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EFFECTS OF PLANTING DATES, FOLIAR MICROELEMENT MIXTURE RATES AND WEEDING REGIMES ON PERFORMANCE OF SESAME CROP (*Sesamum indicum* L.).

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ABSTRACT

Two field experiments were conducted at the farm of the Faculty of Agriculture, Demo, Fayoum University, Egypt, during 2013 and 2014 growing summer seasons to study the effect of planting dates, foliar microelements mixture rates and weeding regimes for Sohag 1 sesame variety. A split- split-plot arrangement in complete block design with three replications was used in both seasons. Two planting dates *i.e.,* April,20 and May,20 were allocated in the main plots, four foliar microelement mixture rates, *i.e.* 100, 200, 300 and 400 g fed^{-1} were distributed in the sub-plots, while four weeding regimes *i.e.*, hand -hoeing, Stomp Extra 45.5% CS, Amex 48% and weedy check were occupied the sub - sub plots. The most important findings could be as follows:

- Planting sesame on April, 20 significantly exhibited higher values of plant height and stem diameter, comparable to May, 20. Such trend was reversed with weeds biomass and weed control efficiency%, where higher values were recorded with May, 20 planting date. Higher figures of seed yield attributes e.g. capsule No $plant^{-1}$, capsules weight $plant^{-1}$, seed yield $plant^{-1}$ and seed index, were attained due to planting on April, 20. Similar trends were noticed for seed yield, oil seed % and oil seed yield, where higher values resulted from planting on April, 20.
- Higher values of plant height and stem diameter were recorded due to the highest rate of foliar microelements mixture (400 g fed^{-1}) and the values seemed to reduce with decreasing the rate. On the contrary, weeds biomass and weed control efficiency% almost exhibited higher values with the lowest rate of foliar microelements mixture (100 g fed^{-1}) and tended to reduction as the rate was increased. Higher figures of seed yield attributes e.g. capsules No $plant^{-1}$, capsules weight $plant^{-1}$, seed yield $plant^{-1}$ and seed index, were attained with the highest rate of foliar microelements mixture (400 g fed^{-1}) and the values seemed to gradual reduction with decreasing the rate. Similar trends were noticed for seed yield, oil seed% and oil seed yield, where higher values resulted from 400 g fed^{-1} rate of foliar microelements mixture and the values seemed to reduce with decreasing the rate.
- The adopted weeding regimes exerted highly significant effects on all of the assessed growth, seed yield attributes and seed and seed oil yields parameters for sesame crop and both weeds biomass and weed control efficiency as well. Furthermore, hand – hoeing practice achieved higher figures of sesame growth and yield parameters and monetary returns, however, hand – hoeing is labor- intensive, expensive and strenuous practice.

Keywords*: sesame crop, planting date, foliar microelements mixture rate, weeding regime, seed yield attributes, seed and seed oil yields, monetary returns*

INTRODUCTION

Sesame (*Sesamum indicum* L.) is considered as one of the major ancient and important oil crops in the world. The crop has high quality of edible seed containing 42–54% oil and 22 to 25% protein. It is an important oil seed crop of the warm region of the tropics and sub-tropics. The sesame cultivated area all over the world in 2013 was 9.416.368 ha. Africa ranking the first among the continents with cultivated area reached to 4793131 ha producing 54.66% of total world seed yield (FAO, 2015).

In Egypt, sesame is considering a food rather than oilseed crop, because most of its seeds are directly consumed. Total area under sesame production has decreased from 41214, in 2011 to 24639, in 2013 while, the productivity increased from 578 to 586 kg fed^{-1}, respectively, (Bulletin Agricultural Statistics, 2013 and 2014). Due to the increase in the edible oils demand and the shortage of the local production, the expansion of oil crops cultivation in new reclaimed lands would be quite helpful to mitigate the production – consumption gap. Sesame crop is a good choice to increase the local edible oil production due to its short duration (3-4 months), low water requirements and drought resistance (Bedigian and Harlan, 1986).

Low production of sesame is attributable to the fact that the crop is frequent growing in less fertile soils and lack of proper nutrient management as well which are the major reasons for low yield (Purushottam, 2005). Variability of sesame yield could be attributed to growing environment, cultural practices, cultivars used and associated weeds. Elmahdi *et al*. (2007), Olowe (2007) and Sarkar *et al*. (2007) reported that early planting resulted in faster plant elongation and produced significantly greater values of yield and its attributes, as compared with late planting dates. Ahmed *et al*. (2009) and Ogbonna and Umar-Shaba (2012) indicated that planting date had a significant influence on sesame growth and yield components. Furthermore, Bhardwaj *et al.* (2014) reported that early planting dates were increased significantly seed yield and contents of protein and minerals except of Fe and Al ones.

On microelements management, Yadav *et al*. (2009) reported that application zinc and/or iron combined with organic manures resulted in increased all of the growth traits and yield of sesame crop. Eisa *et al*. (2010) showed that micronutrients (Fe, Zn, Mn) applied as foliar spray improved sesame growth and yields. In connection, Heidari *et al.* (2011) found that iron fertilizer had a significant effect to increase sesame seed yield. In addition, Hamideldin and Hussein (2014) showed that spraying sesame plants with boron (B) solutions improved both growth and yield.

Weed infestation is one of the major factors limiting the yield of sesame, due to its poor competition at early stages of growth, Bennett and Conde (2003). In connection, Jain *et al.* (1985) reported that the sesame yield reductions caused by weeds due to slow early growth of sesame, so it is important to suppress weed growth at that early stage. Sinha *et al.* (1992) and Belyan (1993) reported that weed induced yield reduction up to 135%, compared to weed-free check and need for a critical free period of about 50 days after planting.

Weeds can efficiently remove soil nutrients more than sesame, leading to faster growth of weeds and inhibiting sesame growth due to the adverse effect on photosynthesis and assimilates accumulation (Rao, 2000). Therefore, insufficient weed control during early growth period of sesame may cause yield reduction up to 65%, accordingly, there is a critical need of weed-free period up to 50 days after sowing (Grichar *et al.* 2001 a & b).

The traditional method of weed control, namely, hoe-weeding is the most common for weed control in Egypt. This method is not only labor intensive, expensive and strenuous, but it also can cause mechanical damage to growing branches and roots of crops. In addition, Adigun *et al.* (2003) stated that besides higher cost, labor availability is uncertain thus making timelines of weeding is difficult to attain, leading to greater yield loss. On the other hand, chemical weed control has revolutionized farmers approach to weed control in the world. It is one of the recent developments in crop production which is more adapted to large scale of crop production than other weed control methods and in the same time, it is labor saving ((Anonymous, 1997).

