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THE INTEGRATED EFFECT OF DEFICIT IRRIGATION AND WEED CONTROL TREATMENTS ON PEANUT PRODUCTIVITY UNDER SANDY SOIL CONDITIONS WITH REFERENCE TO NEMATODE INFECTION

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Abstract

Water availability is a vital source for crop production in arid and semiarid areas of the world. Therefore, it is important to use water more efficiently to maximize its economic returns. For this reason, two field experiments were carried out in a strip plot design including four replicates at the private experimental farm during 2016 and 2017 seasons of National Research Centre, Nubaria region, El-Behera Governorate, Egypt to study the impact of four water irrigation treatments (40, 60, 80 and 100% of evapotranspiration (Etc) of peanut requirements) and six weed control treatments (oxydiargel, metribuzin, butraline, pendimethline, two hand hoeing and unweeded) as well as their interaction effect on peanut productivity. Application of 100% or 80% of Etc recorded the highest values of total dry weight of weeds in both seasons. Additionally, increasing irrigation levels from 40 up to 100% of Etc exhibited a progressive increase in growth, yield and its attributes besides seed and straw chemical compositions. Moreover, most parameters of yield and yield attributes did not show significant differences between 80 and 100% Etc levels. The maximum values of water use efficiency (WUE) was recorded when plans received 40% of Etc as compared with other irrigation levels. Two hand hoeing followed by oxydiargel treatments gave the lowest total dry weight of weeds and largest averages of seed yield, yield attributes, chemical composition of seeds and straw yields as well as WUE. The maximum seed yield was obtained by application of 100% of Etc of peanut requirements alongside two hand hoeing, followed by 80% of Etc combined with oxydiargel treatment. The present investigation on seasonal fluctuation of nematode species for the both tested seasons showed that the maximum nematode population reached in August with along with highest soil temperature while, decreased as the soil temperature diminished in September.

Keywords: Peanut, water deficient, herbicides, growth, yield, WUE, chemicals compositions, nematode

Introduction

In order to meet the gap between production and consumption of vegetable oil, improvement the production of major oilseed crops through area extension and productivity through adoption of improved technology is most important. Peanut (Arachis hypogaea L.) is one of mainly essential trade and industry oilseeds in the tropical as well as semi tropical regions came after soybean, cotton, canola and sunflower and play an essential role in sustainable agriculture. It is generally growing for its oil, protein and carbohydrate resource. Its seed contain about 43-55% oil, 25-28% protein, 5% fiber and ash and essential vitamins and minerals (Panhwar, 2005; Kambiranda et al. 2011). Moreover, peanut is considered one of the most significant summer oil crops in the new-reclaimed sandy soils in Egypt. According to FAO (2019) the cultivated area of peanut reached about 62000 ha, with total production exceeded 199000 tons in Egypt. However, the cultivated area in the world was about 27.940 million ha produced about 47.097 million tons.

Agriculture and agricultural related activities consume about 70% of the total fresh water resources in the world. At present, total annual water budget in Egypt is estimated of about 67.27 billion cubic meters (Abu Zaid, 2000). In addition, about 80-90% of the total amount assigned to Egypt consumed in agriculture practices. As a result of limited water resources and increased growth population, the per capita share of fresh water resources has dropped dramatically. Drought is the major environmental constraint to peanut limiting productivity (Awal and Ikeda, 2002; Priya et al., 2013) and water stress affects peanut growth depending on the stage of plant growth and the degree or intensity of drought stress. It's also the main reason effect on osmotic potential, availability of water, damage to DNA, lipids and proteins and close of stomata, minimize the process of photosynthesis, reduction in growth characters and yield (Bird et al., 1983; Abd El-Dayem and Ismaeil, 2007). In peanut plants water stress caused reduction in light efficiency and net photosynthesis due to decreasing the availability of hormonal substances imbalance (Heatherly et al., 1994; Cláudio et al., 1997; Hemalatha et al., 2013). Counteractive impacts of water stress on peanut growth, yield and its attributes as well as seed quality have been previously reported (AbouKheira, 2009; El–Boraie et al., 2009; Aboelill et al., 2012; Aydinsakir et al., 2016). According to Jongrungklang et al. (2013) and Faye et al. (2016) water stress significantly affected growth characters, seed yield and yield attributes of peanut plant, and the reduction in seed yield reached about 33% when water stress reached flowering stage and about 50% when stress reached reproductive and seed filling stage. Moreover, the values of water use efficiency were reduced due to the increases in irrigation frequency of peanut plants (Singh et al., 1994; Tiwari et al., 1994; Sounda et al., 2006; Aydinsakir et al., 2016).

No doubt that, water use by weeds is one type of potential losses that contributes to the cost of weeds to agriculture (Norris, 1996). Thus, eliminating sources of water loss via weeds is so important in this regard. Thus, weeds in fertile and irrigated fields can be quite different from those that grow in less fertile and irrigated soils. The presence of weeds with the crop results in reduction in the economic yield as well as its quality. The reduction of yield can vary from slight to massive depending on the weed density. Agostinho et al. (2006) noticed that weed interference caused a reduction in yield reached about between 74 and 92%. In addition, when peanuts were grown under irrigation on sandy soils of Egypt unweeded plot yielded less than half as much as weeded plots (Abouziena et al., 2013). Peanut is less adapted to mechanical cultivation than most other agronomic crops. Although initial elongation of the radical is rapid, peanut foliage grow slowly. The peanut canopy is usually thinner in depth than crop canopies such as soybean or cotton. Also, in early growth of life peanut plants consider are a poor weed competition due to less crop canopy of peanut plants cause strong competing between weed and peanut plants for sunlight, space, soil moisture, nutrients, weeds prevent pegging and the development of pod in peanut plants and interfere with harvest causing significant reduction in growth characters, yield and yield attributes beside seed quality (Shanwad et al., 2011). Moreover, higher peanut yielded depend on weed suppression late in the growing season, since carful hand weeding following herbicides treatments improved weed control and resulted in substantial yield increases. Therefore, inadequate of weed management is considering one of the most critical factors affecting the productivity of peanut plants and seed quality (EL Naim et al., 2010; Garko et al., 2016). Manual weed control is considered as an ancient old practice for weeds control in peanut production due to its difficulty, time consuming and high cost, especially when there is shortage of manpower (Ikisan, 2000). However, chemical weed control has been found to be efficient in reducing weed menace as compared with hand weeding (Kumar, 2009). Moreover, the total averages of weed dry weight were decreased with using twice hand hoeing. In this regard, there are several reports suggested using this technique for weeds control to achieve the highest economic yield (Youssry et al., 2008; El Naim et al., 2011; Fakkar and El-Dakkak 2015; Adhikary et al., 2016; El-Metwally et al., 2017a and b). Also, using pre-emergence or post-mergence application of chemical weed control at their recommended dose might be assumed for effective controlling of weeds and maximize the production of peanut plants.

Nematological survey as well as nematode fluctuations are necessary in providing information on the probability and magnitude of crop losses due to nematode infection, especially with Meloidogyne spp. Their wide host range and favorable environmental conditions provide suitable control measure to achieve reasonable results. Keeping these points of view, this investigation was planned to study the impact of water shortage treatments and weed control treatments on associated weeds, growth characters, productivity as well as seeds and straw chemical compositions of peanut plants with reference to nematode infection.

Material and Method

Experimental site and objectives:

Two successive summer seasons of field experiments during (2016 and 2017) were conducted at the private experimental farm of National Research Centre, Nubaria Region, El-Behera Governorate, Egypt (latitude 30.8667 N, and longitude 31.1667 E). The monthly mean of weather as average of both growing seasons are presented in Table (1) according to the official data recorded by the Central Laboratory of Meteorology, Ministry of Agriculture and Land Reclamation, Egypt. The main purpose of this investigation aimed to study the impact of irrigation water requirements and weed control treatments on weeds growth, peanut growth, yield and yield components as well as chemical compositions of seed and straw. Based on the mechanical and chemical analysis of the surface layer (0-40 cm), the soil of experiment was characterized as sandy in texture. Physical and chemical characteristics are show in Table (2).

