J. Plant Production, Mansoura Univ., Vol. 9 (12): 1021 - 1030, 2018

Efficiency of Weed Control Methods and Planting Population on Controlling Weeds and the Economic Feasibility of Onion Productivity

Geries, L. S. M.[1] and Azza E. Khaffagy[2]
[1]Onion Res. Dept., Field Crops Res. Inst., Agric. Res. Center, Giza, Egypt
[2]Weed Res. Laboratory, Field Crops Res. Inst., Agric. Res. Center, Giza, Egypt

ABSTRACT

Two field experiments were carried out during two successive winter seasons (2016/17-2017/18) at Agricultural Research Station, Kafr El-Sheikh Governorate, Agricultural Research Center, to study the effect of twenty four treatments which were a combination of eight weed control treatments (i.e., Against, Against with hand hoeing once, Floro, Floro with hand hoeing once, Stomp extra, Stomp extra with hand hoeing once, hand hoeing twice and unweeded check) and three planting population including 120, 180 and 240 thousand plants/fad on weeds control, growth characters, onion production and its quality. All tested weed control treatments significantly increased onion growth characters and yield during the two seasons. Weed control treatment by Floro at rate of 750 cm^3/fad+ hand hoeing once at 45 days after transplanting, reduced percentage of dry weight of broad-leaved, grassy and total weeds at 60 and 90 days after transplanting by (97.08 & 96.39 %), (90.50 & 90.50%) and (96.20 & 95.20 %) in the average survey in 2016/17 and 2017/18 seasons, respectively, compared to unweeded check. The same treatment produced the highest average bulb weight, marketable and total bulbs yield per fad by about 45.67, 74.56 and 59.78 % when compared with unweeded check in the average of both seasons, respectively with best storability along with bulbs quality at low cost of onion production, demonstrate that weed control is very important in the onion fields. Also, onion plant grown at 180 thousand plants/fad revealed a very promising effect for marketable and total yield with the average of 17.89 and 20.24 % in conjunction with a great reduction in the total weed biomass/m^2 at 60 and 90 days after transplanting by about 25.51 and 25.77 % in the two seasons compared to 120 thousand plants/fad., respectively. The maximum values of total soluble solids, percentage of dry matter in bulbs, and remaining marketable bulbs after storage for six months were achieved under the density of 120 or 180 thousand plants/fad in both seasons. Total bulb yield/fad showed highly significant negative correlation with each of dry weight of broad-leaved, grassy and total weeds as well as culls yield/fad. Therefore, the use of integration between Floro EC 24% as post-emergence herbicide at rate of 750 cm^3/fad (21 days after transplanting) followed by hand hoeing once at 45 days after transplanting plus plant density of 180 thousand plants/fad is the best choice for the onion farmers of this area to achieve maximum onion bulb yield/fad, storability and quality of onions with higher economic returns.

Keywords: Onion, bulb yield, pendimethalin, oxfluorfen, acetochlor and herbicides.

INTRODUCTION

Onion (*Allium cepa*, L.) is one of the most important crops, in Egypt. As a top agricultural country in the region and Africa, Egypt ranks high among highly producing countries worldwide with total cultivated area of 162,833 faddan in 2016 producing 2 million tons with an average of 14.43 ton/faddan (Yearly Book of Economics and Statistics of the Agric. Ministry in Egypt, 2017).

One of the strong potential causes of the great reduction in onion yield is related to weed competition, because of the peculiar canopy structure of the onions. The traditional methods of weed control (hoeing and hand weeding) are laborious, expensive and scanty. Furthermore, weeding during serious growth stages is very hard due to increased cost of human works and its rare availability. Further, the use of single herbicides alone for weed control is not quit enough due to its narrow spectrum especially through the long competition period for weeds to this crop.

Some researchers estimated onion yield losses due to weed competition by 40 to 80% (Channapagoudar and Biradar, 2007) and as high among 70 to 84% (Swaify, 2009). In this situation the use of broad spectrum weed control herbicides including pre or post emergence herbicides as a single or in combination are good choice to achieve maximum yield with lower cost. Several herbicides (e.g., pendimethalin and oxyflurofen) were used successfully in eliminating onion's weeds. Yet, using such herbicides in combination with hand weeding treatment was more promising option at all levels of enhancing crop productivity (Jilani *et al*., 2007, Hussain *et al*., 2008, Kalhapure and Shete, 2012 and Kalhapure *et al*., 2014).

Also adaptation can integrate partially for weed management in this poor competition crop. Many authors reported that wider spacing caused higher yield per plant, although the closer spacing gave higher yield per unit area due to increased plant density up to a certain limit (Abdelmasieh, 2017 and Walle *et al*., 2018) and the use optimum of plant population or spacing has double characteristic, avoiding strong competition between plants for growth factors such as nutrients, water and light.

Thus, the objective of this study was to evaluate the efficiency of several herbicides in comparison with manual weeding under three planting density and its possible integration for weed control during the competition duration period, select the most effective herbicide in weed control in onion transplanted and their consequent effects on different parameters of onion crop including yield, yield components and its storage characters.

MATERIALS AND METHODS

Two field experiments were conducted during two successive winter seasons 2016/17 and 2017/18 at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate, Egypt. Mechanical and chemical properties of soil samples were determined according to Klute (1986) and Jackson (1973), which taken up to 30 cm depth from the experimental sites before transplanting (Table 1).

Table 1. Mechanical and chemical analysis of soil before cultivation in the two growing seasons.

Season	Soil pH	Sand	Silt	Clay	Organic matter	Textural classes	N	P	K
		%					Ppm		
2016/17	7.90	19.00	33.57	47.43	1.81	Clayey	27.15	16.90	280.0
2017/18	7.88	19.27	30.33	50.40	1.73	Clayey	22.37	18.45	277.10

Previous summer crop was cotton in first season and maize in second one. The recommended rates of NPK at 120:45:50 kg/fad in the form of ammonium nitrate, calcium super phosphate and potassium sulphate were

applied, respectively. All phosphorus and potash rates were applied at the time of soil bed preparation, half of the amount nitrogen was applied after one month of transplanting and half was applied at 2 months after transplantation. Irrigation and insect/disease control measures were performed as recommended by Ministry of Agriculture during the two seasons of study.

The plot size was 3 x 3.5 m with five ridges 60 cm apart between ridges, ridging directions was north-south, transplanting was done on both sides of the ridge. Herbicides were sprayed in both field experiments by CP3 backpack sprayer with 200 liters water volume per fad. In both seasons, Giza red seeds were planted in the nursery on 15th and 16th October and plants were transplanted in the field after 60 days on mid of December.

Weed control and plant population treatments are as following:-

T_1- Against EC 43% (acetochlor 37.5 % + oxfluorfen 5.5%) 2- chloro – *N* - (ethoxymethyl) – N - (2- ethyl - 6-methylphenyl) acetamide + 2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl) benzene, at rate of 1.25 L/ fad, soil surface application directly, (before irrigation and transplanting).

T_2- Against EC 43% , followed by one hand hoeing at 45 days after transplanting (DAT).

T_3- Floro EC 24% (oxfluorfen) 2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl) benzene, at rate of 750 cm^3/fad, application directly, (after 21 days transplanting).

T_4- Floro EC 24%, followed by one hand hoeing at 45 DAT.

T_5-Stomp extra CS 45.5% (pendimethalin) [N-(1-ethylpropyl)-3,4 diethyl- 2,6-dinitrobenzenamine], at the rate of 1.5 L/fad, soil surface application directly, (before irrigation and transplanting).

T_6- Stomp extra CS 45.5%, followed by one hand hoeing at 45 DAT.

T_7- Hand hoeing twice done, 30 and 45 DAT.

T_8- Unweeded check.

Meanwhile planting population was allocated in vertical direction:

B_1- 30 plants/m^2 (120 thousand plants/fad).

B_2- 45 plants/m^2 (180 thousand plants/fad).

B_3- 60 plants/m^2 (240 thousand plants/fad).