This investigation aimed to study the effect of planting dates, foliar mixture of microelements rates, weed control practices and their interactions on associated weeds, yield and yield components of sesame and oil seeds content under newly reclaimed land conditions.

MATERIALS AND METHODS

Two- season field experiment was carried out at the experimental Farm of the Faculty of Agriculture, Demo, Fayoum, Egypt (29º 17'N; 30º 53'E) during 2013 and 2014 summer seasons aiming at studying the effect of planting dates, foliar microelements mixture rates and weeding regimes on associated weeds and yield, yield components of sesame, Sohag 1 variety, under sandy loam soil. Particle size distribution and some chemical properties of the experimental soil, as determined according to Wilde *et al.* (1985), are presented in Table (1). The adopted treatments were arranged in split -split-plot in complete design with three replicates as follows:

Main plots (Planting date)

A- April,20 designated as early planting date

B- May,20 designated as late planting date

Sub plots (foliar microelements mixture rate)

a- 100 $gfed^{-1}$ b- 200 $gfed^{-1}$

b- 300 $gfed^{-1}$ d- 400 $gfed^{-1}$

Microelements in the mixture were in EDTA form and its concentrations% (w/w) were Fe 7.5, Mn 3.5, Zn 0.70, Cu 0.28, B 0.65 and Mo 0.30.The tested microelements mixture rates, dissolved in 200 litres of water per feddan, were foliar applied in three equal doses before the first, second and third irrigation events.

Sub – sub plots (Weeding regime)

1- Hand- hoeing was practiced twice at 20 and 40 days after planting.
2- Stomp Extra 45.5% CS, Pendimethalin, N-(1-ethylpropyl)-3, 4- dimethyl-2,6 dinitrobenzeneamine.
3- Amex 48%, Butralin, 4-(1,1-dimeythylethyl)-N-(1-methylpropyl) 2,dinitrobenzeneamine.
4- Weedy check (un-weeded).

Stomp Extra 45.5% and Amex 48% herbicides were sprayed on the soil surface as pre-emergence application, at 1 and 2.5 lfed^{-1} rates, respectively, just after planting and before planting irrigation. It is worthy to mention that common and chemical names of the tested herbicides are approved by the Weed Science Society of America (2010).

Table.1. Particle size distribution and some chemical properties of the experimental soil in 2013 and 2014 summer seasons.

Season			2012/13	2013/14
Sand%			66.5	76.1
Silt%			12.4	10.8
Clay%			21.1	13.1
Soil texture class			Sandy clay Loam	Sandy Loam
CaCO3%			7.10	5.20
Cations	MeqL^{-1}	Na^{+}	69.80	56.70
		K^{+}	2.82	1.40
		Mg^{+2}	25.00	11.0
		Ca^{+2}	30.88	60.62
Anions		$SO4^{-2}$	28.60	33.40
		CL^{-}	92.40	66.50
		HCO^{-3}	7.50	10.0
		$CO3^{-2}$	-	-
Organic Matter %			1.47	0.70
ECe, dSm^{-1} at 25 Cº			5.89	5.33
pH at 25 Cº			7.63	7.87
Micronutrients (ppm)		Fe	6.86	4.29
		Mn	4.21	3.57
		Cu	1.46	0.69
		Zn	1.10	0.29

The sub sub-plot area was 10.5 m^2 (3 m width x 3.5 m length) which equals 1/400 feddan and each sub- sub plot is consists of five ridges 60 cm in between. The sesame seeds were obtained from the Oil Crops Research Department, Field Crop Res. Institute, Agric. Res. Center, Giza , Egypt. Seeds were planted at 4 kg fed^{-1} rate in hills 10 cm apart and before the 1st irrigation the plants were thinned to leave one plant hill^{-1}. Nitrogenous, phosphoric and potassic fertilizers were applied as recommendations of the Egyptian Ministry of Agriculture for sesame production in the region.

Data recorded:

1- Associated weeds:

Weeds biomass (gm^{-2}) in each sub- sub plot was taken by uprooting weeds from an area of one square meter at 60 days after planting and weed control efficiency (%) was calculated as follows:

The efficiency of weed control % =

$$\left[1-\frac{\text{Weeds fresh wt.in hand – hoeing or herbicides – treated plots} \times 100}{\text{Weeds fresh wt.in weedy check plot}}\right]$$

2-Growth, seed and seed oil yields of sesame crop:

At harvesting, a random sample of five guarded plants was taken from each sub- sub-plot to determine the traits of plant height (cm), stem diameter (cm), number of capsules plant^{-1}, weight of capsules (g plant^{-1}), seed yield (g plant^{-1}), seed index (g), oil percentage. Seed yield of the whole sub-sub plot and those of the sample were combined and weighted and expressed as kg fed^{-1}. Seed oil content was extracted and determined, as % on dry weight basis, according to AOAC (1990). Oil yield kg fed^{-1} was estimated by multiplying seed yield kg fed^{-1} by the seed oil percentage.

All obtained data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the spilt-spilt plot design as outlined by Gomez and Gomez (1984), using MSTAT statistical package (MSTAT- C). Least Significant Difference (LSD) was used to test the differences between treatment means at 5 and 1% levels of probability.

RESULTS AND DISCUSSION

1- Effect of planting date:

Plant height and stem diameter

Data in Table 2 reveal that planting date exerted significant effects to influence sesame plant height in 1st and 2nd seasons of study. Early planting date, April,20, exhibited higher values for such trait reached 12.11 and 11.49% in 1st and 2nd seasons, respectively, comparable with May,20 planting date. Similar trend was observed with stem diameter, where the value was higher by 6.82 and 19.05% with April, 20 planting date in 1st and 2nd seasons, respectively, compared with May, 20 one. Planting on 20th April had enough time to grow vegetatively than 20th May planting which might likely be the reason for producing tallest and thick plants.

Associated weeds biomass and weed control efficiency%

Weeds biomass and weed control efficiency % did not affect due planting date, except for weed biomass in 2nd season, however, higher values were recorded with May,20 planting date and increased by (22.64 and10.50 %) and (39.99 and12.36%) in 1st and 2nd seasons, respectively, comparing with that of April, 20 planting date. The obtained results proved that planting at April, 20 was proper for producing vigorous sesame plants which are capable to be more competitive for weeds and consequently reduced its growth and biomass.

