Performance of different herbicides and their combinations on weed control, growth and yield parameters of onion (*Allium cepa* L.)

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**ABSTRACT**

Two experiments were carried out to study the efficacy of herbicides with different rates for controlling broadleaf and narrow leaves weeds, growth and yield parameters of onion. The treatments of herbicides applied include the single of active ingredient and their combinations. The single of active ingredient such as Oxyfluorfen at the dose of 270; 180; and 90 g a.i./fed, Clethodim at the dose of 93.75; 62.5; and 31.25 g a.i./fed. The combination used the Oxyfluorfen + Clethodim such as 270+93.75; 180+62.5; and 90+31.25 g a.i./fed. Results showed that Weed control efficiency (WCE) for broadleaves species the maximum percent was recorded for Oxyfluorfen (270 g a.i./fed). In controlling narrow leaves weed species, the maximum percent was recorded in Clethodim (93.75 g a.i./fed). While controlling broadleaf and narrow leaves weeds, the maximum percent was recorded in Oxyfluorfen + Clethodim (270+93.75 g a.i./fed). Growth, and yield parameters as plant height, bulb weight and bulb diameters were recorded maximum in Clethodim (93.75 g a.i./fed). While controlling broadleaf and narrow leaves weeds, the maximum percent was recorded in Oxyfluorfen + Clethodim (270+93.75 g a.i./fed). Growth, and yield parameters as plant height, bulb weight and bulb diameters were recorded maximum in Oxyfluorfen + Clethodim (270+93.75 g a.i./fed). We suggest that the best treatment was Oxyfluorfen + Clethodim (270+93.75 g a.i./fed) for controlling all species of weeds in the onion plant.

**KEYWORDS**

Clethodim, Combinations, Oxyfluorfen, Weeds

**Introduction**

Onion, *Allium cepa* L. belonging to the family Alliaceae one of the important bulbous vegetable crop of economic importance and widely cultivated all over the world (Prakash et al. 2000; Ramalingam et al. 2013). Onion is one of the most important field and vegetable crops for both local or export market in Egypt (Ghalwash et al. 2008). Onion is inherently a poor competitor with weeds because of its narrow leave morphology, slow growth, and small leaf canopy (Bond...
Weed competes with crops for water, nutrients and light so weed infestation is one of the major threats to crop (Fahad et al. 2013). Weeds are one of the most important problems in onion (Allium cepa L.) production areas (Uygur et al. 2010). Modern agricultural production depends considerably on the use of herbicides to control weeds in crops (Tadeo et al. 2000). Evaluating appropriate herbicidal combination and their optimum doses and proper time of application is a potential solution for effective weed management in this crop (Patel et al. 2012), there is need to evaluate the efficacy of grass killers in different crop ecosystems. It is also necessary to work out the efficacy of newer herbicides whenever developed in terms of their effect on weed flora, phytotoxicity to the main crop as well as on the succeeding crops under varied agro-climatic situations before recommending them to the farming community. The objective of this research was to evaluate response of different treatment of herbicides applied include the single of active ingredient and their combinations on weed control, growth, and yield parameters of onion.

Materials and Methods

Experimental area and procedures used cultivars: Two field experiments were carried out at farm of Faculty of Agriculture, Al Azhar University, Assiut in 2014/2015 and 2015/2016 seasons. Giza 6 cultivar was used in all studies and obtained from Shandaweel Research Station.

Experimental design and treatments: Each plot in bulb onion experiments consisted of 3×3.5 m², 15 rows×3.5 long and 20 cm. apart, with transplants spaced 7 cm apart 1/400 from Feddan. Sowing dates were November 15th, 18th in the first and second season. Both of the experiment used the Randomized complete block (RCB) design was used with three replications having eight treatments in each replication.

Herbicide used: Clethodim: Select super® 12.5% EC ((±)-2-[(E)-1-[(E)-3-chloroallyloxyimino]propyl]-5-[2 (ethylthio) propyl]-3-hydroxycyclohex-2-enone). Oxyfluorfen: Goal 24% EC (2-chloro-α,α,α-trifluoro-p-tolyl 3-ethoxy-4-nitrophenyl ether).

