency and it was reduced from about 50% with yield is higher than full fertilization recommendation without calcium carbide. Humic acid was increased from yield and yield components of sunflower and its behavior was as nitrification inhibitor helped to increase yield and improve from plant growth. Nitrogen fertilizer application was increased the vegetative growth and yield of sunflower, the best treatment was the triple interference between calcium carbide, humic acid and nitrogen fertilizer in T_{15} (60 kg CaC_2 ha^{-1} + 70 kg humic acid ha^{-1} + 100 kg N ha^{-1}) which gave the best yield for sunflower.

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