Capsules No. plant^{-1}and Capsules weight plant^{-1}

Data in Table 3 reveal that capsules No. plant^{-1} and capsules weight plant^{-1} for sesame were significantly affected due to the tested planting dates and early planting was better than late one in this respect, and such findings were true in 1st and 2nd seasons. The increases in capsules No. plant^{-1}and capsules weight plant^{-1} traits, with early planting date, comprised (17.37 and 18.81%) and (27.83 and 22.13%), respectively, in 1st and 2nd seasons as compared with the late planting date.

Seed yield plant^{-1} and seed index

Seed yield plant^{-1} and seed index for sesame were significantly influenced due to the assessed planting dates and that trend was true in 1st and 2nd seasons. Early planting surpassed the late one where values of seed yield plant^{-1} and seed index were higher by (45.88 and 1.93%) and (34.09 and 1.68%) in 1st and 2nd seasons, respectively, than the late planting date.

Seed oil%, seed yield and seed oil yield (kg fed^{-1})

The adopted planting dates significantly altered seed oil%, seed yield and seed oil yield in1st and 2nd seasons, Table 3. April, 20 planting date was superior than May, 20 one to increase seed oil %, seed yield and seed oil yield and such findings were true in1st and 2nd seasons. Higher values of seed yield fed^{-1}. Seed oil %, seed yield and seed oil yield were increased by (4.03, 27.39 and 32.92%) and by (2.98, 20.57 and 24.68%) due to April, 20 planting date, respectively, in 1st and 2nd seasons in comparison with May, 20 one. The higher seed yield fed^{-1} (kg) obtained from the early planting sesame was mainly due to the production of higher number of capsules, the heaviest weight of capsules (g), seed yield per plant^{-1} (g). Furthermore, the higher seed oil yield fed^{-1} (kg) obtained from the early planting sesame was mainly due to the production of higher seed oil % and seed yield per fed^{-1} (kg). These findings were previously reported by Elmahdi *et al*. (2007), Olowe (2007), Sarkar *et al*. (2007), Ahmed *et al*. (2009), Ogbonna and Umar-Shaba (2012), Bhardwaj *et al.* (2014).The increases in seed oil yield are attributable to higher values of both seed yield and % seed oil content.

Table 2: Effect of planting date, foliar microelements mixture rate, weed control regime and interactions on plant height, stem diameter, associated weed biomass and weed control efficiency% for sesame crop in 2013 and 2014 seasons.

Treatment		Plant height (cm)	Stem diameter (cm)	Weeds biomass (g plot^{-1})	Weed control efficiency (%)
2013 season					
Planting date (D)	April,20	146.24	0.94	730.85	44.66
	May,20	130.44	0.88	896.38	49.35
F- test		**	*	NS	NS
LSD 05%		4.74	0.04	-	-
Foliar microelements mixture rate, gfed^{-1} (M)	100	132.17	0.75	885.79	45.66
	200	136.25	0.85	867.04	44.32
	300	138.02	0.94	773.42	48.96
	400	146.92	1.08	728.21	49.08
F- test		**	**	**	NS
LSD 05%		6.02	0.03	51.47	-
Weeding regime (W)	Hand hoeing	159.83	1.03	481.50	68.50
	Stomp Extra 45.5% CS	152.73	0.97	570.79	62.46
	Amex 48%	151.69	0.93	652.54	57.06
	Weedy check	89.10	0.70	1549.63	0.00
F- test		**	**	**	**
LSD 05%		3.42	0.03	54.53	2.12
Interactions	DM	**	**	NS	NS
	DW	NS	**	**	**
	MW	NS	**	NS	NS
	DMW	NS	**	NS	NS
2014 season					
Planting date (D)	April,20	145.21	1.00	733.73	44.97
	May,20	130.24	0.84	1027.13	50.53
F- test		*	**	*	NS
LSD 05%		14.20	0.06	217.93	-
Foliar microelements mixture rate, gfed^{-1} (M)	100	125.13	0.83	956.29	45.24
	200	138.40	0.91	939.21	46.67
	300	140.54	0.96	870.71	47.43
	400	146.83	0.98	755.50	51.67
F- test		**	**	**	**
LSD 05%		3.70	0.06	63.21	2.89
Weeding regime (W)	Hand hoeing	155.02	1.03	528.00	68.63
	Stomp Extra 45.5% CS	149.62	0.98	598.08	64.12
	Amex 48%	147.79	0.93	689.33	58.27
	Weedy check	98.46	0.74	1706.29	0.00
F- test		**	**	**	**
LSD 05		2.86	0.04	46.17	1.50
Interactions	D x M	NS	NS	*	NS
	D x W	**	**	**	**
	M x W	**	*	NS	**
	D x M x W	**	*	NS	NS

***, ** and NS are referred to significant, highly significant and non-significant, respectively.**

Table 3: Effect of planting date, foliar microelements mixture rate, weed control and interactions on some seed yield attributes, seed yield and oil yield for sesame crop in 2013 and 2014 seasons.