Data recorded:

A. Dry weight of annual weeds:

Annual weeds were hand pulled after 60 and 90 DAT identified to species and classified into three categories (broad-leaved, grassy and total weeds). The weight of the dry grass was determined (g/m^2), after drying in a forced draft oven at 70 C° for 48 hours.

B. Weed species susceptibility rating of weeds:

The susceptibility of weeds to herbicides was measured after 25 days from application the herbicides by the reduction percentage of the dry weight of each species compared to the un-weeded check according to Frans and Talbert (1977) as follow:

- Susceptible (S) = > 90 %.
- Moderately susceptible (MS) = 80 - 89 %.
- Moderately tolerant (MT) = 60 - 79 %.
- Tolerant (T) = < 60%

C. Vegetative growth characteristics of crop:

Samples of ten onion plants were collected randomly from each plot after 90 and 120 DAT to evaluate onion growth attributes, *i.e.*, plant height (cm), number of leaves/plant, bulb diameter (cm) and plant dry weight (g).

D. Onion bulbs yield:

The onion yield were harvested when 50% plant tops were down of each plot and after harvest, onion plants were left in the field to cure for two weeks, then tops were removed, and the following data: average weight of the bulb (g), marketable, culls and total yield (t/fad) were recorded.

E. Bulb quality:

At the time of harvest, ten bulbs were randomly taken from each plot and bulb diameter (cm), total soluble solids (T.S.S %) were analyzed by hand Refractrometer and percentage of dry matter in bulbs (D.M. %) were estimated.

F. Storability of onion bulbs:

Storability was measured as percentage of marketable total loss in weight of bulbs during a storage period of six months. Then rotting and sprouting bulbs were discarded and the remaining marketable bulbs were weighted.

G- Economic feasibility study:

The following economic criteria were used to determine the net income (LE) and economic profitability:

1. Total costs of onion production (L.E./ fad): as affected by different treatments.
2. Total income (L.E./fad) = (Price L.E./ ton) ×Yield (ton/fad).
3. Net farm return (L.E./fad) = Total income - Total costs.
4. Benefit/Cost ratio (B/C) = Total income/ Total cost.

One ton of marketable onion =2000 L.E. and one ton of culls onion =800 L.E. as an average of the two seasons. The economic return was calculated based on current local market price of onion bulbs and cost of input. Economical evaluation was conducted using the formulas described by Cimmyt, 1988.

Correlation study:

Simple correlation matrix was carried out for the two seasons to investigate the relationship between dry weight of different weed categories and onion yield and its quality according to Steel and Torrie (1980).

Experimental Design and Statistical Analysis:

Each experiment was designed in a strip-plot in RCBD design with four replications. Twenty four treatments which were a combination of eight weed control treatments in horizontal plots, also, three levels of planting population in vertical plots. The obtained data were statistically analyzed and treatment effects were compared using least significant difference test (LSD, $P < 0.05$) as described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

A. Effect of weed control methods and planting population on weeds:

List of most important weeds present in the field:

The common weed species, at the experimental sites, were *Phalaris minor,* (as annual grassy weeds); *Rumex dentatus, Anagallis arvensis, Malva parviflora, Chenopodium album, Coronopus sp, Beta vulgaris, Ammi majus* and *Melilotus indica* (as annual broad-leaved weeds).

Results in Table 2 showed the significant variations among different treatments under investigation. They

caused a significant reduction in the dry weight of broad-leaved, grassy and total annuals weeds at 60 and 90 DAT. Along with Floro at rate of 750 cm^3/fad, application directly 21 days after transplanting followed by hand hoeing once at 45 DAT gave a significant reductions in dry weight of broad-leaved, grassy and total annuals weeds at 60 and 90 DAT by (97.08 & 96.39%), (90.50 & 90.50%) and (96.20 & 95.20 %) in the average survey in 2016/17 and 2017/18 seasons, respectively, compared to unweeded check. On the other hand, results due to successfully destroy most of the weed were much effective in reduce the weed density as the field was invaded by all types of weeds. Hence, weed competition by post emergence herbicide implementation was furthermore enhanced by combination hand hoeing at 45 DAT in weed control treatments, which provides efficient and prolonged weed control and kept the crop weed free during the critical periods of competition. These results are in harmony with Khokhar *et al*. (2006), Chandrika *et al*. (2009), Kalhapure *et al*. (2014) and Elian *et al*. (2016), Gaharwar *et al.* (2017) and Ramalingam *et al.* (2017).

Data presented in Table 2 showed that increasing planting population from 120 to 240 thousand plants/fad decreased dry weight of broad-leaved, grassy and total annual weeds by 34.10, 35.70 and 34.40 %, 35.40, 35.60 and 35.40% at 60 and 90 DAT respectively, as an average in both seasons. These were anticipated due to the less inter-specific competition between onion and weeds plants in the lowest density as compared to the high density, which caused decreasing in light transmittance through the leaf canopy of crops, planted in narrow rows or at high populations could suppress growth and development of weeds. These results are in coincidence with those obtained by Abdelmasieh (2017) and Walle *et al*. (2018).

Table 2. Effect of weed control treatments and planting population on dry weight of broad-leaved, grassy and total weeds (g/m^2) after 60 and 90 day from transplant during 2016/17 and 2017/18 winter seasons.

Character	2016/17 season						2017/18 season					
	Dry weight of annual weeds (g/m^2)											
	Broad-leaved		Grassy		Total		Broad-leaved		Grassy		Total	
	Days after transplant (DAT)											
	60	90	60	90	60	90	60	90	60	90	60	90
Weed control treatment												
Against	126.15	200.08	22.15	52.21	148.30	252.22	113.54	140.42	19.27	45.95	132.80	186.42
Against + H.H	47.85	89.68	18.62	44.17	66.46	133.77	43.06	62.72	16.20	38.87	59.26	101.59
Floro	100.21	200.58	22.01	49.84	122.22	250.43	90.23	140.01	19.22	45.49	109.45	185.50
Floro + H.H	35.42	67.93	17.85	42.10	53.26	110.05	31.88	47.57	15.53	37.05	47.40	84.62
Stomp extra	127.02	245.94	26.58	62.73	153.60	308.60	114.32	172.11	23.13	55.20	137.44	227.31
Stomp extra + H.H	99.25	165.67	21.23	51.70	120.48	217.28	89.33	115.90	18.47	43.86	107.80	159.76
Hand hoeing twice	133.14	283.81	37.70	88.89	170.85	372.65	119.83	199.46	32.80	78.23	152.63	277.69
Unweeded check	1212.53	1883.46	188.07	443.26	1400.60	2326.81	1075.41	1318.48	163.62	389.34	1239.03	1707.82
$LSD_{(0.05)}$	51.87	54.10	10.89	38.11	53.63	76.56	81.29	91.91	8.99	14.20	78.59	86.42
Planting population (thousand plants/fad)												
120	291.99	492.53	55.73	131.22	347.72	623.75	262.79	344.77	48.49	115.47	311.28	460.24
180	217.69	365.78	41.31	97.25	259.00	463.00	195.92	256.03	35.94	85.58	231.86	341.61
240	195.91	318.13	35.78	84.62	231.69	402.67	170.38	222.95	31.16	74.19	201.54	297.14
$LSD_{(0.05)}$	37.90	37.33	3.20	7.50	38.45	41.07	21.24	50.86	6.60	6.18	20.35	54.45

H.H: Hand hoeing

Results in Table 3 indicated that the effect of interactions between weed control treatments and planting population on dry weight of broad-leaved, grassy and total annual weeds were significant at 5% level. All weed control treatments studied in its combinations with hand hoeing was highly effective for reducing the dry weight of broad-leaved, grass and total annual weeds compared to untreated or using different treatments alone. This means that applying one supplementary hoeing was essential to eliminate the weed plants that survived or escaped from herbicides. Total annual weeds tended to decrease under high densities than under low densities, this may be attributed to the less light transparency, which falls on weeds and consequently weed growth was decreased. Application of Floro at 750 cm^3/fad plus hand hoeing once at 45 DAT reduced the density of total annual weeds (96.50 to 95.60 %) at 60 and 90 DAT respectively, the average in both seasons in onion compared with the untreated plots. Several research findings showed that Floro has successfully controlled total annul weeds in onion. The best results were obtained from the interaction between high plant densities (240 thousand plants/fad) with weed control treatments followed by 180 thousand plants/fad as compared with low plant density (120 thousand plants/fad) in the same weed control treatments under studying. Similar observations were achieved by Kalhapure *et al*. (2014).