Table 1: Monthly weather data of the experimental site as average over both seasons 2016 and 2017 growing summer seasons.

Month	Solar radiation [W/m²]	Precipitation [mm]	Wind speed [m/sec]	Air temperature [°C]			Relative humidity [%]
				Min.	Max.	Average	
May	21.40	0.05	4.25	32.90	22.30	27.60	51.15
June	23.95	0.10	4.60	35.00	17.60	26.30	51.80
July	24.75	0.00	4.25	36.8	24.85	30.85	47.70
August	25.35	0.00	4.25	37.9	24.20	31.05	44.25
September	22.55	0.05	3.90	35.75	21.85	28.8	46.3

Table 2: Physical and chemical characteristics of the used soil as average over both growing seasons 2016 and 2017.

Sand (%)	Silt (%)	Clay (%)	Texture	Field capacity (%)		O.M (%)		$CaCo_3$
68.7	24.5	6.8	Sandy loam	19.5		0.16		7.00
pH (1:2:5)	EC (ds/m)	Cations and Anions (meq/l)						
		Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{-2}
7.8	0.20	3.00	2.00	2.09	0.23	1.41	0.70	5.21
Macronutrients (mg/100 g soil)			Micronutrients (mg/kg)					
N	P	K	Fe	Mn	Zn		Cu	
14.5	9.20	16.0	7.36	3.19	1.66		3.0	

Experimental design and layout of the experimental treatments:

The experiment was laid out a strip plot design including four replicates. The vertical plots were devoted to four irrigation levels (40, 60, 80, and 100% of evapotranspiration (Etc) of peanut requirements). The seasonal amounts of irrigation water amount (m3 ha-1) during both growing seasons are show in Table 3.

The horizontal plots were assigned to six weed control treatments (oxydiargel, metribuzin, butraline, pendimethline, two hand hoeing and unweeded).The solution of herbicides was sprayed by using manual hand sprayer using 500 Littre water/ha after adding wetting agents to spray solution (tween 20 a surfactant 0.05%), and all plots were received equal volume of herbicide solutions. The common name, trade and chemical, molecular formula, rate of application and times of application are shown in Table (4).

The experimental unit was 10.5 m2, the experimental unit comprised five ridges, (70 cm width and 3.0 m long). All agricultural practices of peanut plants were conducted (two ploughings, compaction and division). Calcium superphosphate (15.5% P2O5) was added in the form of single super-phosphate during land preparation using 55 kg P2O5 ha-1. Ammonium nitrate (33.5 % N) at the rate of 50 kg N ha-1 was used as a source of nitrogen fertilizer and added at four equal rations, the first dose after 20 DFS and then after two weeks intervals. After 35 days from sowing 72 kg K2O ha-1 of potassium sulphate (48 % K2O) was added.

Peanut seeds (Giza 6) cultivar were obtained from Oil Research Section, Field Crops Research Institute, Agricultural Research Center, Giza, Egypt and the seeds inoculated with the specific rhizobium strain, bradyrhizobia strains (USDA 3456), which obtained from Agricultural Microbiology Department, Biological and Agricultural Division, National Research Centre, Egypt.

According to the improved package of the ministry of agricultural recommendation practices for growing peanut were allowed, excluding the factors under study.

Measurements:

On weed plants:

The dominant floras at the experimental field were Nalta jute (Corchorus olitorius), Common purslane (Portulaca oleraceae) and Venice mallow (Hibiscus trionum) as broadleaved weeds. While, the major grassy weeds were Jungle rice (Echinochloa colonum) and Field Sandbur (Cenchrus ciliaris). After 70 and 110 days from sowing (DFS) during both seasons, samples of weed were randomly collected from each plot by using area of one square meter, drying until constant weight at 70 oC by using forced draft oven to calculate the dry weights of broadleaved, grasses and total weeds.

On peanut plants:

After 70 DFS in both seasons five random plants were taken from the two external ridges of each plots to determine the following characteristics: total chlorophyll (SPAD value), chlorophyll reading according to Minolta Co. (2013), plant height (cm), leaf dry weight (g), stem dry weight (g). At harvest date (120 DFS) the following characters were estimated: number of branches plant-1, number of pods plant-1, pods weight of plant-1 (g), seeds weight plant-1 (g) and seed yield (ton ha-1): all plants in the three inner ridges of each plot were collected and drying, threshed and the seeds (12 % moisture) were weighted (kg), then converted to (ton ha-1). Straw yield (ton ha-1) resulted from all plants in the three inner ridges of each plot weighted and converted to (ton ha-1).

Table 3: The irrigation water amount (m^3 ha^{-1}) during 2016 and 2017 seasons.

Irrigation treatments	Growing seasons	
	2016 (m^3 ha^{-1})	2017 (m^3 ha^{-1})
40%	1545.6	1592.0
60%	2318.4	2388.6
80%	3091.2	3184.0
100%	3864.0	3980.0

Table 4: Common, trade, chemical names, rate and application time of the used herbicides.

Common name	Trade name	Chemical name	Molecular Formula	Rate of application	Time of application
Oxadiargyl	Topstar 400 SC	3-[2, 4-dicloro-5-(2-Propynyloxy) phenyl]-5- (1, 1-dimethylethyl)-1, 3, 4, oxdiazol-2(3H)-one]	$C_{15}H_{14}C_{l2}N_2O_3$	480 g ha^{-1} (a.i.)	Pre-emergence
Metribuzin	Sencor 70% WP	(4-amino-6-tert-butyl-3-(mrthylthio)1,2,4-triazine-5(4H) one]	$C_8H_{14}N_4O_3$	833 g ha^{-1} (a.i.)	Pre-emergence
Butralin	Amex, 820	4-(1, 1dimethylethyl)-N- 1-methyl propyl)-2, 6-dinitrobenzenamine	$C_{14}H_{21}N_3O_4$	2.40 kg ha^{-1} (a.i.)	Pre-emergence
Pendimethline	Stomp	N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine	$C_{13}H_{19}N_3O_4$	1.875 kg ha^{-1} (a.i.)	Pre-emergence

Gravimetric soil samples were collected at 15-60 cm depth before and after each irrigation and at harvesting date to calculate the actual evapotranspiration (ETa) values and water use efficiency. ETa values were calculated by using the equation as given by Israelson and Hansen (1962) as follows:

$$\text{Eta} = \sum_{i=1}^{n=4} \frac{(\theta 2 - \theta 1)}{100} \times \text{Pb} \times \text{D (cm)}$$

Where: Eta is actual evapotranspiration (cm), "i" is soil layer, n is total number of soil layers, θ2 is the percentage of soil moisture after irrigation based on gravimetric measurement, θ1 is the percentage of soil moisture before irrigation based on gravimetric measurement, Pb is the soil bulk density and D is the layer depth (cm).

After that water use efficiency (WUE kg m-3) were calculated using the following equation given by James (1988):

$$\text{WUE} = \frac{\text{Pods yield (Kg/ha)}}{\text{Total water consume (cubic meter/ha)}}$$

The values of crop coefficient (Kc) of peanut plants were calculated using the following equation:

$$\text{Kc} = \frac{\text{Eta}}{\text{Eto}}$$

Where: Eta is the water consumptive use (actual evapotranspiration) and Eto is the potential evapotranspiration, it was calculated by using the class A pan according to Doorenbos and Kassam (1979)

Chemical composition of seeds and straw:

Oil percentage (%). It was estimated in dried grains as described by (AOAC, 2007) using Soxhelt apparatus.

Macronutrients (N, P and K) of peanut seeds and straw were determined according to Cottenie et al. (1982).