Treatments		Capsules No. plant^{-1}	Capsules weight (g plant^{-1})	Seed index (g)	Seed yield (g plant^{-1})	Seed yield (Kg fed^{-1})	Seed oil (%)	Seed oil yield (Kg fed^{-1})
2013 season								
Planting Date (D)	April,20	76.02	35.31	4.22	18.60	571.17	53.38	309.43
	May,20	64.72	29.72	4.14	12.75	448.35	51.31	232.79
F- test		**	**	*	**	**	**	**
LSD 05		0.74	**	0.07	2.01	17.58	0.57	9.70
Foliar microelements mixture rate, gfed^{-1} (M)	100	58.96	29.67	4.03	12.91	383.33	50.43	195.80
	200	68.23	32.01	4.14	14.36	520.67	52.34	275.61
	300	74.75	32.20	4.21	16.43	534.83	52.62	284.08
	400	79.65	35.18	4.35	17.42	600.20	54.00	329.41
F- test		**	**	**	**	**	**	**
LSD 05		3.00	1.12	0.04	1.11	17.49	0.39	6.88
Weeding regime (W)	Hand hoeing	88.44	36.79	4.37	20.63	665.30	54.83	367.70
	Stomp Extra 45.5% CS	74.56	35.98	4.24	17.80	570.95	52.59	303.42
	Amex 48%	72.25	35.74	4.17	16.87	557.23	51.97	290.58
	Weedy check	46.34	21.55	3.95	7.42	245.56	50.00	123.20
F- test		**	**	**	*	**	**	**
LSD 05		2.42	1.03	0.04	0.93	16.82	0.41	9.12
Interactions	D x M	*	*	**	*	**	**	**
	D x W	**	**	**	**	**	**	**
	M x W	**	**	**	**	**	**	**
	D x M x W	**	NS	**	NS	**	**	**
2014 season								
Planting Date (D)	April,20	81.11	34.10	4.23	17.66	563.49	53.14	304.04
	May,20	63.45	27.92	4.16	13.17	467.37	51.60	243.85
F- test		**	**	*	*	**	*	**
LSD 05		6.31	2.63	0.01	3.33	5.23	1.56	7.57
Foliar microelements mixture rate, gfed^{-1} (M)	100	58.03	28.60	4.06	13.84	409.24	50.76	209.91
	200	71.83	30.48	4.15	14..59	510.93	52.08	268.86
	300	75.48	31.55	4.23	15.69	535.31	52.89	286.50
	400	83.77	33.40	4.35	17.53	606.23	53.76	330.51
F- test		**	**	**	**	**	**	**
LSD 05		3.43	1.65	0.02	1.77	10.42	0.57	6.80
Weeding regime (W)	Hand hoeing	85.90	34.89	4.37	19.23	696.21	54.34	380.32
	Stomp Extra 45.5% CS	80.32	34.24	4.25	16.94	578.06	52.92	307.75
	Amex 48%	78.02	34.15	4.20	16.09	554.04	52.28	290.90
	Weedy check	44.88	20.76	3.96	9.40	233.40	49.94	116.82
F- test		**	**	**	**	**	**	**
LSD 05		2.21	1.35	3.00	0.85	9.93	0.58	6.33
Interactions	D x M	**	NS	**	NS	**	NS	**
	D x W	**	**	NS	*	**	NS	**
	M x W	**	**	**	**	**	NS	**
	D x M x W	**	NS	**	*	**	**	**

***, ** and NS are referred to significant, highly significant and non-significant, respectively.**

Effect of foliar microelements mixture rate:

Plant height and stem diameter cm

The adopted foliar microelements mixture rates resulted in highly significant effects on both plant height and stem diameter of sesame in 1st and 2nd seasons. Values of plant height and stem diameter seemed to increase as microelements mixture rate increased and such findings were true in 1st and 2nd seasons. The increase in plant height and stem diameter amounted to (3.09 and 13.33 %), (4.43 and 25.33 %) and (11.16 and 44.00 %) with increasing the microelements mixture rate to be 200, 300 and 400 g fed^{-1} in 1st season, respectively, comparable with 100 g fed^{-1}. In 2nd season, the corresponding increases were (10.60 and 9.64%), (12.32 and 15.66%) and (17.34 and 18.07%) in the same order of treatments, respectively.

Associated weeds biomass and weed control efficiency%

The tested foliar microelements mixture rates, with sesame crop, exerted a significant influence to affect the associated weeds biomass. In addition, it is notable from data in Table 2 that higher values of associated weeds biomass were attained with the lowest rate of foliar microelements mixture, which tended to decrease as the rate of foliar microelements mixture increased. The reduction in associated weeds biomass were 2.12, 12.68 and 17.79% in 1st season and were 1.79, 8.95 and 21.00% in 2nd one, respectively, with 200,300 and 400 g fed^{-1} rates, comparable with 100 one. Such findings could be attributed to the fact that the sesame crop performance was enhanced with increasing the rate of foliar microelements mixture and the plants were more competitive for natural resources e.g. soil water, nutrients, light etc resulting in lower weeds biomass values. On the contrary, weed control efficiency % was gradually increased with increasing rate of foliar microelements mixture and such trend was true in 1st and 2nd seasons. Higher weed control efficiency % values were 49.08 and 51.67% in 1st and 2nd seasons were detected with 400g fed^{-1} rate, which tended to reduction by (0.24 and 8.94%), (10.74 and 10.71%) and (7.49 and 14.21 %), respectively, with 300,200 and 100 g fed^{-1} rates in 1st and 2nd seasons as compared with 400 g fed^{-1}.

Capsules No. plant^{-1}and Capsules weight plant^{-1}

Data in Table 3 illustrate that, in 1st and 2nd seasons, higher values of capsules No. plant^{-1} (79.65 and 83.77) and capsules weight plant^{-1} (35.18 and 33.40 g) were recorded with 400 g fed^{-1} rate. Reducing foliar microelements mixture rate to be 300, 200 and 100 g fed^{-1} resulted in lower values of capsules No. plant^{-1}and capsules weight plant^{-1}comprised (6.15 and 5.63 %), (14.34 and 9.01%) and (25.98 and 15.66%) in 1st season and (9.90 and 5.54%), (14.25 and 8.74%) and (30.73 and 14.37%) in 2nd season, respectively, comparable with 400 g fed^{-1} rate of foliar microelements mixture.

Seed yield plant^{-1} and seed index

Seed yield plant^{-1} and seed index for sesame were highly significant differed due to the assessed foliar microelements mixture rates 1st and 2nd seasons, Table 3. The highest figures of seed yield plant^{-1} e.g.17.42 and 17.53 g in 1st and 2nd seasons, respectively, were attained with 400 g fed^{-1} rate of foliar microelements mixture and seemed to reduce as the rate of foliar microelements mixture was decreased. The reduction in seed yield plant^{-1} amounted to (5.68 and 10.50%), (17.57 and 16.77%) and (25.89 and 21.05%), respectively, with 300, 200 and 100 g fed^{-1} rates in 1st and 2nd seasons. Data in Table 3 show that seed index exhibited a similar trend to that of seed yield plant^{-1}, where the highest figures i.e. 4.35 and 4.35 g were recorded with the highest rate of foliar microelements mixture (400g fed^{-1}) and tended to reducing with decreasing the rate. The reduction values in seed index comprised (3.22 and 2.76%), (4.83 and 4.60%) and (7.36 and 6.67%), respectively, with 300, 200 and 100 g fed^{-1} rates of foliar microelements mixture in 1st and 2nd seasons.