B. susceptibility rating of weeds:

Nine weed species and eight herbicides treatments according to the scale of the susceptibility scores of used by Frans and Talbert (1977) were measured depending on the reduction % of the dry weight of each species in g/m^2 of any herbicide compared with broadleaved and grassy weeds untreated, which measured as mentioned in Table 4, during 2016/17 and 2017/18 seasons, *Rumex dentatus, Anagallis arvensis, Malva parviflora, Chenopodium album, Coronopus sp*, *Beta vulgaris, Ammi majus and Melilotus indica* as annual broad-leaved as well *Phalaris minor*, as annual grassy weeds were susceptible (S) and moderate susceptible (MS) to Floro (750 cm^3 /fad) plus once hand hoeing at 45 DAT with ranged between 90-97%, followed by Against plus hand hoeing once percent 89-90%, Stomp extra + hand hoeing once by 85-90%, Floro 750 cm^3/fad by ranged between 85-90%. Herbicides Floro, Against and Stomp extra approximately gave the moderate susceptible (MS) to the previous weeds species meaning that there herbicides had wide spectrum of weed control. The same trend with little differences was observed in weed control treatments in the second season.

Table 3. The interaction effect between weed control treatments and planting population on dry weight of broad-leaved, grassy weeds (g/m^2) and total annual weeds at 60 and 90 DAT during 2016/17 and 2017/18 seasons.

Weed control treatment	Planting population (thousand plants/fad)	2016/17 season						2017/18 season					
		Dry weight of annual weeds (g/m^2)											
		Broad-leaved		Grassy		Total		Broad-leaved		Grassy		Total	
		Day after transplant (DAT)											
		60	90	60	90	60	90	60	90	60	90	60	90
Against	120	162.25	259.00	28.37	66.87	190.62	325.87	146.03	166.40	24.68	58.85	170.71	225.25
	180	115.00	181.25	20.25	47.75	135.25	229.15	103.50	146.89	17.62	42.02	121.12	188.91
	240	101.20	160.00	17.82	42.02	119.02	201.65	91.08	107.95	15.50	36.98	106.58	144.93
Against +H.H	120	60.35	112.55	22.95	54.49	83.29	167.04	54.31	78.79	19.97	47.96	74.28	126.74
	180	44.25	83.25	17.50	41.50	61.75	124.60	39.83	58.17	15.23	36.52	55.05	94.69
	240	38.94	73.25	15.40	36.52	54.34	109.65	35.05	51.19	13.40	32.14	48.44	83.33
Floro	120	117.10	237.75	26.44	66.79	143.54	304.51	105.39	181.30	23.00	54.47	128.39	235.77
	180	106.00	209.75	23.50	44.00	129.50	253.85	95.40	126.98	20.45	48.40	115.84	175.38
	240	77.54	154.25	16.08	38.72	93.62	192.93	69.91	111.74	14.21	33.62	84.12	145.36
Floro +H.H	120	44.22	85.05	22.05	52.04	66.26	137.11	39.79	59.55	19.18	45.79	58.97	105.34
	180	33.00	63.25	16.75	39.50	49.75	102.69	29.70	44.24	14.57	34.76	44.27	78.99
	240	29.04	55.50	14.74	34.76	43.78	90.37	26.14	38.93	12.82	30.59	38.96	69.51
Stomp extra	120	158.27	306.83	32.75	77.26	191.02	384.08	142.44	214.78	28.49	67.98	170.94	282.76
	180	118.50	229.25	25.00	59.00	143.50	288.15	106.65	160.40	21.75	51.92	128.40	212.32
	240	104.28	201.75	22.00	51.92	126.28	253.57	93.85	141.15	19.14	45.69	112.99	186.84
Stomp extra+ H.H	120	134.19	225.00	28.45	61.89	162.64	286.89	120.77	157.50	24.75	58.78	145.52	216.27
	180	87.00	144.75	18.75	55.00	105.75	199.54	78.30	101.18	16.31	38.72	94.61	139.90
	240	76.56	127.25	16.50	38.20	93.06	165.40	68.90	89.04	14.36	34.07	83.26	123.11
Hand hoeing twice	120	156.96	346.43	47.31	111.58	204.27	458.02	141.26	242.50	41.16	98.19	182.42	340.69
	180	130.25	268.50	35.00	82.50	165.25	351.03	117.23	187.97	30.45	72.60	147.68	260.57
	240	112.22	236.50	30.80	72.60	143.02	308.90	100.99	167.91	26.80	63.89	127.79	231.80
Unweeded check	120	1502.60	2367.63	237.75	558.84	1740.15	2926.47	1352.34	1657.35	206.67	491.77	1559.01	2149.12
	180	1107.50	1746.25	173.75	408.75	1281.25	2155.03	996.75	1222.39	151.16	359.70	1147.91	1582.09
	240	1027.5	1536.50	152.90	362.20	1180.40	1898.92	877.14	1075.70	133.02	316.54	1010.16	1392.24
$LSD_{(0.05)}$		80.27	68.54	5.69	20.16	82.56	74.59	48.43	122.12	15.49	15.78	47.67	126.15

H.H: Hand hoeing

Table 4. Susceptibility of annual weed species to some herbicides treatments at 60 DAT during 2016/17 and 2017/18 winter seasons.

Weeds species	Controlling % & weeds species susceptibility to herbicides								Species of an annual grassy weeds
	Species of an annual broad-leaved weeds (g/m^2)								
Herbicides	*Rumex dentatus*	*Anagallis arvensis*	*Malva parviflora*	*Chenopodium album*	*Coronopus sp*	*Beta vulgaris*	*Ammi majus*	*Melilotus indica*	*Phalaris minor*
	2016/17 season								
Against	86 (MS)	87 (MS)	88 (MS)	86 (MS)	87 (MS)	89MS)	86 (MS)	88(MS)	87 (MS)
Against+ H.H	90 (S)	89 (MS)	90 (S)	90 (S)	89 (MS)	94 (S)	91 (S)	91 (S)	90 (MS)
Floro	89 (MS)	85 (MS)	89 (MS)	87 (MS)	89 (MS)	90 (S)	89 (MS)	89(MS	89 (MS)
Floro + H.H	95 (S)	90 (S)	92 (S)	93 (S)	91 (S)	97 (S)	95 (S)	93 (S)	91 (MS)
Stomp extra	80 (MS)	84 (MS)	83 (MS)	83 (MS)	83 (MS)	87MS)	83 (MS)	85(MS)	86 (MS)
Stomp extra + H.H	89 (MS)	88 (MS)	90 (S)	85 (MS)	88 (MS)	90 (S)	90 (S)	90 (S)	89 (MS)
	2017/18 season								
Against	87 (MS)	87 (MS)	88 (MS)	86 (MS)	88 (MS)	87 MS	86 (MS)	89MS	88 (MS)
Against+ H.H	90 (S)	91 (S)	90 (S)	90 (S)	90 (S)	91 (S)	91 (S)	92 (S)	91 (MS)
Floro	89 (MS)	88 (MS)	89 (MS)	88 (MS)	90 (S)	89MS)	89 (MS)	90 (S)	89 (MS)
Floro +H.H	93 (S)	92 (S)	92 (S)	91 (S)	92 (S)	95 (S)	92 (S)	94 (S)	93 (MS)
Stomp extra	85 (MS)	86 (MS)	83 (MS)	84 (MS)	85 (MS)	85MS)	84 (MS)	87 (MS)	86 (MS)
Stomp extra + H.H	89 (MS)	89 (MS)	90 (S)	89 (MS)	89 (MS)	90 (S)	90 (S)	90 (S)	90 (S)

Susceptible (S) = > 90 %. Moderately susceptible (MS) = 80 - 89 % H.H: Hand hoeing
Moderately tolerant (MT) = 60 - 79 %. Tolerant (T) = < 60%

C. Vegetative growth characteristics:

Statistical analysis of the data showed that different weed control treatments significantly affected the vegetative growth characteristics of onion plants at 90 and 120 DAT during 2016/17 and 2017/18 seasons as compared with the unweeded check treatment (Table 5). Consequently, the highest values of plant height, number of leaves per plant, bulb diameter and plant dry weight were obtained from Floro followed by one hand hoeing once at 45 DAT as compared with all the other herbicidal treatments. Meantime, unweeded check listed the lowest values of plant height, number of leaves/ plant, bulb diameter and plant dry weight of onion plants, followed by hand hoeing twice and Stomp extra alone in both seasons. Similar results of application of oxfluorfen in onion were also reported by Gaharwar *et al.* (2017), Ramalingam *et al.* (2017) and kumara *et al.* (2018).