Seasonal fluctuation of certain nematode species of peanut plantation:

The tested region which was naturally infested with nematodes species i.e. Meloidogyne javanica, Pratylenchus penetrans, Helicotylenchus sp., Criconemella sp. and Heterodera sp. that was stated to study the fluctuation of nematode population starting from April to November for the both two seasons (2016 and 2017). The root-knot nematode was identified to species by perineal pattern according to Taylor et al., (1955) and other selected nematode were previously identified according to the morphometrics of the body for adult females of the three former species, whereas, juveniles of the latter nematode species (Taylor, 1957; Sher, 1966 and Handoo and Golden, 1989). Five locations were randomly selected, marked and labeled as sampling sites. Then, samples were taken from the sampling sites at monthly intervals for the both two seasons. A total of five soil sub samples were taken at each sampling site to form a composite sample. The samples were sent to the nematology laboratory and kept in refrigerator at 4ºC until extraction. Number of nematode species /250 g soil was monthly determined and recorded during the period of investigation.

Statistical Analysis:

Data of each season were subjected to ANOVA for the strip plot design according to Casella (2008), using MSTAT–C software program (MSTAT-C with MSTAT-C with MGRAPH version 2.10, Crop and Soil Sci. Dept., Michigan State Univ.). At probability0.05, the least significant difference test (LSD0.05) was used for distinguishing among the treatment means as subjected by Snedecor and Cochran (1980).

Results and Discussion

Weeds growth:

The water shortage had a significant effect on the broadleaved, grasses as well as total dry weights of associated weeds of peanut plant as presented in Table 5. In this connection, supplying peanut plants with 100% of crop evapotranspiration (Etc) caused increases in dry weight of weed groups (broadleaved, grasses and total weeds), followed by using the irrigation treatment of 80% Etc. In contrast, the application of 40% of crop water requirements gave the lowest values of dry weight of weed groups. Reducing irrigation levels from 100% to 40% of (Etc) led to decreases in the dry weight of broadleaved, grasses and total weeds by (23.43 and 24.48 %), (27.96 and 26.98%) and (25.66 and 25.71%) after 70 and 110 DFS, respectively as an average over both seasons. These results are consent with those obtained by (Awal and Ikeda 2002; AbouKheira, 2009; Priya et al., 2013).

All weed control treatments reduced the broadleaved, grasses and total dry weeds as compared with the unweeded treatment (Table 5). After 70 and 110 days from sowing, two hand hoeing was the most effective in controlling broadleaved weeds, while Metribuzin was the second most effective herbicide treatment. In this regard, two hand hoeing was the most effective in controlling grasses and total weeds, while oxydiargel was the second most effective herbicide treatment. In general, two hand hoeing, oxydiargel, pendimethline and butraline recorded the greatest efficiency and reduced the total dry weight of weeds by (90.05 and 88.58%), (88.19 and 87.15%), (86.69 and 85.66%) and (85.00 and 84 46%) after 70 and 110 days from sowing, respectively as an average in both growing seasons as compared with the unweeded treatment. The reduction of dry weeds may be ascribed to the inhibitory influence of hand hoeing and herbicidal treatments on the growth and development of associated weeds. These findings are harmonious with those obtained by (Agostinho et al., 2006; El Naim et al., 2011; Fakkar and El-Dakkak, 2015; El-Metwally et al., 2017a and b).

Significant interactions were found between irrigation levels and weed control treatments on the total dry weight of broadleaved and grasses after 70 and 110 days from sowing in 2016 and 2017 seasons (Fig. 1). Whether using 80 or 100 of Etc in combined with hoeing twice has possessed the highest efficiency for weed control in peanut plants. Contrariwise, in unweeded plots, weeds produced more biomass with irrigation treatment of 100% than 80%.

Vegetative growth:

The results in Table 6 revealed significant impacts of irrigation level on the total chlorophyll (SPAD value), plant height, leaf dry weightand steam dry weight during both seasons. Data revealed that irrigation at 100% of Etc significantly maximized all vegetative growth as compared with other irrigation treatments. Therefore, supplying peanut plants with suitable amounts of water requirements might help peanut plants to absorb greater amounts of water and soluble nutrients, encourage the process of cell division, cell elongation, photosynthetic, improving pigments and enlargement and meristematic activity. These results are in congruence with those noticed by (Heatherly et al., 1994; Cláudio et al.,1997; El–Boraie et al., 2009; Aydinsakir et al., 2016).

Two hand hoeing was the most effective treatment resulting in increasing total chlorophyll (SPAD value), plant height, leaf dry weight and stem dry weight of peanut plants (Table 6). Moreover, oxydiargel treatment was statistically at par with two hand hoeing for improving these peanut growth characters followed by pendimethline, butraline, metribuzin and unweeded. The development of peanut growth in the weeded plots might be ascribed to the efficiency in weed elimination (Table 5) and the reducing of competition between weeds and peanut plants on the life sources such as light, space, nutrients and gases. Similar findings confirming these results were reported by (Agostinho et al., 2006; Youssry et al., 2008; El Naim et al., 2011; Adhikary et al., 2016).

Table 5: Averages dry weight of broad leaved, grasses, and total weight of weeds (g m^{-2}) as affected by irrigation and weed control treatments as well as their interaction at 70 and 110 DFS during 2016 and 2017 growing seasons.

Characters Sampling times Treatments / Seasons	Dry weight of broad leaved (g m^{-2})				Dry weight of grasses (g m^{-2})				Total dry weight of weeds (g m^{-2})			
	70 DFS		110 DFS		70 DFS		110 DFS		70 DFS		110 DFS	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
A- Irrigation treatments:												
40% of Etc	50.33	47.81	65.93	59.32	47.54	45.12	60.71	57.96	97.88	92.93	126.64	117.28
60% of Etc	57.47	53.59	76.27	71.65	55.76	52.41	70.07	67.08	113.23	106.00	146.35	138.73
80% of Etc	63.86	60.17	82.67	77.51	60.60	58.28	76.51	74.89	124.46	118.46	159.18	152.41
100% of Etc	65.45	62.56	84.75	80.98	65.90	62.72	81.95	80.55	131.36	125.28	166.70	161.53
LSD at 5 %	1.23	2.26	1.45	1.28	1.63	1.31	1.76	0.77	1.07	1.40	2.91	1.47
B-Weed control treatments:												
Oxydiargel	28.22	25.10	37.33	34.63	22.55	20.64	30.52	28.25	50.77	45.75	67.85	62.89
Metribuzin	25.05	23.10	34.80	32.88	46.54	43.86	59.39	58.90	71.59	66.96	94.20	91.78
Butraline	32.77	31.13	44.77	39.35	30.15	28.49	37.56	36.39	62.93	59.62	82.34	75.75
Pendimethline	30.96	28.17	42.24	38.25	26.34	23.33	33.46	31.90	57.30	51.50	75.70	70.15
Two hand hoeing	23.20	20.89	33.05	30.38	19.40	17.81	27.35	25.43	42.60	38.70	60.40	55.81
Unweeded	215.47	207.81	272.25	258.69	199.73	193.66	245.57	239.85	415.20	401.48	517.82	498.54
LSD at 5 %	1.23	1.65	2.19	2.33	3.93	0.88	2.88	1.07	4.75	2.16	5.03	3.23
C- Interaction (F. test):	3.06	5.81	4.10	1.54	1.65	2.60	2.80	1.04	2.97	4.61	5.75	5.34