Seed oil%, seed yield and seed oil yield (kg fed^{-1})

The assessed foliar microelements mixture rates were highly significant altered seed oil%, seed and seed oil yields (kg fed^{-1}) of sesame, Table 3. In addition, the highest seed oil%, seed and seed oil yields values were recorded with the highest rate of foliar microelements mixture and such findings were true in 1st and 2nd seasons. Seed yield (kg fed^{-1}) was decreased with reducing the rate of foliar microelements mixture, where the reduction with 300, 200 and 100 g fed^{-1} rates reached to (10.89 and 11.70%), (13.25 and 15.72%) and (36.13 and 32.49 %) in 1st and 2nd seasons, respectively, comparable with 400g fed^{-1} rate. Data illustrate that seed oil yield followed the same trend of seed yield, where the figures seemed to reduce with decreasing the rate of foliar microelements mixture. The reduction amounted to (13.76 and 13.32%), (16.33 and 18.65%) and (40.56 and 36.49%) with 300, 200 and 100 g fed^{-1} rates in 1st and 2nd seasons, respectively, comparable with 400 g fed^{-1} rate. The corresponding reductions in seed oil % were (2.56 and 1.62%), (3.07 and 3.13 %) and (6.61 and 5.58%) in 1st and 2nd seasons in the same order of treatments, respectively.

The beneficial effect of micronutrients on the seed yield could be due to activation of various enzymes and efficient utilization of applied nutrients, in particular, nitrogen and phosphorus. In addition, positive and cumulative effects resulting in higher values of number of capsules No. plant^{-1}, seed weight plant^{-1} and seed index, which responsible for higher seed yield values. The obtained results are in accordance to those reported by Yadav *et al*. **(**2009), Eisa *et al*. (2010), Heidari *et al.* (2011), Hamideldin and Hussein (2014) and Mahdi (2014). In addition, the present findings can be attributed to the positive role of the assessed micronutrients on the metabolic processes inside the sesame plant and its importance in formation and multiplying meristem cells and stimulating growth buds and form new branches. Besides, the role of foliar fertilization by zinc and iron on the activity of reproductive cells. Furthermore, these nutrients will have led to the activity of the vaccinatum tubes and then increase the number of fertile flowers that resulted in more number of capsules formed.

Effect of weeding regime:

The prevailing weeds species could be categorized as mentioned bellow:

	2013	2014
Annual narrow-leaved weeds percentage:		
Echinochloa colonum	10.78	4.54
Digitaria sanguinalis	6.81	8.05
Total	17.59	12.59
Annual broad-leaved weeds percentage:		
Xanthium brasilicum	54.72	61.51
Portulaca oleraceae	9.54	7.24
Corchorus oiltorus	8.94	5.12
Hibiscus trionum	9.21	13.54
Total	82.41	87.41

It is clear that the broad leaf weeds comprised the major portion of the total weed population in the experimental site in both seasons.

Plant height and stem diameter cm

Data in Table 2 reveal that the tested weeding regimes exerted highly significant effects to influence sesame plant height and stem diameter cm in 1st and 2nd seasons of study. Hand - hoeing regime exhibited higher values i.e. 159.83 and 155.02 cm, respectively, in 1st and 2nd seasons. Stomp Extra 45.5% CS, Amex 48% herbicides and un-weeded regime resulted in figures amounted to (4.44 and 3.48%), (5.09 and 4.66 %) and (44.25 and 36.49 %), respectively, in 1st and 2nd seasons lower than the hoeing practice. Stem diameter exhibited a similar trend, where the highest of sesame plant height was noticed with hand -hoeing practice in 1st and 2nd seasons and comprised 1.03 and 1.03 cm. Comparing with hoeing practice, Stomp Extra 45.5% CS, Amex 48% herbicides and un-weeded regime resulted lower stem diameter values reached to (5.83 and 4.85%), (9.71and 9.71 %) and (32.04 and 28.16%), respectively, in 1st and 2nd seasons.

Associated weeds biomass and weed control efficiency %

The tested weeding regimes, with sesame crop, exerted a significant influence to affect the associated weeds biomass, Table 2. Naturally, un - weeded treatment resulted in the highest values of associated weeds biomass which amounted to 1549.63 and 1706.29 g in 1st and 2nd seasons, respectively. The tested weeding regimes exhibited reduced associated weeds biomass values, where the reduction reached to (63.17 and 64.95 %), (57.89 and 59.60 %) and (68.93 and 69.06%), respectively, with Stomp Extra 45.5% CS, Amex 48% herbicides and hand - hoeing practice in 1st and 2nd seasons, comparable with un-weeded plot. Regarding weed control efficiency % as affected due to the tested weeding regimes, hand – hoeing practice was the superior and exhibited values reached to (9.67and 20.05%) and (7.03and 17.78 %) higher than those of Stomp Extra 45.5% CS and Amex 48% herbicides, respectively, in 1st and 2nd seasons.

Capsules No. plant^{-1}and Capsules weight plant^{-1} g

Data in Table 3 illustrate that, in1st and 2nd seasons, the adopted weeding regimes exerted highly significant influence to affect capsules No.

plant^{-1}and capsules weight plant^{-1} (g) for sesame. The assessed weeding regimes proved to be effective to increase such traits and hand-hoeing is the superior in this respect. The increases in capsules No. plant^{-1} reached to (60.90 and 78.97%), (55.91and 73.84%) and (90.85 and 91.40 %), respectively, with Stomp Extra 45.5% CS, Amex 48% herbicides and hoeing practice in 1st and 2nd seasons, comparable with un-weeded plot. Capsules weight plant^{-1} exhibited similar trends, where the increases comprised (66.96 and 64.93%), (65.85 and 64.50%) and (70.72 and 68.06%), respectively, with Stomp Extra 45.5% CS, Amex 48% herbicides and hoeing practice in 1st and 2nd seasons, compared with un-weeded plot.

Seed yield plant^{-1} and seed index

Seed yield plant^{-1} and seed index for sesame were highly significant differed due to the assessed weeding regimes 1st and 2nd seasons, Table 3. The highest figures of seed yield plant^{-1} e.g. 20.63 and 19.23 g in 1st and 2nd seasons, respectively, were attained with hand – hoeing practice and seemed to reduce by (13.72 and 11.91 %), (18.23 and 16.33%) and (64.03 and 51.12%), respectively, with Stomp Extra 45.5% CS, Amex 48% herbicides and un- weeded plot in 1st and 2nd seasons. Data in Table 3 show that seed index exhibited a similar trend to that of seed yield plant^{-1}, where the highest figures i.e. 4.37 and 4.37g were recorded with hand-hoeing practice and tended to reduce by (2.97 and 2.75%), (4.58 and 3.89%) and (9.61 and 9.38%), respectively, in the same order of treatments in 1st and 2nd seasons.