Concerning the effect of planting population, results in Table 5 reflected that plant density significantly affected vegetative growth characters at the different two samples in both seasons. The highest values of number of leaves/ plant, bulb diameter and plant dry weight of onion bulbs were always associated with the lowest planting population (120 thousand plants/fad) followed by 45 and 60 plants/m^2 (180 and 240 thousand plants/fad, respectively) and this trend was correct in the two seasons. These findings could be attributed to the role of competition among plants on the available resources with increasing plant density. Our results are in agreement with the findings of Bardisi *et al.* (2013) and Walle *et al.* (2018).

Results in Table 6 revealed that the interaction between weed management practices and planting population had significant effects on vegetative growth characters of onion at 90 and 120 DAT in the two seasons. The best results for number of leaves/plant, bulb diameter (cm) and plant dry weight (g) were obtained in weed control treatment by Floro at rate of 750 cm^3/fad plus hand hoeing once at 45 DAT with plant density of 120 thousand plants/fad (30 plants/m^2) was applied, whereas the lowest values of this trait were achieved at higher planting density (240 thousand plants/fad) with untreated control in both growing seasons.

Table 5. Plant height (cm), number of leaves per plant, bulb diameter (cm) and plant dry weight (g) of onion plants as affected by different herbicides treatments and planting population at 90 and 120 DAT in 2016/17 and 2017/18 seasons.

Character	2016/17 season								2017/18 season							
	Plant height (cm)		No. of leaves/plant		Bulb diameter(cm)		Plant dry weight (g)		Plant height (cm)		No. of leaves/plant		Bulb diameter(cm)		Plant dry weight (g)	
	Days after transplant (DAT)															
	90	120	90	120	90	120	90	120	90	120	90	120	90	120	90	120
Weed control treatment																
Against	54.09	60.65	5.68	6.60	2.02	5.23	9.94	18.70	52.93	66.23	4.90	7.85	1.88	4.64	8.46	15.55
Against + H.H	62.83	73.07	7.06	7.83	2.47	5.67	11.60	21.40	55.89	73.58	5.67	8.57	2.39	5.16	10.50	19.22
Floro	59.67	67.25	6.03	7.38	2.22	5.35	10.66	19.41	53.89	67.70	5.25	7.97	1.97	4.72	9.01	16.44
Floro + H.H	67.78	78.10	7.30	8.74	2.74	6.28	12.24	22.66	58.13	75.06	6.05	8.75	2.66	5.62	11.60	20.33
Stomp extra	52.84	63.26	5.45	6.34	1.73	5.00	9.01	17.83	51.16	63.34	4.83	7.54	1.68	4.48	8.25	14.18
Stomp extra +H.H	60.18	70.35	6.15	7.56	2.30	5.57	11.28	20.11	55.03	70.95	5.41	8.40	2.15	4.91	9.93	17.09
Hand hoeing twice	49.36	57.31	5.33	6.03	1.47	4.34	7.99	13.27	50.43	60.27	4.28	6.87	1.46	3.91	6.77	11.97
Unweeded check	41.95	52.09	4.62	5.41	1.05	3.44	5.34	5.74	47.11	53.73	3.81	5.50	0.74	3.18	5.09	8.23
$LSD_{(0.05)}$	2.25	2.18	0.22	0.22	0.21	0.17	0.26	0.64	1.84	2.55	0.25	0.31	0.09	0.30	0.36	0.81
Planting population (thousand plants/fad)																
120	53.52	63.41	6.05	7.24	2.21	5.47	10.85	20.28	50.36	62.99	5.33	8.48	1.99	5.27	10.53	17.34
180	55.96	65.21	5.96	6.91	1.99	5.08	9.76	18.37	53.20	64.44	4.90	7.52	1.87	4.63	9.04	15.02
240	58.78	67.17	5.84	6.80	1.80	4.78	8.66	13.51	55.65	71.64	4.85	7.05	1.74	3.83	6.53	13.76
$LSD_{(0.05)}$	2.35	1.92	0.10	0.08	0.19	0.15	0.11	0.51	1.44	2.66	0.21	0.26	0.10	0.22	0.29	0.38

H.H: Hand hoeing

Table 6. Effect of the interaction between some herbicides treatments and planting population on some onion growth characters at 90 and 120 DAT in 2016/17 and 2017/18 seasons.

Weed control treatment	Planting population (thousand plants/fad)	2016/17season						2017/18 season		
		Plant height (cm)	No. of leaves /plant		Bulb diameter(cm)	Plant dry weight (g)		Plant height (cm)	No. of leaves/plant	Plant dry weight (g)
		Day after transplant (DAT)								
		120	90	120	120	90	120	90	90	90
Against	120	59.88	5.72	6.97	5.65	11.72	21.61	50.46	5.34	10.02
	180	60.47	5.70	6.46	5.18	9.91	20.12	52.34	4.45	8.78
	240	61.62	5.63	6.39	4.86	8.21	14.37	55.99	4.93	6.59
Against +Hand hoeing	120	70.58	6.92	8.10	6.09	12.45	26.08	52.59	6.01	13.09
	180	73.16	7.16	7.75	5.71	11.73	21.82	55.47	5.53	10.86
	240	75.46	7.09	7.64	5.23	10.63	16.29	59.60	5.48	7.54
Floro	120	65.82	6.13	7.46	5.66	12.07	22.00	50.51	5.50	10.93
	180	66.85	6.04	7.38	5.31	10.61	20.96	53.75	5.18	9.52
	240	69.09	5.90	7.29	5.08	9.31	15.27	57.41	5.07	6.58
Floro +Hand hoeing	120	77.80	7.25	9.31	6.45	13.19	26.75	53.70	6.70	14.53
	180	79.33	7.53	8.51	6.30	12.32	23.86	58.49	5.95	12.41
	240	77.17	7.13	8.41	6.08	11.22	17.38	62.21	5.50	7.87
Stomp extra	120	62.25	5.58	6.50	5.81	10.19	20.29	50.11	5.03	9.53
	180	63.23	5.40	6.29	4.82	9.09	19.32	52.03	4.80	8.82
	240	64.31	5.37	6.22	4.39	7.76	13.87	51.36	4.66	6.40
Stomp extra +Hand hoeing	120	68.08	6.25	7.73	5.97	12.23	23.25	51.99	5.73	12.39
	180	70.71	6.11	7.54	5.58	11.23	21.67	54.49	5.33	10.30
	240	72.27	6.09	7.42	5.16	10.37	15.42	58.60	5.18	7.09
Hand hoeing twice	120	54.86	5.42	5.99	4.54	8.80	15.34	50.04	4.32	7.65
	180	56.27	5.32	6.17	4.35	7.90	13.69	50.62	4.26	6.99
	240	60.82	5.25	5.94	4.12	7.26	10.76	50.63	4.26	5.68
Unweeded check	120	48.02	5.17	5.95	3.61	6.15	6.97	43.51	3.99	6.07
	180	51.64	4.42	5.18	3.44	5.28	5.52	48.40	3.74	4.67
	240	56.63	4.28	5.10	3.30	4.60	4.73	49.40	3.69	4.53
$LSD_{(0.05)}$		2.81	0.36	0.34	0.29	0.43	1.10	3.06	0.34	0.57

H.H: Hand hoeing

D. Onion bulbs yield:

Weed control treatments significantly increased bulb yield per faddan and its attributes in 2016/17 and 2017/18 seasons (Table 7). These parameters were significantly increased under all weed control treatments as compared to hand hoeing twice treatment or unweeded check. Floro at the rate of 750 cm^3/fad, in combination with hand hoeing once at 45 DAT raised the average bulb weight, marketable and total bulbs yield by about 39.69 g, 11.80 and 10.03 t/fad, respectively in 2016/17 season and these increases raised to be about 59.82 g, 12.42 and 10.50 t/fad, respectively in 2017/18 season as compared with unweeded check treatment with reduction in culls yield, which gave the best results. Finally, use of hand hoeing with herbicides gave the highest values for marketable bulbs yield in the two seasons. Because weed population and weed growth remain less during the entire crop growth, which leads to increase in various growth parameters of onion and the recover in bulb yield. Similar results were obtained by Hussain *et al.* (2008), Kalhapure (2013), Elian *et al*. (2016) and Gaharwar *et al.* (2017) and Ramalingam *et al.* (2017).