***; significant at 0.05 level of probability and NS; non-significant at 0.05 level of probability.**

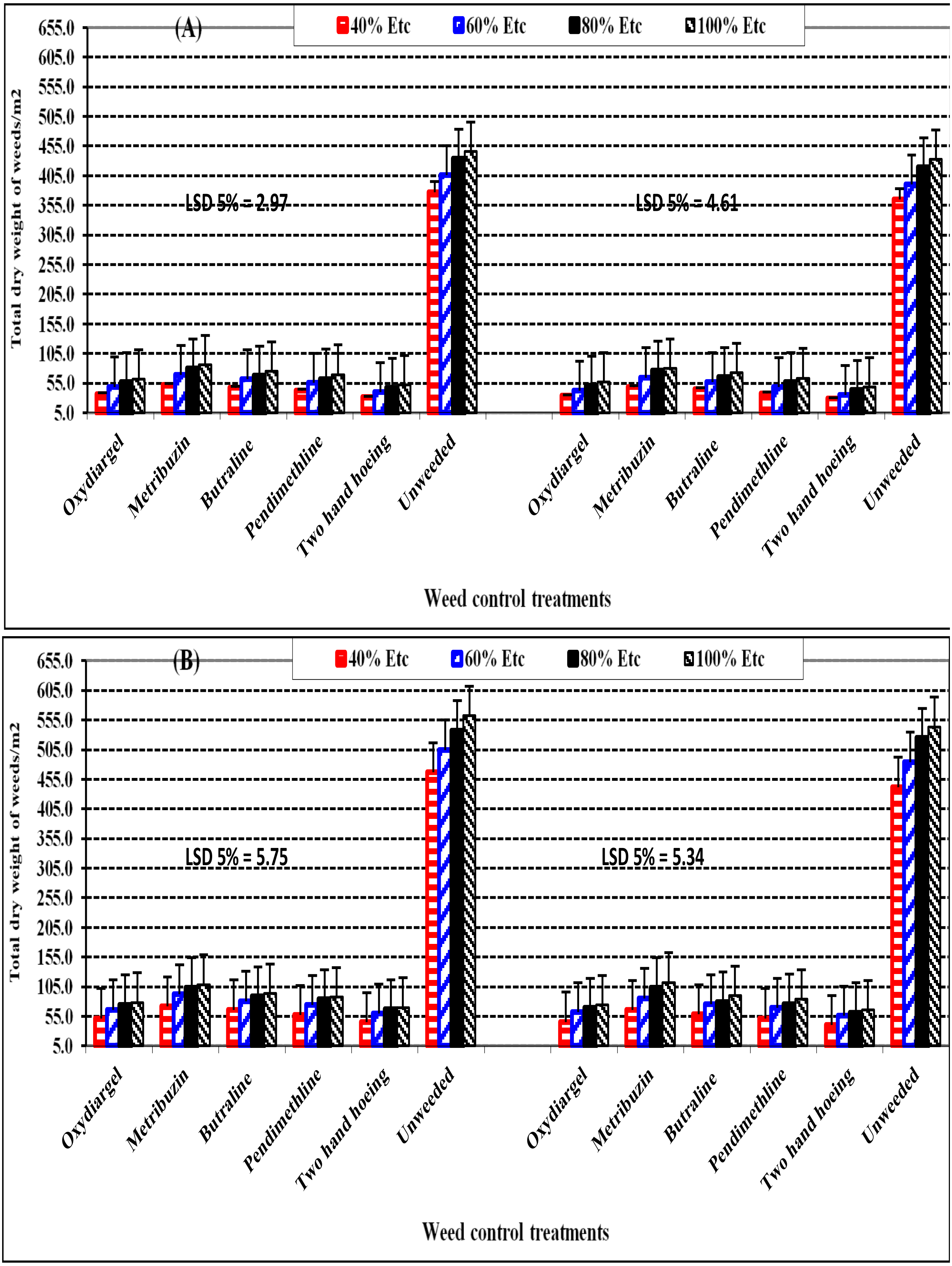

Fig. 1. Total dry weight of weeds(gm-2) as affected by the interaction between irrigation and weed control treatments at 70 (A) and 110(B) DFS during 2016 and 2017 grwoing seasons.

Yield and yield attributes:

Data presented in Table 7 revealed that the application of 100% or 80% of ETc led to the maximum values of number of branches plant-1, number of pods plant-1, weight of pods plant-1 (g), weight of seeds plant-1 (g) as well as seed and straw yields (ton ha-1). In contrast, using 40% of Etc recorded the lowest values of these crop characters. Results also indicated showed no significant differences between 100 and 80% of Etc levels suggesting the applicability potential of 80% of Etc level. Drought increases respiration, which decreases assimilates for seed filling, and there are several studies reported that drought stress reduced photosynthesis, translocation rates and decreased growth and seed yield (El–Boraie et al., 2009; El-Metwally and El-Saidy, 2016). Thus, sufficient water application via100% or 80% of Etc will provide the plant with sufficient water amounts alongside with dissolved plant nutrients necessarily for encouraging the processes of cell enlargement and cell division beside the meristematic activity (Fageria et al., 2010). In addition, the useful effect of water for enhancing the performance of photosynthetic pigments and photosynthesis process will increase the synthesis and accumulation of metabolites, thereby increasing yield and its attributes. These results agree with those recorded by Jongrungklang et al., 2013; Aydinsakir et al., 2016; Garko et al., 2016; Faye et al., 2016).

Concerning the effect of weeded practices on yield and its attributes, all weeded plots produced more yield over the weedy control treatment (Table 7). The two hand hoeing treatment resulted in increasing the number of branches plant-1, number of pods plant-1, weight of pods plant-1 (g), weight of seeds plant-1 (g) and seed and straw yields (ton ha-1) yield by (53.03%), (51.53%), (80.91%), (44.16%), (31.53%) and (24.97%), respectively over the weedy control treatment as an average over both seasons. These results are associated with the minimization of the competition among weed and peanut plants (Table 5) and saving more of the available resources (water and plant nutrients) for improving plant growth and yield production (Table 6). This weed controlling treatment increased also plant height and resulted in greater straw and grain yields. The desirable effect of weed control on peanut yield and its attributes have been concluded by Agostinho et al., 2006; El Naim et al., 2011; Adhikary et al., 2016; Garko et al., 2016); whereas, weed competition causes a reduction in growth characters, yield and its attributes production (Agostinho et al., 2006). Data illustrated in Figs. 2, 3 and 4 showed that there was a significant effect due to the interaction between irrigation levels and weed control treatment on number of pods plant-1, seed and straw yield (tonsha-1). Irrigation with 100% Etc significantly increased previous characters when two hand hoeing was applied as compared with the other treatments. Results also indicated that the treatment of 100% of Etc alongside with oxydiargel application was slightly less effective than the superior treatment without a significant difference between the two treatments. The smallest seeds yield was recorded with the unweeded treatment and irrigation of 40% of Etc.

Water parameter

Water use efficiency (WUE):

Irrigation water use efficiency as affected by irrigation and weed control treatments are presented in Table 7. Results showed that increasing level of irrigation treatments from 40 to 100% of crop evapotranspiration (Etc) caused greatly reduced in WUE of peanut plants in both seasons. the maximum value of WUE as an average of both seasons (2.13 kg/m3) was recorded under the irrigation treatment of 40% of Etc. But, the irrigation treatment of 100% of Etc (control treatment) recorded the minimum value of WUE during both growing seasons. The lower seasonal consumptive use of water under the condition of 40% of Etc might be the main reason for produce the high values of WUE. These results agree with those obtained by Singh et al., 1994; Tiwari et al., 994; Sounda et al., 2006).

Regarding the effect of weed control treatments on WUE, data in Table 7 clearly showed that all weed control treatments Effect on WUE in both seasons. The maximum values of WUE were recorded with the treatment of two hand hoeing followed by oxydiargel, pendimethline, butraline, metribuzin and then unweeded (control) came at the last rank and recorded the lowest value of WUE, the corresponding data were (1.86, 1.78, 1.71, 1.62, 1.54 and 1.39 kg/m3), respectively as an average over both summer seasons. These results are in good line with those obtained by (Heatherly et al., 1994).

Chemical compositions:

It is cleared from the data in Table (8) that irrigation level treatments significantly affected oil and macronutrients (N, K and P) concentration in seeds and straw of peanut plants at harvest. In this regard, with increasing irrigation levels from 40% up to 100% of Etc there was a progressive increase in concentrations of oil and macronutrients. On the other side, the lowest values of aforementioned characters were recorded with 40% of Etc. The increase in content of oil % and macronutrients in seed and straw due to the increasing of water requirement levels may be due to promotion effect to the growth, which enables plants to absorb its optimum amount of water and nutrient requirements, which reflected on improving plant growth, yield and quality indices of oil and nutrient concentrations (El–Boraie et al., 2009; El-Metwally and El-Saidy, 2016).