Seed oil%, seed yield and seed oil yield (kgfed^{-1})

The assessed weeding regimes were highly significant altered seed oil%, seed and seed oil yields (kg fed^{-1}) of sesame, Table 3. In addition, the highest seed oil%, seed and seed oil yields values were recorded with hand – hoeing practice and such findings were true in 1st and 2nd seasons. Seed yield (kg fed^{-1}) was decreased with Stomp Extra 45.5% CS, Amex 48% herbicides and un-weeded plot, by (14.18 and 16.97%), (16.24 and 20.43%) and by (63.09 and 66.48 %) in 1st and 2nd seasons, respectively, comparable with hand – hoeing practice. Data illustrate that seed oil yield followed the same trend of seed yield, where the figures seemed to reduce with Stomp Extra 45.5% CS, Amex 48% herbicides and un- weeded plot and amounted to (17.48 and 19.08%), (20.97 and 23.51%) and (66.49 and 69.28 %) in 1st and 2nd seasons, respectively, comparable with hand – hoeing practice. The corresponding reductions in seed oil % were (4.08 and 2.61%), (5.22 and 3.80 %) and (8.81 and 8.10%) in 1st and 2nd seasons in the same order of treatments, respectively.

Data of growth, seed yield attributes, seed oil%, seed yield and seed oil yield for sesame, as affected by the adopted weeding regimes, it is obviously indicated the superiority of hand - hoeing practice in this respect. In addition, hand - hoeing practice reveal favorite effects on the associated weeds biomass and higher values for weed control efficiency %. In connection, the present results are in accordance with those of Hussein *et al*. (1983), Yadav (2007) and Bhadauria *et al.* (2012) whom reported the superiority of hand-hoeing practice to enhance growth and improve seed yield for sesame. Moreover, Sootrakar *et al.* (1995) reported that, with sesame, hand weeding

3 times (25, 40 and 55 days after sowing) resulted in the highest weed control efficiency (98.8%).

Effect of interactions

The plant growth, yield and yield components parameters for sesame as well as the associated weeds biomass as affected by the adopted treatments interactions could be as follows:

Planting dates and foliar microelements mixture rates bilateral interaction.

Data illustrated in Table (2&3) showed that a highly significant ($P \leq 0.01$) effect on seed index g, seed yield kg fed^{-1} and oil yield kg fed^{-1} in both seasons, as well as plant height cm, stem diameter cm and seed oil % in the first season, No. capsules plant^{-1} in the second one. While, the results reported a significant ($P \leq 0.05$) effect on No. capsules plant^{-1}, capsules weight g plant^{-1} and seed yield g plant^{-1} in the first season, also weed weight g in the second one. The highest plant height (cm), stem diameter (cm), number of capsules plant^{-1}, capsules weight plant^{-1} (g), seed yield plant^{-1} (g), seed yield fed^{-1} (kg), seed index (g), oil (%) and oil yield fed^{-1} (389.03 and 384.93 kg) were obtained by early planting dates on 20th April with the higher rates of foliar mixture microelements 400 g fed^{-1}. Conversely, the heaviest weed (1160.00 g) was obtained by latest planting dates on 20th May with lowest rate of foliar mixture microelements 100 g fed^{-1}.

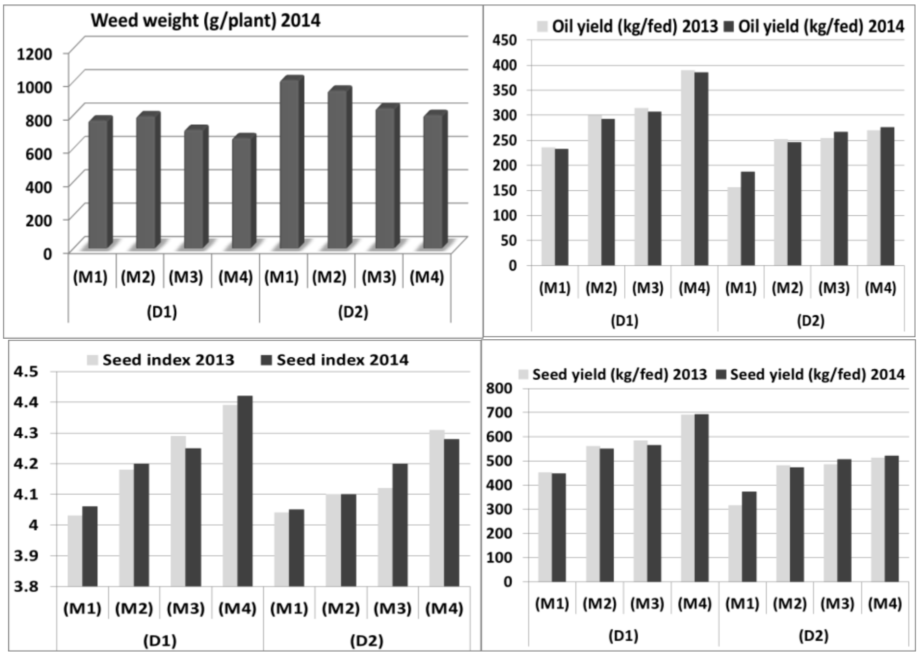

Fig.1.The effect of planting dates and foliar microelements mixture rates bilateral interaction on weed weight, seed index, seed yield and oil yield in both seasons.

Planting dates and weeding regimes bilateral interaction

Regarding this interaction, the results clearly showed a highly significant ($P \leq 0.01$) effect on stem diameter (cm), number of capsules plant^{-1}, capsules wt. plant^{-1}, seed yield fed^{1-} (kg), weed weight (g), weed control efficiency (%) and oil yield fed^{-1} (kg) in both seasons, as well as seed yield plant^{-1}, seed index (g) and seed oil (%) in the first season, plant height (g) in the second one. While, the results reported a significant ($P \leq 0.05$) effect on seed yield plant^{-1} only in the second season. The highest plant height (cm), stem diameter (cm), number of capsules plant^{-1}, capsules wt. plant^{-1} (g), seed yield plant^{-1} (g), seed yield fed^{-1} (kg), seed index (g), oil (%) and oil yield fed^{-1} (438.96 and 413.93 kg) were obtained by early planting date on 20th April with hand hoeing twice. On the contrary, the heaviest weed (1772.42 and 2074.08 g) was obtained by latest planting dates on 20th May with weedy check (unwedded). On the other hand, the higher weed control efficiency (70.12 and 70.72 %) was obtained by planting on 20th May with hand hoeing twice.