For the influence of planting population on the onion crop and its components, data in Table 7 clearly revealed that the differences in these traits between the three plant densities were significant in both seasons. Plant density 180 thousand plants/fad gave the best marketable and total yield/fad followed by 240 thousand plants/fad then 120 thousand plants/fad, in 2016/17 and 2017/18 seasons. The impact of plant density on onion yield showed a similar trend as that number of leaves/plant, bulb diameter and plant dry weight. This result showed a clear positively correlation between early vegetative vigour, due to eliminating competition by weed growth, and plant investment towards enhancing the crop yield. Many investigation *i.e*., Geries *et al.* (2015), Ali *et al.* (2016 a&b) and Abdelmasieh (2017) confirming this conclusion.

Overall, the combined interaction between weed control treatments and planting population 180 thousand plants/fad had the greatest marketable and total yield/fad of onion with the lowest culls weight compared with the other treatments including planting population 120 or 240 thousand plants/fad in the two seasons (Table 8). The highest values of this parameter (18.18 and 17.70 t/fad) and (19.10 and 18.66 t/fad) were registered in planting density 180 thousand plants/fad under Floro at the rate of 750 cm^3/fad + hand hoeing once at 45 DAT in both 2016/17 and 2017/18 seasons, respectively. In contrast, the highest culls yield of onion (3.61 and 3.50 t/fad) was resulted from the unweeded check under planting population 240 thousand plants/fad conditions in two seasons, respectively. The other combined interactions occupied an intermediate position. The superiority of herbicides treatments along with hand hoeing over the untreated control with 180 thousand plants/fad in bulb weight, marketable and total yield might be refer to that onion plants were exposed to low weed competition as a result of eliminating weeds, decreasing weeds which competitive with onion plants for nutritional requirements and the feasibility of maintaining yield with quality in the absence of effective weed control is strongly doubtful.

Table 7. Average bulb weight (g), marketable yield, culls yield and total yield (t/fad) as affected by some herbicides treatments and planting population in 2016/17 and 2017/18 seasons.

Character	2016/17 season				2017/18 season			
	Average bulb weight (g)	Marketable yield (t/fad)	Culls yield (t/fad)	Total yield (t/fad)	Average bulb weight (g)	Marketable yield (t/fad)	Culls yield (t/fad)	Total yield (t/fad)
Weed control treatment								
Against	90.69	12.88	1.60	14.48	75.63	13.77	1.49	15.26
Against + H.H	105.13	15.62	0.99	16.61	93.41	15.36	1.11	16.47
Floro	94.20	13.38	1.38	14.76	80.75	14.10	1.36	15.46
Floro + H.H	112.11	16.43	0.94	17.37	106.96	16.07	0.93	17.00
Stomp extra	87.37	11.74	1.86	13.60	71.60	13.38	1.73	15.11
Stomp extra + H.H	97.44	14.46	1.06	15.52	86.34	14.33	1.24	15.57
Hand hoeing twice	80.84	11.01	2.12	13.13	62.61	12.42	2.11	14.53
Unweeded check	72.42	4.63	2.71	7.34	47.14	3.65	2.84	6.49
$LSD_{(0.05)}$	3.05	0.58	0.20	0.56	3.42	0.41	0.19	0.49
Planting population (thousand plants/fad)								
120	100.24	11.22	0.99	12.22	89.04	11.59	1.10	12.70
180	95.80	13.72	1.66	15.39	79.63	14.06	1.79	15.85
240	81.55	12.60	2.10	14.70	65.31	12.99	1.91	14.91
$LSD_{(0.05)}$	1.94	0.37	0.17	0.31	3.46	0.25	0.16	0.23

Table 8. Average bulb weight (g), marketable yield (t/fad), culls yield (t/fad) and total yield (t/fad) as affected by the interaction between some herbicides treatments and planting population in 2016/17 and 2017/18 seasons.

Weed control treatment	Planting population (thousand plants /fad)	2016/17 season				2017/18 season			
		Average bulb weight (g)	Marketable yield (t/fad)	Culls yield (t/fad)	Total yield (t/fad)	Average bulb weight (g)	Marketable yield (t/fad)	Culls yield (t/fad)	Total yield (t/fad)
Against	120	96.08	11.62	0.91	12.53	87.07	12.55	0.99	13.54
	180	94.03	13.81	1.96	15.77	75.33	14.77	1.66	16.43
	240	81.99	13.22	1.93	15.14	64.50	13.99	1.82	15.81
Against +H.H	120	111.66	13.77	0.51	14.29	102.93	13.46	0.83	14.29
	180	109.96	17.07	1.19	18.26	101.94	17.34	1.20	18.54
	240	93.96	16.03	1.26	17.29	75.37	15.27	1.31	16.58
Floro	120	99.35	12.21	0.87	13.08	94.80	13.07	0.95	14.02
	180	98.17	14.45	1.46	15.91	80.22	15.05	1.62	16.67
	240	85.09	13.47	1.83	15.30	67.24	14.17	1.52	15.69
Floro +H.H	120	125.82	14.44	0.66	15.10	125.79	14.19	0.69	14.88
	180	114.19	18.18	0.93	19.10	107.14	17.70	0.96	18.66
	240	96.32	16.66	1.23	17.89	87.94	16.31	1.14	17.45
Stomp extra	120	93.66	10.54	1.04	11.57	79.34	12.16	1.17	13.33
	180	90.70	13.06	1.91	14.97	72.98	14.31	1.86	16.17
	240	77.75	11.64	2.63	14.26	62.49	13.67	2.16	15.84
Stomp extra +H.H	120	104.72	13.63	0.75	14.38	100.93	13.32	0.91	14.23
	180	100.31	14.98	1.01	15.99	87.55	15.29	1.48	16.77
	240	87.29	14.78	1.43	16.20	70.55	14.39	1.33	15.72
Hand hoeing twice	120	90.17	9.87	1.31	11.18	70.24	11.44	1.40	12.84
	180	83.64	12.66	2.16	14.82	62.89	13.22	2.40	15.61
	240	68.73	10.49	2.90	13.40	53.25	12.61	2.54	15.15
Unweeded check	120	80.47	3.73	1.87	5.59	51.24	2.55	1.91	4.46
	180	75.37	5.62	2.67	8.29	48.97	4.82	3.12	7.94
	240	61.43	4.53	3.61	8.14	41.21	3.58	3.50	7.07
$LSD_{(0.05)}$		5.29	0.89	0.35	0.76	7.36	0.61	0.36	0.71

H.H: Hand hoeing

E. Bulb quality:

The results presented in Table 9 revealed a significant variation between the different treatments. The treatment of Floro plus hand hoeing once exhibited the better results in bulb diameter, T.S.S. and D.M. % of onion. However, seven other herbicides treatments did not provide enough weed control and consequently, the quality of the onion had been reduced due to weed competition. Likewise, Khohlar *et al.*, 2006 and Uygur *et al.*, 2010 found that pendimethalin did not produce any crop response on onion plants.