As shown in Table 8, all of the weed control treatments significantly improved the concentrations of oil and macronutrients (N, K and P) in seeds and straw of peanut plants at harvesting stage. The highest values were obtained from the two hand hoeing followed by oxydiargel application treatment; however, the difference between these treatments was insignificant. These results might be ascribed to less competition for the environmental life resources (light, nutrients and water) via minimize weeds infestation with two hand hoeing or herbicidal treatments due to improving nutrients absorption and reversed on chemical compositions of seeds and straw. Affirmative effect of weeded practices on chemical compositions of peanut have been previously confirmed by (Fakkar and El-Dakkak, 2015).

Table 6: Averages of total chlorophyll (SPAD value), plant height (cm), leaf dry weight (g) and stem dry weight as affected by irrigation and weed control treatments as well as their interaction during 2016 and 2017 growing seasons.

Characters Sampling times Treatments Seasons	**Total chlorophyll (SPAD value)**		**Plant height (cm)**		**Leaf dry weight (g)**		**Stem dry weight (g)**	
	2016	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
A- Irrigation treatments:								
40% of Etc	39.14	40.17	28.17	27.89	25.60	27.25	21.58	23.03
60% of Etc	42.05	40.95	29.13	28.32	31.95	33.05	24.87	26.16
80% of Etc	42.17	41.43	31.17	30.72	34.24	35.67	26.70	29.64
100% of Etc	42.92	43.78	33.93	30.89	36.26	38.31	27.97	33.45
LSD at 5 %	0.45	1.04	1.55	0.85	0.26	0.33	0.51	3.02
B-Weed control treatments:								
Oxydiargel	44.34	43.20	35.39	33.41	34.10	35.95	26.71	28.73
Metribuzin	38.83	39.29	26.35	25.31	31.93	33.79	25.23	27.21
Butraline	40.17	40.55	28.80	28.80	32.72	34.45	25.69	27.70
Pendimethline	42.67	41.51	30.70	29.62	33.62	35.00	26.33	28.42
Two hand hoeing	45.77	46.01	37.26	36.05	34.67	36.10	26.45	29.25
Unweeded	37.64	38.95	25.10	23.53	25.03	26.12	21.27	27.11
LSD at 5 %	1.59	0.92	1.15	2.34	0.68	0.62	1.24	1.30
C- Interaction (F. test):	NS	NS	NS	NS	NS	NS	NS	NS

***; significant at 0.05 level of probability and NS; non-significant at 0.05 level of probability.**

Table 7: Averages number of branches plant-1, number of pods plant-1, weight of pods plant-1, weight of seeds plant-1, seed yield (ton ha-1), straw yield (ton ha-1) and water use efficiency (Kg/m3) as affected by irrigation and weed control treatments as well as their interaction during 2016 and 2017 growing seasons.

Characters Treatments / Seasons	**Number of branches plant^{-1}**		**Number of pods plant^{-1}**		**Weight of pods plant^{-1}**		**Weight of seeds plant^{-1}**		**pods yield ton ha^{-1}**		**Straw yield ton ha^{-1}**		**WUE (Kg/m^3)**	
	2016	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**201 6**	**2017**
A- Irrigation treatments:														
40% of Etc	17.80	19.27	23.16	31.71	62.04	66.50	18.22	19.54	3.287	3.423	5.198	5.474	2.12	2.14
60% of Etc	18.93	19.80	27.73	33.68	64.21	77.94	21.88	21.56	3.633	3.870	5.517	6.033	1.56	1.62
80% of Etc	22.20	20.92	30.40	35.72	75.13	82.17	22.55	22.35	4.739	4.988	6.102	6.504	1.53	1.56
100% of Etc	24.17	22.23	32.54	37.86	77.98	83.80	23.60	24.81	5.137	5.391	6.430	6.757	1.32	1.35
LSD at 5 %	1.99	1.75	2.53	2.45	5.01	2.44	1.51	2.54	0.720	0.670	0.410	0.350	0.11	0.13
B-Weed control treatments:														
Oxydiargel	24.62	22.93	31.81	40.52	80.85	94.85	24.20	24.50	4.553	4.770	6.203	6.607	1.77	1.79
Metribuzin	18.03	18.78	25.50	29.20	60.58	66.65	19.35	20.40	3.918	4.173	5.465	5.923	1.52	1.57
Butraline	18.61	20.02	27.07	32.55	69.07	76.15	21.13	21.40	4.147	4.349	5.714	6.141	1.61	1.64
Pendimethline	20.61	22.20	29.84	36.53	70.01	82.85	22.52	23.03	4.365	4.596	5.973	6.433	1.69	1.73
Two hand hoeing	27.19	23.91	33.90	44.78	89.12	97.27	24.55	26.82	4.777	4.965	6.459	6.857	1.85	1.87
Unweeded	15.58	15.49	22.62	24.87	49.42	47.85	17.63	16.22	3.434	3.656	5.058	5.190	1.37	1.41
LSD at 5 %	1.61	1.04	1.40	1.61	4.65	2.10	1.35	0.69	0.130	0.260	0.250	0.340	0.07	0.12
C- Interaction (F. test):	NS	NS	2.44	2.84	NS	NS	NS	NS	0.22	0.29	0.23	0.34	NS	NS

***; significant at 0.05 level of probability and NS; non-significant at 0.05 level of probability.**

Table 8: Averages of seed oil%, seed N%, seed P%, seed K%, straw N%, straw P% and straw K% as affected by irrigation and weed control treatments as well as their interaction during 2016 and 2017 growing seasons.

Characters / Treatments / Seasons	Seed oil%		Seed N%		Seed P%		Seed K%		Straw N%		Straw P%		Straw K%	
	2016	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
40% of Etc	42.88	43.98	3.22	3.42	0.57	0.65	1.66	1.74	1.87	1.97	0.34	0.39	1.30	1.36
60% of Etc	44.32	44.59	3.47	3.72	0.71	0.75	1.93	1.98	2.02	2.14	0.42	0.51	1.56	1.64
80% of Etc	46.27	46.31	3.82	4.09	0.77	0.84	2.37	2.54	2.19	2.34	0.50	0.54	1.76	1.87
100% of Etc	47.47	46.62	4.18	4.24	0.91	0.95	2.51	2.65	2.34	2.51	0.52	0.61	1.90	2.03
LSD at 5 %	0.32	0.22	0.29	0.15	0.04	0.03	0.10	0.10	0.18	0.09	0.04	0.04	0.07	0.16
***B-Weed control treatments*:**														
Oxydiargel	45.46	45.97	3.86	4.14	0.82	0.86	2.27	2.39	2.30	2.42	0.50	0.59	1.78	1.87
Metribuzin	44.99	45.01	3.46	3.63	0.66	0.74	1.98	2.16	1.90	2.10	0.39	0.45	1.53	1.68
Butraline,	45.20	45.34	3.59	3.81	0.71	0.78	2.06	2.19	1.99	2.17	0.42	0.49	1.60	1.72
Pendimethline	45.67	45.73	3.78	3.98	0.77	0.82	2.17	2.30	2.12	2.30	0.46	0.55	1.69	1.81
Two hand hoeing	45.96	46.25	3.95	4.29	0.88	0.94	2.37	2.45	2.46	2.51	0.55	0.62	1.83	1.93
Unweeded	44.13	43.95	3.42	3.35	0.60	0.65	1.85	1.86	1.85	1.92	0.35	0.37	1.34	1.34
LSD at 5 %	NS	0.43	0.19	0.17	0.05	0.04	0.10	0.11	0.13	0.15	0.05	0.06	0.11	0.09
C- Interaction (F. test):	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

***; significant at 0.05 level of probability and NS; non-significant at 0.05 level of probability.**

Nematode Seasonal fluctuation:

Data in Figs. 5 and 6 show the seasonal fluctuation of five plant parasitic nematode species i.e. Meloidogyne javanica, Pratylenchus penetran, Helicotylenchus sp., Criconemella sp. and Heterodera sp. during the two growing seasons of 2016 and 2017 (June to September). Obviously, the initial population means of the tested five nematodes species were 45, 9, 11, 34 and 5 individuals per 250 g soil at the beginning of peanut sowing seeds, respectively. In general, the population of each nematode species gradually increased as the soil temperature increased (Fig. 5 and 6) and reached their peaks in August (31.04 Cº), where a full peanut plant growth occurred. These nematode population densities were recorded to be 196, 31, 96, 151, and 24 individuals per 250 g soil, respectively. Then the decline of nematode population densities were happened at harvest time on September 2016 and 2017 when their minimum population densities were recorded on November (24.3 Cº) when low soil temperature (Fig. 5 and 6), as well as, absence of host occurred. These minimum densities were recorded to be 69, 9, 33, 69, and 9 individuals per 250 g soil, respectively. The present findings on seasonal fluctuation of such nematode showed that their peaks reached in August with the maximum population densities per 250 g along with highest temperature and then decreased as the temperature diminished in September. These present findings of such seasonal fluctuations are in agreement with those of El-Mosalamy (2005), who found that nematodes were found in relatively low population densities during March which increase gradually through April, May and June to reach their highest peaks in July at which the soil temperature reached the maximum degree, then gradual decrease in population density occurred till October at which nematode reached their modest densities. It is worthy to note that nematode populations of either H. avenae or P. penetrans were lower than other nematode species tested during the seasonal fluctuation study. This may be due to peanut plant cv. Giza 6 was not the suitable host comparing to M. javanica, H. pseudorobustus and T. claytoni, since their population densities increased up to 6.13, 2.38 and 6.0 folds over those two nematode species at harvesting time, respectively

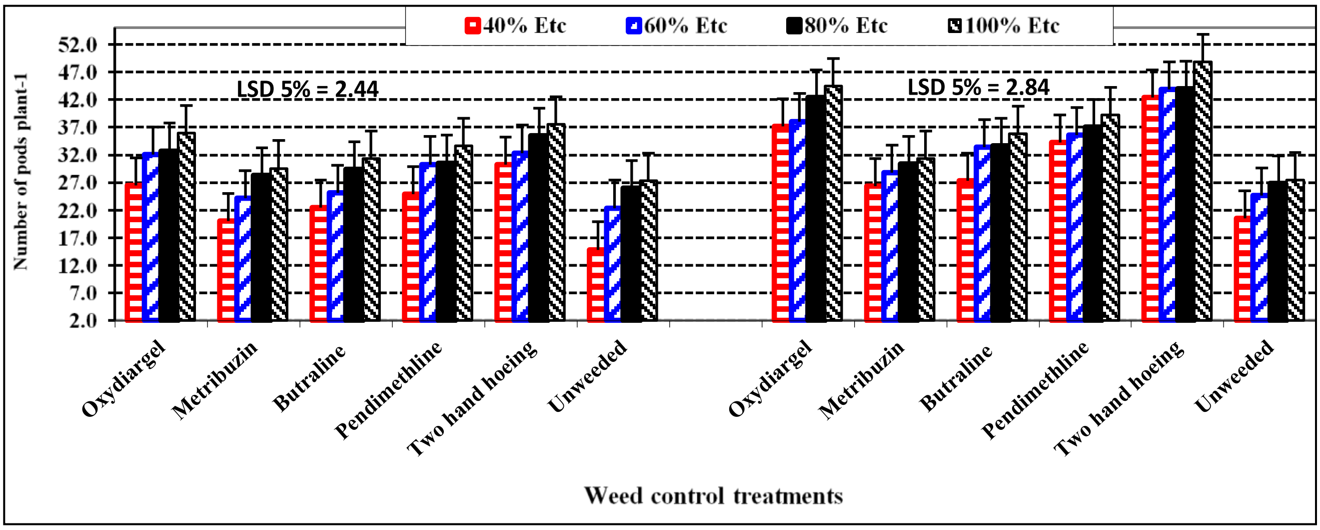

Fig. 2. Number of pods plant^{-1} as affected by the interaction between irrigation and weed control treatments during 2016 and 2017 seasons.

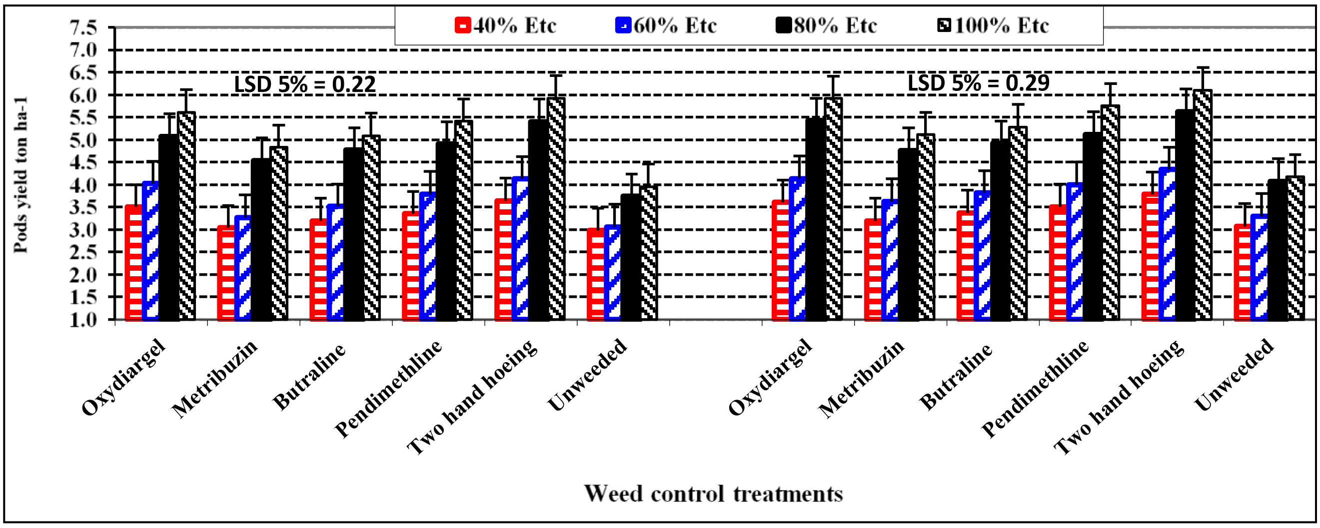

Fig. 3. Pods yield (ton ha^{-1}) as affected by the interaction between irrigation and weed control treatments during 2016 and 2017 seasons.