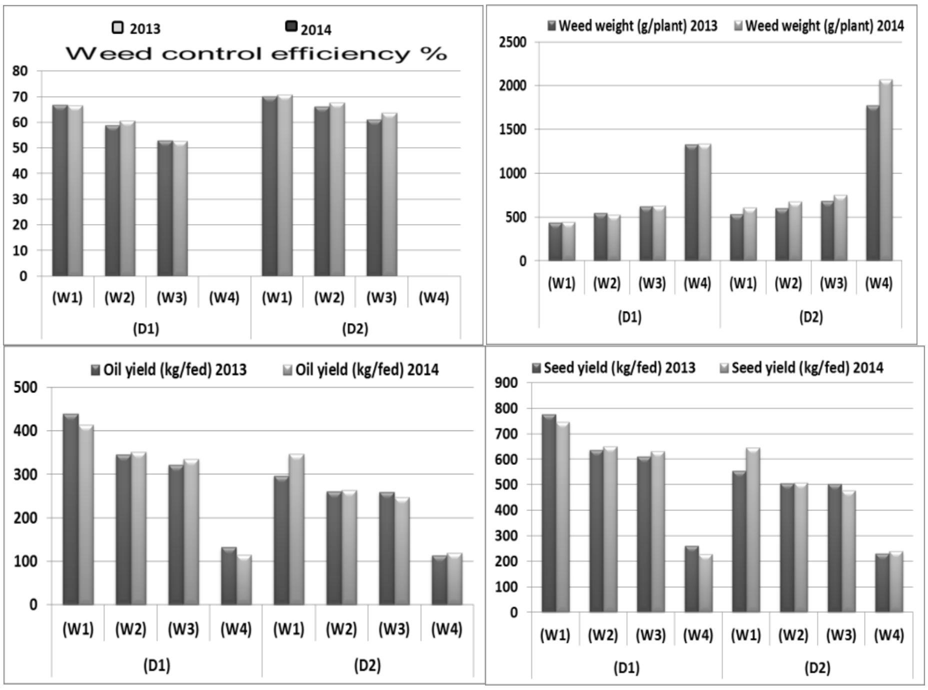

Fig.2. The effect of planting dates and foliar microelements mixture rates bilateral interaction on weed control efficiency %,weed weight, seed yield and oil yield in both seasons

Foliar microelements mixture rates and weeding regimes bilateral interaction.

Results in Table (2&3) indicate that the mean number of capsules plant^{-1}, capsules weight g plant^{-1}, seed yield g plant^{-1}, seed yield kg fed^{-1}, seed index (g) and oil yield kg fed^{-1} in both seasons, while stem diameter (cm) and oil (%) in the first season, plant height (cm) and the efficiency of weed control (%) in the second one were highly significantly ($P \leq 0.01$) affected by this interaction, however stem diameter (cm) in the second season was significantly ($P \leq 0.05$) affected. The highest plant height (cm), stem diameter (cm), number of capsules plant^{-1} (g), capsules weight plant^{-1} (g), seed yield plant^{-1} (g), seed yield fed^{-1} (kg), seed index (g), oil (%), the efficiency of weed control (74.94 %) and oil yield fed^{-1} (447.445 and 457.858 kg) were obtained by the higher foliar spray with mixture of microelement rates 400 g fed^{-1} and hand hoeing twice at 20 and 40 days after planting.

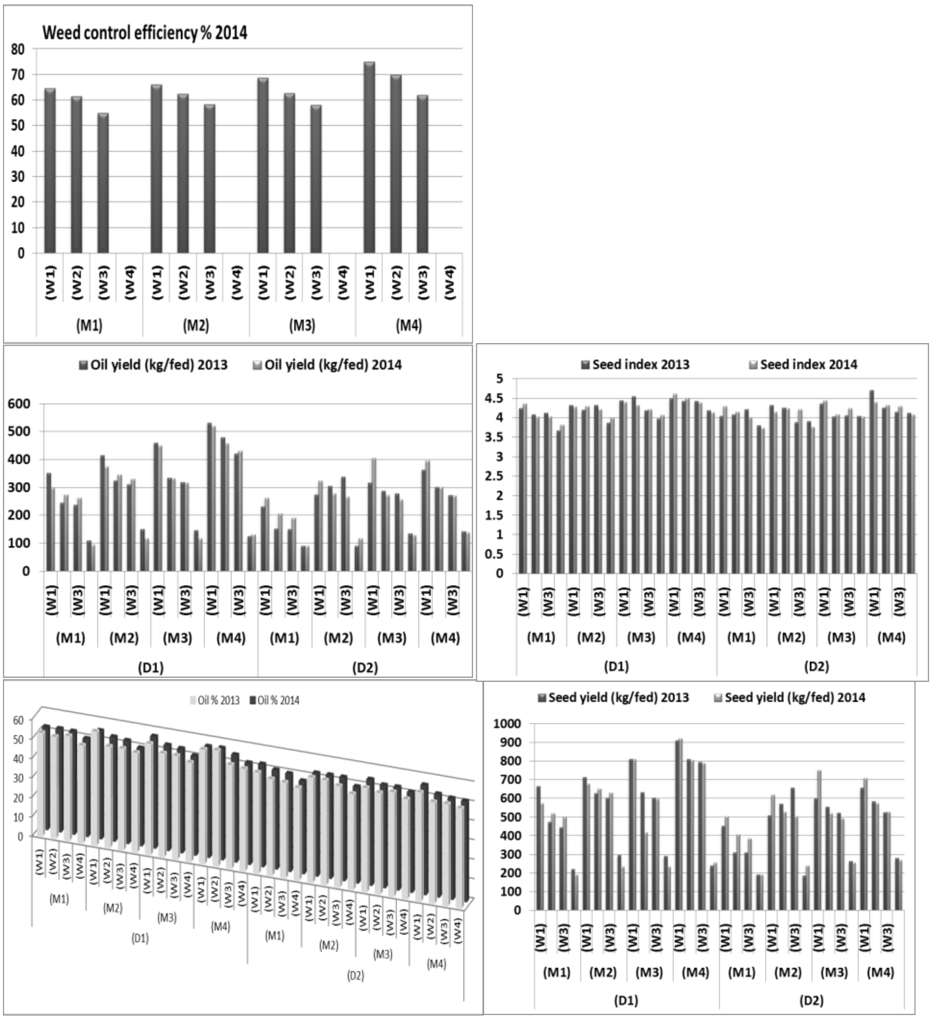

Fig.3.The effect of planting dates and foliar microelements mixture rates bilateral interaction on weed control efficiency %, seed index, seed yield and oil yield in both seasons

Planting dates, foliar microelements mixture rates and weeding regimes trilateral interaction.