Data for both seasons indicated that the onion bulb quality under the three evaluated planting population significantly differed (Table 9). The bulb diameter, T.S.S and D.M % for plant density that had been tested were arranged as follows: 120 > 180 > 240 thousand plants/fad in both studied seasons. The explanation of low density on these characters may be attributed to reduce competition for moisture and nutrients at low dense plants that resulted in bulbs with higher bulb weight and bigger diameter, when extra plants are overcrowded per meter, leaves are overlapped at an early stage and the benefits from light interception, on a ground area basis, are eroded. Similar results were obtained by Geries *et al.* (2015), Islam *et al.*(2015), Shock *et al.*(2015), Ali *et al.* (2016 a&b) and Gaharwar *et al.* (2017).

With regard to the interaction of studies factors had significantly affected on bulb diameter in the two seasons as well as total soluble solids percentage and dry matter content in the first and second seasons, respectively (Table 10). The largest bulb with the maximum values of TSS and DM% was produced in plots, which were sprayed with Floro+hand hoeing once under the lowest planting population (120 thousand plants/fad), but the lowest values were produced by unweeded check at higher planting population (240 thousand plants/fad). The results of this experiment suggest that onion crops should be kept weed-free all season long.

F. Storability of onion bulbs:

Data in Table 9 revealed that the differences between weed control treatments were statistically significantly in weight loss% of stored bulbs for six months in the two seasons. Thus, all studied weed control treatments along with hand hoeing treatment were significantly superior to the untreated control and weed control without hand hoeing treatments in both seasons. For this, Floro + hand hoeing once at 45 DAT gave the greatest remaining of marketable bulbs weight after storing (13.62 and 13.67 t/fad) and significantly reduced weight loss percentage more than the unweeded check by about 60.32 and 59.91% after six months of storage in 2016/17 and 2017/18 seasons, respectively.

Regarding the influence of planting density treatment on weight loss and remained of marketable bulbs weight, data presented in Table 9 denoted that there were significant variations among different planting density treatments. After storing for six months, the lowest weight loss with the highest remaining of marketable bulbs weight was achieved by 180 thousand plants/fad following by 120 thousand plants/fad and 240 thousand plants/fad which allowed the lowest weight of remained marketable bulbs. Abdelmasieh (2017) and Abou Khadrah *et al.* (2017) denoted a similar results.

Data in Table 10 indicated also that bulbs weight loss percentage and remained marketable bulbs weight were insignificantly affected by combined interaction between different treatments in the first seasons, except for that in second season. The lowest values of bulbs weight loss% were obtained by Floro followed by one hand hoeing once at 45 DAT under low planting density 120 or 180 thousand plants/fad. This could be explained in terms of increasing vegetative growth due to curbing weed stress, which ultimately lead to improve total yield and its components. (Abdelmasieh, 2017 and Abou Khadrah *et al.*, 2017).

Table 9. Effect of different herbicides treatments and planting population on bulb quality and storability of onion bulbs for six months during 2016/17 and 2017/18 seasons.

Character	2016/17season					2017/18 season				
	Bulb quality			Storability		Bulb quality			Storability	
	Bulb diameter (cm)	TSS %	Dry matter %	Total weight loss %	Remained bulbs (t/fad)	Bulb diameter (cm)	TSS %	Dry matter %	Total weight loss %	Remained bulbs (t/fad)
Weed control treatment										
Against	6.30	14.19	14.76	28.75	9.14	6.37	13.73	15.40	27.84	9.91
Against + Hand hoeing	6.91	15.13	16.18	22.35	12.08	7.32	15.30	17.18	19.94	12.27
Floro	6.57	14.35	15.32	27.51	9.65	6.50	13.98	15.91	24.78	10.58
Floro + Hand hoeing	7.27	15.66	16.66	16.86	13.62	7.42	16.01	18.05	14.78	13.67
Stomp extra	5.89	13.62	14.48	32.74	7.88	6.13	13.49	13.18	31.55	9.12
Stomp extra + Hand hoeing	6.81	14.82	15.62	25.46	10.74	6.74	14.14	16.26	22.89	11.03
Hand hoeing twice	5.39	12.51	13.76	35.69	7.07	5.40	12.42	12.40	33.08	8.28
Unweeded check	3.96	10.34	12.85	42.49	2.64	3.91	11.22	10.61	36.87	2.29
$LSD_{(0.05)}$	0.28	0.49	0.94	4.39	0.68	0.18	1.06	0.32	2.13	0.32
Planting population (thousand plants/fad)										
120	7.34	15.00	15.93	22.47	8.91	7.10	14.65	15.82	20.65	9.37
180	6.32	13.82	14.97	30.17	9.84	6.02	13.97	14.83	25.63	10.65
240	4.75	12.66	13.97	34.30	8.54	5.56	12.74	13.97	33.12	8.92
$LSD_{(0.05)}$	0.21	0.32	0.71	2.81	0.38	0.28	0.92	0.48	1.39	0.27

G- Economic feasibility study:

Table 11 presents the total cost, which calculated as fixed cost (rental cost land preparation, seeding and planting, irrigation, fertilizers, weeding, harvesting, transportation and other expenses) total income and benefit/cost in relation to the different treatments. The main findings of this study show that used of Floro with hand hoeing once at 45 DAT gave the maximum values of economic evaluation. The average of total income per fad of onion yield ranged from about 6282 L.E/fad with minimum B/C ratio of 0.62 which was recorded with low planting density (120 thousand plants/fad) along with unweeded check treatment to about 35881 L.E/fad with maximum B/C ratio of 3.00 when used Floro followed by hand hoeing once at 45 DAT together with planting density

of 180 thousand plants/fad, which led to an increase in total income and net return beside benefit/cost ratio in both seasons. This was a natural result to the reduction occurred on weed growth which reflected positively on crop development consequently, rising economic return. In this concern, Sraw *et al*. (2016), Abdelmasieh (2017), Abou Khadrah *et al.* (2017) and Gaharwar *et al.* (2017) displayed similar findings.

Table 10. Bulb quality and storability of onion bulbs for six months as affected by the interaction between different herbicides treatments and planting population during 2016/17 and 2017/18 seasons.

Weed control Treatment	Planting population (thousand plants /fad)	2016/17 season		2017/18 season			
		Bulb quality		Bulb quality		Storability	
		Bulb diameter (cm)	TSS %	Bulb diameter (cm)	Dry matter %	Total weight loss %	Remained marketable bulbs(t/fad)
Against	120	7.75	15.30	7.43	16.29	21.74	9.83
	180	6.41	14.11	6.22	15.44	27.10	10.77
	240	4.73	13.16	5.46	14.48	34.69	9.13
Against +H.H	120	8.55	16.53	8.13	18.00	14.68	11.49
	180	6.74	14.92	7.20	17.15	17.49	14.29
	240	5.44	13.95	6.62	16.40	27.67	11.04
Floro	120	7.85	15.48	7.52	16.53	17.96	10.72
	180	6.84	14.28	6.28	16.08	23.17	11.56
	240	5.01	13.30	5.70	15.13	33.21	9.47
Floro +H.H	120	8.72	17.30	7.93	18.87	11.58	12.54
	180	7.51	15.32	7.30	18.13	15.51	14.96
	240	5.59	14.35	7.05	17.16	17.26	13.50
Stomp extra	120	6.97	14.75	7.05	14.69	24.63	9.17
	180	6.23	13.79	5.84	12.85	32.84	9.61
	240	4.48	12.30	5.50	12.01	37.19	8.59
Stomp extra +H.H	120	8.04	16.15	7.64	16.96	17.00	11.06
	180	7.23	14.40	6.47	16.33	21.33	12.03
	240	5.16	13.92	6.10	15.49	30.35	10.02
Hand hoeing twice	120	6.41	13.57	6.35	13.82	26.64	8.39
	180	5.54	13.26	5.29	12.19	33.39	8.80
	240	4.23	10.70	4.56	11.19	39.22	7.66
Unweeded check	120	4.42	10.90	4.73	11.41	30.96	1.76
	180	4.08	10.47	3.52	10.47	34.24	3.17
	240	3.37	9.64	3.47	9.94	45.41	1.95
$LSD_{(0.05)}$		0.60	0.80	0.36	0.54	3.29	0.64

Table 11. Effect of some herbicides treatments and planting population on economic analysis of onion (Combined data of two years).