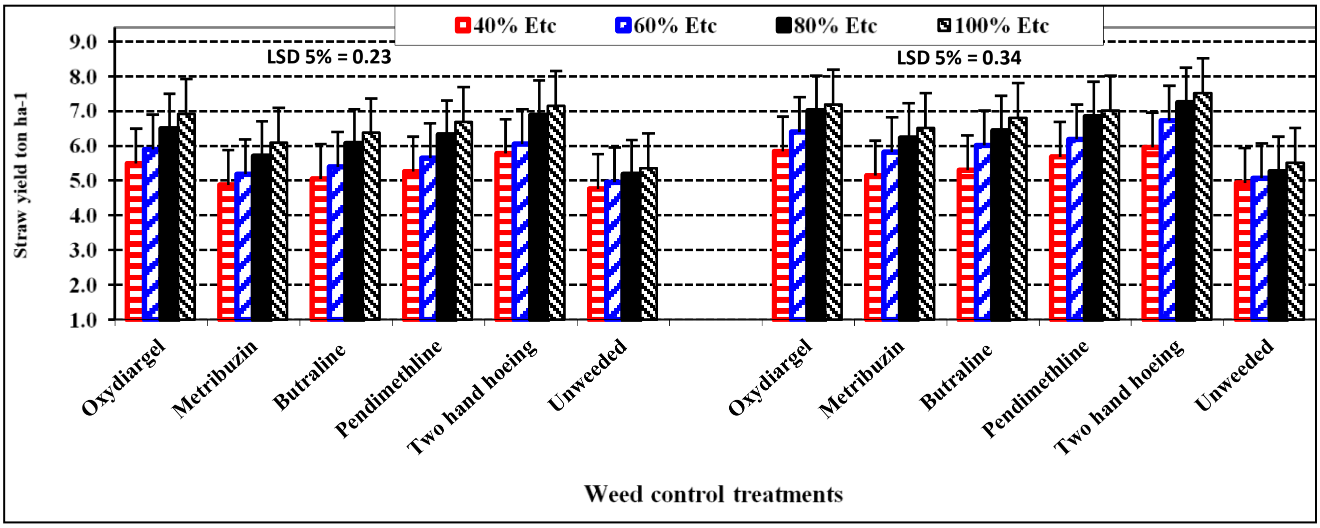

Fig. 4. Straw yield (ton ha^{-1}) as affected by the interaction between irrigation and weed control treatments during 2016 and 2017 seasons.

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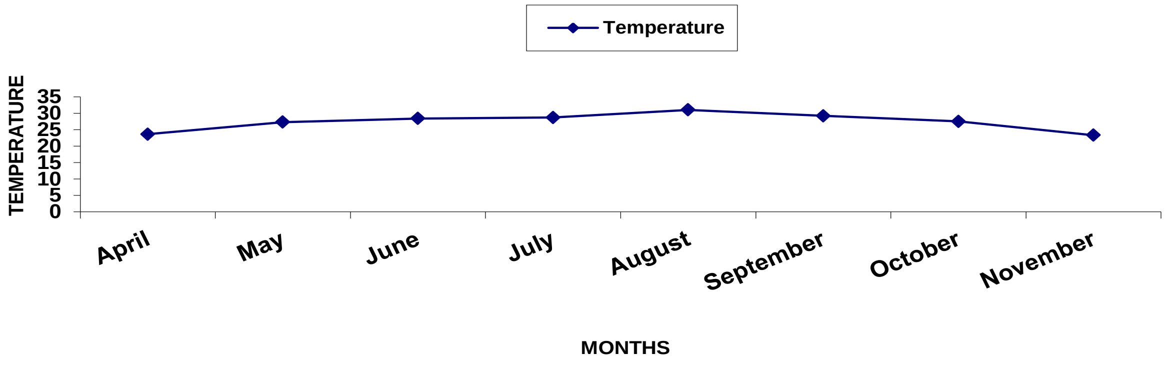

Fig. 5. Average of soil temperature from April to November 2016 and 2017

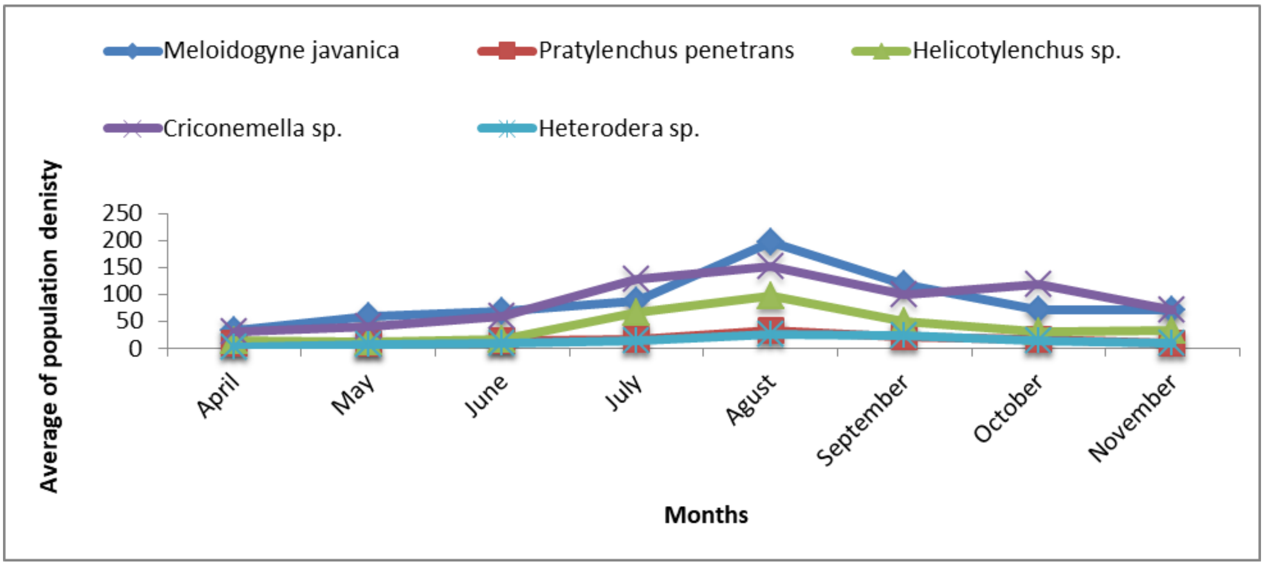

Fig. 6. Average of nematode genera from April to November 2016 and 2017.

Conclusion

Eventually, it could be concluded that with each increase in irrigation levels there was a progressive increase in dry weight of associated weed, growth, yield, yield attributes beside seed and straw chemical compositions of peanut. Applying 100% or 80% of Etc recorded the highest values of total dry weight of weeds in both seasons. The maximum values of WUE were recorded when plans received 40% of Etc as compared with other irrigation treatments. Two hand hoeing followed by oxydiargel treatments decreased dry weight of total weeds and increased averages of seed yield, its attributes, chemical composition of seeds and straw as well as WUE. Generally, application of 100% of Etc besides two hand hoeing, followed by 80% of crop water requirement combined with oxydiargel treatment produced the maximum seed yield, with insignificant difference between them in both two interaction treatments under the new reclaimed sandy soil conditions of Nubaria Governorate, Egypt.

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References

Abd El-Dayem HM, and Ismaeil FHM (2007). Effect of potassium and boron on drought tolerance of cotton plants. Arab Conference of Soil and Water Management for Sustainable Agricultural Development, 10-11 April (Conference Hall, Faculty of Agriculture, Mansoura University) pp141-153.

Aboelill AA, Mehanna HM, Kassab OM and Abdallah EF (2012). The response of peanut crop to foliar spraying with potassium under water stress conditions. Australian Journal of Basic and Applied Sciences 6(8):626-634.

AbouKheira AA (2009). Macro management of deficit irrigated peanut with sprinkler irrigation. Agriculture Water Management 96(10):1409–1420.