Results in Table (2&3) indicate that the mean number of capsules plant^{-1}, seed yield kg fed^{-1}, seed index (g), oil (%) and oil yield kg fed^{-1} in both seasons, while stem diameter (cm) in the first season, plant height (cm) in the second one were highly significantly (P ≤ 0.01) affected by this interaction. However stem diameter (cm) and seed yield g plant^{-1} in the second season were significantly (P ≤ 0.05) affected. The highest plant height (cm), stem diameter (cm)**,** number of capsules plant^{-1}, seed yield plant^{-1} (g), seed yield fed^{-1} (kg), seed index (g), oil (%) and oil yield fed^{-1}(531.41 and 520.59 kg) were obtained by ($D_1M_4W_1$) the early planting date on 20th April with the higher foliar spray with mixtures of microelement rates 400 g fed^{-1} and hand hoeing twice at 20 and 40 days after planting.

Monetary returns

All the assessed weeding regimes resulted in higher monetary returns compared to weedy check due to reducing the weeds competition. Saharia and Bayon (1996) recorded that on sesame production, integrated weed control resulted in increased net return (4396 INR/ha) as compared to un-weeded plots. Data of the present trials proved that hand - hoeing twice resulted in the highest net return per fed which amounted to 2653.00 and 2962.10 Egyptian pounds followed by Stomp Extra 45.5% CS which resulted in 1709.50 and 1780.60 Egyptian pounds in comparison with weedy check in 1st and 2nd seasons of the present study.

CONCLUSION

Data proved that under the present research trial conditions it could be recommended that planting early on April, 20 and applying the highest rate of foliar microelements mixture i.e.400 g fed^{-1} with hand- hoeing twice at 20 and 40 days post planting is favorable interaction capable to accomplish acceptable profit yield of sesame seed and oil yields and higher monetary returns as well.

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تأثير مواعيد الزراعة, معدلات الرش الورقى بالعناصر الصغرى وأنظمة مكافحة الحشائش والتفاعل بينهم على أداء نباتات السمسم.

على عبدالله على مقداد
قسم المحاصيل – كلية الزراعة - جامعة الفيوم

تم تنفيذ تجربتين حقليتين في مزرعة كلية الزراعة بالفيوم بمنطقة دمو– جامعة الفيوم - مصر. خلال الموسم الصيفى لعامى ٢٠١٣ و٢٠١٤ لدراسة تأثير مواعيد الزراعة، الرش الورقى بالعناصر الصغرى وأنظمة مكافحة الحشائش على المحصول ومكوناتة للسمسم صنف سوهاج ١. وتم إستخدام القطع المنشقة مرتين فى تصميم القطاعات كاملة العشوائية ذى ثلاثة مكررات فى الموسمين. وقد احتلت معاملتى مواعيد الزراعة (٢٠ إبريل و٢٠ مايو) القطع الرئيسية ووزعت أربعة معدلات للرش الورقى بالعناصر الصغرى (١٠٠،٢٠٠ ، ٣٠٠ و ٤٠٠ جم/ف) والتى تم إذابتها فى ٢٠٠ لتر ماء/ف فى القطع الشقية الأولى فى حين تم توزيع أربع معاملات لمكافحة الحشائش (العزيق مرتين، أستخدام استومب ٤٨%، أمكس ٤٨% و بدون معاملة) فى القطع الشقية الثانية . وقد تم استخدام العناصر الصغرى فى صورة EDTA تحتوى على
(Fe 7.5 %, Mn 3.5 %, Zn 0.70 %, Cu 0.28 %, B 0.65 % and Mo 0.30 % w/w)

أظهرت النتائج المتحصل عليها أن ميعاد الزراعة المبكر في٢٠ أبريل ومعاملة المعدل العالى من التسميد الورقى بالعناصر الصغرى ٤٠٠ جم/ف ومعاملة العزيق مرتين أدت إلى تحسن معنوى فى صفات محصول السمسم ومكوناته ومصحوباً بأنخفاض معنوى فى وزن الحشائش. الزراعة المبكرة أدت إلى زيادة محصول البذور للفدان ومحتوى البذور من الزيت ومحصول الزيت للفدان بنسبة ٢٧.٣٩ & ٢٠.٥٧ و٤.٠٣ & ٢.٩٨ و ٣٣.٠٢ & ٢٤.٦٨ % فى الموسم الأول والثانى على التوالى، بينما أدى إلى إنخفاض وزن الحشائش بنسبة ٢٨.٥٧ % فى الموسم الثانى. أظهرت النتائج أن إستخدام معاملة المعدل العالى من التسميد الورقى بالعناصر الصغرى٤٠٠ جم/ف أدى إلى زيادة معنوية فى محصول البذور للفدان ومحتوى البذور من الزيت والنسية المئوية لكفاءة مكافحة الحشائش ومحصول الزيت للفدان بنسبة ٥٦.٥٨ & ٤٨.١٤ و ٧.٠٨ & ٥.٩١ و ٧.٤٩ & ١٤.٢١ و ٦٨.٢٤ & ٥٧.٤٥ %، بينما إنخفض وزن الحشائش بنسبة ١٧.٧٩ & ٢١.٠٠ ولوحظ أن تطبيق معاملة العزيق مرتين سلك نفس الأتجاة حيث أدى إلى زيادة معنوبة لنفس الصفات السابقة بنسبة ١٧٠.٩٣ & ١٩٨.٢٩ و ٩.٦٦ & ٨.٨١ و ٦٨.٥٠ & ٦٨.٦٣ و ١٩٨.٤٦ & ٢٢٥.٥٦ %، بينما إنخفض وزن الحشائش بنسبة ٦٨.٩٣ & ٦٩.٠٦ % خلال الموسم الأول والثانى على التوالى، أيضاً أدى إلى زيادة صافى العائد المادى للفدان. أظهرت النتائج فعالية أستخدام البندميثيلين والبيوترايلين بالمقارنة بدون معاملة، كما سجلت أقل وزن للحشائش، ولوحظ أيضاً أن كفاءة مكافحة الحشائش ومحصول البذور أعطى أعلى قيم تحت تأثير نفس المعاملتين السابقتين.