Weed control treatment	Planting population (thousand plants/fad)	Total Costs (L.E./fad)	Total income (L.E./fad)	Net farm return (L.E./fad)	Benefit/Cost ratio (B/C)
Against	120	10850	24171	13321	2.23
	180	10900	28581	17681	2.62
	240	10950	27212	16262	2.49
	Mean	10900	26655	15755	2.45
Against +H.H	120	12350	27231	14881	2.20
	180	13900	34411	20511	2.48
	240	15450	31301	15851	2.03
	Mean	13900	30981	17081	2.23
Floro	120	10475	25281	14806	2.41
	180	10525	29501	18976	2.80
	240	10575	27641	17066	2.61
	Mean	10525	27474	16949	2.61
Floro +H.H	120	11975	28631	16656	2.39
	180	12025	35881	23856	3.00
	240	12075	32971	20896	2.73
	Mean	12025	32494	20469	2.70
Stomp extra	120	10820	22701	11881	2.10
	180	10870	27372	16502	2.52
	240	10920	25312	14392	2.32
	Mean	10870	25128	14258	2.31
Stomp extra +H.H	120	12320	26951	14631	2.19
	180	13870	30271	16401	2.18
	240	15420	29171	13751	1.89
	Mean	13870	28798	14928	2.08
Hand hoeing twice	120	13100	21311	8211	1.63
	180	13150	25882	12732	1.97
	240	13200	23102	9902	1.75
	Mean	13150	23432	10282	1.78
Unweeded check	120	10100	6282	-3818	0.62
	180	10150	10442	292	1.03
	240	10200	8113	-2087	0.80
	Mean	10150	8279	-1871	0.82
Planting population (thousand plants/fad)	120	11499	22820	11321	1.98
	180	11924	27793	15869	2.33
	240	12349	25603	13254	2.08

H.H: Hand hoeing

Correlation study:

Correlation coefficient estimations were done for some characters studied over the two seasons (Table 12). Significant positive correlations were recorded among dry weight of broadleaf, grassy and total weeds and culls yield/fad. The values of the correlation coefficient between dry weight of broadleaf, grassy and total weeds at 90 DAT and each of average bulb weight, marketable yield/fad, total bulbs yield and remaining of marketable bulbs weight after storing for six months were negative and significant, while the correlations between bulb weight and each of marketable yield/fad, total bulbs yield and remaining of marketable bulbs weight after storing for six months were significant and positive. Also, correlation analysis revealed that the yield increases as a result of decreased weed competition which positively contributed to the increases in growth characters and yield components. The correlation between dry weight of grasses, broadleaved, total species and onion yield was statistically significant and negative. The correlation among marketable yield/fad and each of total bulbs yield and remaining of marketable bulbs weight after storing for six months was significant and positive. While, Correlation among marketable yield/fad and culls yield/fad was significant and negative. Hence, weed control plays a major role in increasing onion productivity and its quality, however these features are conditional; if applied at the suitable time, rate and stage of weed growth.

Table 12. Correlation coefficient between some studied characteristics and onion yield and its components, (combined data of 2016/17 and 2017/18 seasons).

Studied characteristics	Dry weight of grassy weeds (g/m^2)	Dry weight of total weeds (g/m^2)	Bulb weight (g)	Marketable yield (t/fad)	Culls yield (t/fad)	Total yield (t/fad)	Remained marketable bulbs (t/fad)
Dry weight of broad-leaved weeds (g/m^2)	0.98**	0.99**	-0.56**	-0.91**	0.54**	-0.90**	-0.83**
Dry weight of grassy weeds (g/m^2)		0.98**	-0.52**	-0.90**	0.51**	-0.89**	-0.81**
Dry weight of total weeds (g/m^2)			-0.55**	-0.91**	0.54**	-0.89**	-0.83**
Bulb weight (g)				0.66**	-0.86**	0.55**	0.83**
Marketable yield (t/fad)					-0.62**	0.98**	0.95**
Culls yield (t/fad)						-0.47**	-0.75**
Total yield (t/fad)							0.89**

**** Correlation is highly significant at 1% probability.**

CONCLUSION

In conclusion, integration of herbicides with manual weeding and the proper plant density exhibited excellent weed control efficiency coupled with good outcome on yield productivity. From the results of the present study it can be concluded that the use of integration between Floro EC 24% (750 cm^3/fad; 21 days after transplanting) in combination with hand hoeing once (45 DAT) plus plant density of 180 thousand plants/fad performed comparatively well than any other treatment at all levels, and is strongly suggested to the onion's farmers of this area.

REFERENCES

Abdelmasieh, W.K.L. (2017). Onion productivity and quality as influenced by planting date, method and density. Ph.D. Thesis, Fac. Agric., Kafrelsheikh Univ., Egypt.

Abou Khadrah, S.H.; A. A. El-Sayed; L. S. M. Geries and W.K.L. Abdelmasieh (2017). Response of onion yield and quality to different planting date, methods and density. Egypt.J.Agron., 39(2):203 – 219.

Ali, L.; M.W. Hassan; M. Jamil; J. Iqbal; M.S. Yaqub; M. Akram; I. Ahmed and A. Hussain (2016 a). Effect of nursery bulb size and planting density on Thirps population, plant height and yield of onion (Phulkara variety) in Bahawalpur, Pakistan. Pak. J. Life Soc. Sci., 14(2): 96-103.

Ali, M.; A. Rab; J. Ali; H. Ahmad; S. Hayat; K. Wali; A. Rashid; W. Ahmad and H. Muhammad (2016 b). Influence of transplanting dates and population densities on the growth and yield of onion. Pure Appl. Biol., 5(2):345-354.

Bardisi, Samar A.; E.A. El-Ghamriny; A.A. Gad and Nawar, A.S. Dalia (2013). Bulbing ratio and dry weight of onion plant grown in sandy soil as affected by planting date, planting distance and potassium fertilizer rate. Zagazig J. Agric. Res., 40(3): 399-410.

Chandrika, V., Reddy, D. Srinivasulu, K. Sagar, G. Reddy and Prabhakara (2009). Influence of graded levels of nutrients, time of N application and weed management practices on weed dynamics, yield attributes and bulb yield of onion (*Allium cepa* L.). Indian J. of Weed Sci., 41(1&2): 80–89.

Channapagoudar, B.B. and N. R. Biradar (2007). Physiological studies on weed control efficiency in direct sown onion. Karnataka J. Agri. Sci., 20(2): 375–76.

Cimmyt (1988). "From Agronomic Data to Farmer Recommendation: An Economic Work Book" D.F: pp. 31- 33.

Elian, H. M. A.; G. A. Sary; A. Roshdy; N. Kh. El-Gizawy; M. R. Moshtohry and S. D. M. Eid (2016). Effect of weed control and N, K fertilizers on productivity of onion (*Allium cepa,* L.) and associated weeds under new land soils. Am-Euras. J. Agric. & Environ. Sci., 16 (2): 348-356.

Frans, R.E. and R. Talbet (1977). Design of field experminent and the measurement and analysis of plant response. Res. Methods in Weed Sci. Soc. Field. South. USA, Aburn, Alabama.

Gaharwar, A. M.; N. Patil and D. Ughade (2017). Effect of integrated weed management on growth, yield and economic returns on onion (*Allium cepa,* L.). Asian J. Hort., 12(2): 193-197.

Geries, L. S. M.; E. A. Moursi and A.M.A. Abo – Dahab (2015). Effect of irrigation levels, cultivation methods and plant densities on productivity, quality of onion crop and some water relations in heavy clay soils. J. Soil Sci. and Agric. Eng., Mansoura Univ., 6(12): 1467 – 1495.

Gomez, K. A. and A. A. Gomez (1984). Statistical procedures for agricultural research (Second Ed.) John Willey and Sons, New York, pp: 680.

Hussain, Z.; K. B. Marwat; A. Shah; S. A. Arifullah and N. M. Khan (2008). Evaluation of different herbicides for weed control in onion. Sarbad, J.Agric., 24 (3): 453-456.