AbouZied M (2000). Egypt water resource management and policies. Al- Mohandeseen Magazine p528.
Abouziena HF, Abd El Wahed MSA, Eldabaa MAT and El-Desoki ER (2013). Effect of sowing date and reduced herbicides rate with additives on peanut (Arachis Hypogaea L.) productivity and associated weeds. Journal of Applied Sciences Research 9(3):2176-2187.
Adhikary P, Patra PS and Ghos R (2016). Influence of weed management on growth and yield of groundnut (Arachis hypogaea) in Gangetic plains of West Bengal, India. Legume Research 39(2):274-278.
Agostinho FH, Gravena R, Alves PLCA, Salgado TP and Mattos ED (2006). The effect of cultivar on critical periods of weed control in peanuts. Peanut Science 33(1):29-35.
AOAC (2007). Association of Official Agriculture Chemists. Official Methods of Analysis 16th Ed., Washington, DC, USA.
Awal MW and Ikeda T (2002). Recovery strategy following the imposition of Episodic soil moisture deficit in stands of peanut (Arachis hypogaea L.). Journal of Agronomy and Crop Science 188: 185–192.
Aydinsakir K, Dinc N, Buyuktas D and Bastug R (2016). Assessment of different irrigation levels on peanut crop yield and quality components under Mediterranean conditions. Journal of Irrigation and Drainage Engineering142(9):1-9. DOI: 10.1061/(ASCE)IR.1943-4774.0001062.
Bird BR, Hung SSO, Hadley M and Draper HH (1983). Determination of malondealdehyde in biological matrices. Free. Rad. Bio. Med., 27: 647- 666.
Casella G (2008). Statistical Design. 1st Ed. Springer, Gainesville, FL 32611–8545, USA.
Cláudio Cost L, Morison J and Dennett M (1997). Effects of water stress on photosynthesis, respiration and growth of faba bean (Vicia faba L.) growing under field conditions. RevistaBrasileira de Agrometeorologia 5:9-16.
Cottenie A, Verloo M, Kiekens L, Velgh G and Camerlynck R (1982). Chemical Analysis of Plant and Soil. Lab. Anal Agrochemistry State Univ Gthent, Belgium63.
Doorenbos J and Kassam AH (1979). Yield response to water. FAO Irrigation and Drainage Paper No. 33. Rome, Italy. p.93.
El Naim AM, Eldoma, MA and Abdalla, AE (2010). Effect of weeding frequencies and plant density on vegetative growth characteristic of groundnut (Arachis hypogaea L.) in North Kordofan of Sudan. International Journal of Applied Biology and Pharmaceutical Technology 1(3):1188-1193.
El Naim AM, Eldouma MA., Ibrahim EA, Moayad and Zaied MB (2011). Influence of plant spacing and weeds on growth and yield of peanut (Arachis hypogaea L.) in Rain-fed of Sudan. Advances in Life Sciences 1(2): 45-48.
El–Boraie FM, Abo–El–Ela HK and Gaber AM (2009). Water requirements of peanut grown in sandy soil under drip irrigation and biofertilization. Australian Journal of Basic and Applied Sciences 3(1):55–65.
El-Metwally IM, Abido WAE and Tagour RMH (2017a). Influence of plant population and weed control treatments on associated weeds, growth, yield and quality of faba bean. Journal of Plant Production, Mansoura University, 8(10):983–991.
El-Metwally IM, Elewa TA and Dawood MG (2017b). Response of soybean cultivars to weed control treatments. Agricultural Engineering International: CIGR Journal, Special issue 159-165.
El-Metwally IM and El-Saidy AEA (2016). Physiological and chemical response of faba bean to water regime and cobalt supplement in sandy soils. International Journal of Applied Biology and Pharmaceutical Technology 9(9):158-169.
El-Mosalamy, AF (2005). Studies on some plant parasitic nematodes infecting peanuts. Ph.D.Thesis, Faculty of Agriculture, Al-Azhar University 168 pp.
Fageria NK, Baligar VC and Jones CA (2010). Growth and mineral nutrition of field crops. Third Edition. CRC Press, Taylor & Francis Group, 586 pp. ISBN 9781439816950.
Fakkar AAO and El-Dakkak AAA (2015). Effect of crop sequence and weed control treatments on weeds and pea crop productivity. Annals of Agricultural Science 60(1):157-168.
FAO (2019). Food and Agriculture Organization of the United Nations, FAOSTAT, FAO Statistics Division 2017, November, 2019.
Faye B, Webber H, Gaiser T, Diop M, Sekyere JDO and Naab JB (2016). Effects of fertilization rate and water availability on peanut growth and yield in Senegal (West Africa). Journal of Sustainable Development 9(6):111-131.
Garko MS, Mohammed IB, Yakubu AI and Muhammad ZY (2016). Performance of groundnut (Arachis Hypogaea L.) varieties as influenced by weed control treatments in Kano State of Nigeria. International Journal of Scientific and Technology Research 5(3):134-140.
Handoo, ZA and Golden AM (1989). A key and diagnostic compendium to the species of the genus Pratylenchus Filipjev, 1936(Lesion nematodes). J. Nematol.21:202-218.
Heatherly C, Elmore CD and Spurlock SR (1994). Effect of irrigation and weed control treatment on yield and net return from soybean (Glycine max). Weed Technology 8(1):69-76.
Hemalatha S, Rao VP, Padmaja J and Suresh K (2013). An overview on role of phosphorus and water deficits on growth, yield and quality of groundnut (Arachis hypogaea L.). International Journal of Applied Biology and Pharmaceutical Technology 4(3):188-201.
Ikisan (2000). Weed Management in Groundnut: http//www.Ikisan.com link/ap cultivation Htm retrieved 12/06/2010.
Israelson OW and Hansen VE (1962). Irrigation principles and practices. 3rd Edit. Hohn Willey and Sons Inc. New York, USA.
James LG (1988). Principles of farm irrigation system design. John Willey & sons. Inc., Washington State University p.73, 152-153, 350-351.
Jongrungklang N, Toomsan B, Vorasoot N, Jogloy S, Boote K, Hoogenboom G and Patanothai A (2013). Drought tolerance mechanisms for yield responses to pre-flowering drought stress of peanut genotypes with different drought tolerant levels. Field Crops Research 144:34-42.
Kambiranda DM, Vasanthaiah HK, Katam R, Ananga A, Basha SM and Naik K (2011). Impact of drought stress on peanut (Arachis hypogaea L.) productivity and food

safety. Plants and Environment, In Tech Publisher. (http://www. intechopen. com/books/plants-and-environment/impact-of-drought-stress-onpeanut-arachis-hypogaea-l-productivity-and-food-safety)249-272.

Kumar NS (2009). Effect of plant density and weed management practices on production potential of groundnut (Arachis hypogaea L.). Indian Journal of Agricultural Research 43(1):57-60.

Minolta Co., (2013). Manual for Chlorophyll Meter SPAD-502 plus. Minolta Camera Co., Osaka, Japan.

Norris RF (1996). Water use efficiency as a method for predicting water use by weeds. Weed Technology 10(1):153–155.

Panhwar F (2005). Oilseed crops future in sindh Pakistan. Digitalvelarg, Gmbh, Germany, 38. 64.

Priya RS, Chinnusamy C, Manickasundaram P and Babu C (2013). A review on weed management in groundnut (Arachis hypogaea L.). International Journal of Agricultural Science 3(1):163–172.

Shanwad UK, Agasimani CA, Aravndkumar BN, Shuvamurth SD, Surwenshi A and Jalageri BR (2011). Integrated weed management (IWM): A long time case study in groundnut –wheat cropping system in Northern Karnataka. Research Journal of Agricultural Science 1: 196-200.

Sher SA (1966). Revision of the Hoplolaiminae (Nematoda). VI. Helicotylenchus Steiner, 1945. Nematologica 12:1-56.

Singh BV, Sharma SK, Verma BL and Siag RK (1994). Effect of irrigation schedule and phosphorus fertilization on yield, water use and phosphorus uptake by groundnut in North-West Rajasthan, Indian Journal of Agronomy 39(l):58-61.

Snedecor GW, Cochran WG (1980). Statistical Methods. 7Th Ed. Iowa State University Press, Iowa, USA., PP 507.

Sounda G, Mandal A, Moinuddin G and Mondal SK (2006). Effect of irrigation and mulch on yield, consumptive use of water and water use efficiency of summer groundnut. Journal of Crop and Weed 2(1):29-32.

Taylor AL (1957). Heterodera taxonomy. In S-19 workshop in Phytone-matol. proc. Univ. Tenn.PP. (H.tax) 4:1-12.

Taylor AL, Dropkin VH and Martin GC (1955). Perineal patterns of root-knot nematodes. Phytopathology 45:26-34.

Tiwari RC, Chaplot PC and Shanna A (1994). Effect of irrigation schedules and sulfur levels on summer groundnut. Legume Research 11(2):101-104.

Youssry MA, Abo-Sabana ML, Alaa AR, Khozimy M and Mosleh YY (2008). Efficacy of the select herbicides in controlling weeds and their side effect of peanut. Journal of Plant Protection Research 48(3):255-263.