Islam, M. R.; A. Mukherjee; K.G. Quddus; P. K. Sardar and M. Hossain (2015). Effect of spacing and fertilizer on the growth and yield of onion. Int. J. Sci. Tech. Res., 4(10): 308 – 312.

Jackson, M. I. (1973). Soil Chemical Analysis. Prentice Hall of India Private, LTD New Delhi.

Jilani, M. S.; M. Ramzan and K.Waseem (2007). Impact of weed management practices on growth and yield of some local genotypes of onion. Pak. J. weed Sci. Res., 13 (3-4) 191-198.

Kalhapure , A. H; B. T. Shete and D. Madhukar (2014). Weed management in onion by pre-planting and post-emergence herbicides for seed production. Indian J. Weed Sci., 46(2):142-145.

Kalhapure, A. H. and B. T. Shete (2012). Integrated weed management in onion.Indian J. Weed Sci., 44(2): 88-91.

Kalhapure, A.H., Shete, B.T. and P.S. Bodake (2013). Integarted weed management in onion (*Allium cepa*, L.). Indian J. Agron., 58 (3): 408-411.

Khokhar, K. M., T. Mahmood, M. Shakeel and M. F. Chaudhry (2006). Evaluation of integrated weed management practices for onion in Pakistan. Crop Protection, 25: 968–972.

Klute, A. C. (1986). Water retention: Laboratory Methods, In:A. Koute(ed.), Methods of Soil Analysis, part 1-2nd(ed.)Agron Monogr.9, ASA, Madison, W, USA, pp.635-660.

Kumara, S., S. Das, R. Kumar and Kavita (2018). Herbicide mixture for enhancing weed control efficiency and yield of onion (*Allium cepa,* L.). Int.J.Curr.Microbiol.App. Sci., Special Issue-7: 2710-2714.

Ramalingam, S. P.; C. Chinnagounder; M. Perumal and M. A. Palanisamy (2017). Evaluation of new formulation of oxyfluorfen (23.5% EC) for weed control efficacy and bulb yield in onion. American Journal of Plant Sciences, 4: 890-895.

Shock, C.C.; E.B.G. Feibert; A. Riveira and L. D. Saunders (2015). Response of onion yield, grade, and financial return to plant population and irrigation system. Hort Science, 50(9): 1312-1318.

Sraw, P. K.; B. Kaur, A. Kaur and K. Singh (2016). Efficacy of different herbicides for controlling weeds in onion. Journal of Crop and Weed, 12(1):125-128.

Steel, R. G. D. and Jour. H. Torrie (1980). Principles and Procedures of Statistics. MC. Graw Hill Book Company Inc. New York, 481 pp.

Swaify, N. G. (2009). Studies on weed control in onion, Ph.D. Theses, Fac. Agric., Al-Azhar Univ., Cairo, Egypt.

Uygur, S., R. Gurbuz and F.N. Uygur (2010). Weeds on onion fields and effects of some herbicides on weeds in Cukurova region, Turkey. African J. Biotechnol. 9:7037–7042.

Walle, T., N. Dechassa and K. Tsadik (2018). Yield and yield components of onion (*Allium cepa*, var. cepa) cultivars as influenced by population density at Bir Sheleko, North-Western Ethiopia. Acad. Res. J. Agri. Sci. Res., 6(3):172-192.

كفاءة طرق مكافحة الحشائش وكثافة الزراعة والجدوي الأقتصادية علي مكافحة الحشائش وأنتاجية محصول البصل

لبيب صبحى ميخائيل جريس[1] و عزة السيد أحمد خفاجي[2]

[1] قسم بحوث البصل - معهد بحوث المحاصيل الحقلية -مركز البحوث الزراعية – الجيزة - مصر.

[2] المعمل المركزى لبحوث الحشائش –مركز البحوث الزراعية –الجيزة– مصر.

أجريت تجربة حقلية بمحطة البحوث الزراعية بسخا – محافظة كفرالشيخ – خلال الموسمين 2017/2016 م و 2017/ 2018 وذلك بهدف دراسة تأثيرمعاملات مكافحة الحشائش المختلفة وبعض كثافات الزراعة علي محصول البصل وقد أستخدم تصميم الشرائح المتعامدة فى اربع مكررات بحيث وزعت ثمانى مبيدات حشائش على القطع الافقيه (أجينست منفردا, أجينست + عزقة بعد 45 يوم من الشتل, فلورو منفردا, فلورو + عزقة بعد 45 يوم من الشتل, ستومب أكسترا منفردا, ستومب أكسترا + عزقة بعد 45 يوم من الشتل, العزيق مرتين بالأضافة لمعاملة المقارنة) - كذلك ثلاث معاملات من الكثافة النباتية في القطع العمودية وهي (120 ,180 ,240 الف نباتاً /فدان) لمكافحة الحشائش الحولية المصاحبة للبصل. وأثر ذلك علي النمو الخضرى و المحصول ومكوناته والجودة تحت ظروف منطقة شمال الدلتا وفيما يلى أهم النتائج المتحصل عليها: أظهرت النتائج ان معاملات مكافحة الحشائش والكثافة النباتية كان لهما تأثير معنوى علي انخفاض الوزن الجاف للحشائش الحولية العريضة والضيقة والكلية وزيادة في محصول الابصال مع كل معاملات مكافحة الحشائش تحت الدراسة . وأوضحت النتائج افضل أنخفاض فى الوزن الجاف للحشائش الكلية وزيادة فى محصول الابصال الكليه والتسويقية مع زيادة جودة الابصال باستخدام معاملة الرش بمبيد فلورو بمعدل 750 سم^3/فدان + عزقة بعد 45يوم من الشتل. وكانت اعلي نسبة أنخفاض فى الوزن الجاف للحشائش الحولية العريضة والضيقة الأوراق والكلية (97.08, 96.39 %) , (90.5, 90.5 %) ,(96.20, 95.20 %) عند 60 , 90 يومًا بعد الشتل فى كلا الموسمين2017/2016م و2018/2017م على الترتيب مقارنة بمعاملة الكنترول . وأيضا أعطيت هذة المعاملة أعلى متوسط لوزن البصلة ومحصول الأبصال القابلة للتسويق والكليه بنحو 45.67, 74.56 , 59.78 مقارنتا بمعاملة الكنترول على التوالى بكل من الموسمين مع زيادة القدرة التخزنية للابصال بجودة عالية وهذا أثبات على أهمية مكافحة الحشائش فى حقول البصل . أوضحت النتائج أن الكثافه النباتية قد أثرت معنويا علي الوزن الجاف للحشائش الحولية مقارنة بمعاملة الكنترول . فقد أدى الشتل بالكثافة النباتية 180 الف نباتاً /فدان الى زيادة المحصول التسويقى والكلى بمعدل17.89 ,20.24 % وانخفاض فى الوزن الكلى للحشائش بالمتر المربع عند 60 و 90 يومًا بعد الشتل بنحو 25.51 و 25.77 % مقارنتا بالكثافة النباتية 120 الف نباتاً /فدان فى كل من الموسمين على الترتيب. بينما كانت أعلى القيم لكل من المواد الصلبة الذائبة الكلية وكذلك النسبة المئوية للمادة الجافة ووزن الأبصال القابلة للتسويق المتبقية بعد التخزين لمدة ستة أشهر تحت كثافة 120 أو 180 الف نباتاً /فدان. وكان معامل الارتباط سالباً وعالى المعنوية بين المحصول الكلى للأبصال ومحصول الأبصال القابلة للتسويق وكل من الوزن الجاف للحشائش الحولية العريضة والضيقة الأوراق والكلية ومحصول النقضة. وتوصى الدراسة بأستخدام مبيد فلورو بمعدل 750 سم^3/فدان + عزقة بعد 45 يوم من الشتل بكثافة نباتية متوسطة (180 الف نباتاً /فدان) وذلك للحصول على أعلى محصول بوحدة المساحه بجودة عاليه وزيادة العائد الاقتصادى مع زيادة القدرة التخزنيه للابصال.