Herbicide treatments: Oxyfluorfen (270, 180 and 90) a.i. g/fed; Clethodim (93.75, 62.5 and 31.25) g a.i./fed; Oxyfluorfen+Clethodim (270+93.75, 180+62.5 and 90+31.25) a.i. g/fed.

Weed parameters

Weed Density: The density of narrow and broadleaf weeds was recorded at 30 and 60 days after treatment. The weed count was recorded species wise using one square meter from each plot in the experiments.

Total fresh weight of weeds: Weeds were sprayed at 30 and 60 days after transplanting. Weed species in each plot were isolated and then weed plants were cleaned from mud and fresh weight of weeds was measured by scale.
Total dry weight of weeds: After scaling fresh weight, weeds were putted at oven with temperature of 70°C for 48 hours (Mirshekari and Karimi, 2015).

Weed control efficiency (WCE): Weed population was counted before harvesting (transplanting) in each treatment and weed control efficiency was calculated by the formula as suggested by (Mani et al. 1973).

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\text{Weed control efficiency} = \frac{WPC}{WPT} \times 100
\]

Where: WPC = Weed population in control WPT = Weed population in treatment.

Vegetative characteristics: Plant height (cm): Height of plant was measured in centimeters from ground level to tip.

Bulb weight: Average bulb weight was worked out and expressed as grams and bulb diameter (cm).

Bulb diameter (cm): The diameter of onion bulbs was determined using vernier calliper and the average bulb diameter was calculated

Total bulb yield (kg/plot): The crop was harvested and bulbs of each plot were weighted in kilogram

Statistical Analysis

All studied data were statistically analyzed according to the procedures outlined by (Gomez and Gomez, 1984) and the treatments mean were compared by least significant range according to (Duncan, 1955).

Results and Discussion

Effect of oxyfluorfen herbicides on broadleaf weed density in 2014/2015 season:

As showed in Table 1, At 30 days after oxyfluorfen (270 a.i g/fed) application, the minimum decreased significant density was recorded in A. majus with (0.67), C. endivia with (0.67), P. major with (0.67), A. viridis with (1), M. parviflora with (1), S. marianum with (1), C. arvensis with (1), R. dentatus with (1.33), C. ambrosioides with (1.67), S. oleraceus with (1.67). At 60 days after oxyfluorfen (270 a.i g/fed) application, the minimum decreased significant density was recorded in A. majus with (2.67), C. ambrosioides with (3), R. dentatus with (3.33), S. marianum with (3.33), C. arvensis with (3.33), C. endivia with (3.67), P. major with (3.67), A. viridis with (4), M. parviflora with (5.33) and S. oleraceus with (5.33). The pre-emergence application of oxyfluorfen at 250 g ha-1controlled weeds effectively but resulted in lower yield because of its higher phytotoxicity on onion crop and it was only for a short period. Severity of the symptoms increased in onion with increase in rate of herbicide application and symptoms were visible up
to 30 DAS when the herbicide was applied at higher dose of 400 g ha-1. The crop injury was transient and appeared stunted for one month, after that the crop appeared normal (Sathyapriya et al. 2013). At 30 days after oxyfluorfen (180 a.i g/fed) application, the minimum decreased significant density was recorded in *C. endivia* with (1), *P. major* with (1), *S. marianum* with (1), *C. arvensis* with (1), *A. majus* with (1.33), *C. ambrosioides* with (1.33), *M. parviflora* with (1.33), *R. dentatus* with (1.33), *S. oleraceus* with (1.33) and *A. viridis* with (2). At 60 days after oxyfluorfen (180 a.i g/fed) application, the minimum decreased significant density was recorded in *R. dentatus* with (5.33), *C. ambrosioides* with (5.67), *A. majus* with (6), *C. endivia* with (6), *C. arvensis* with (6), *A. viridis* with (6.67), *P. major* with (7.67), *S. marianum* with (8), *M. parviflora* with (8.33) and *S. oleraceus* with (9.33).

Hand hoeing at 30 days, the minimum decreased significant density was recorded in *Chenopodium ambrosioides*, *Plantago major*, *Silybium marianum* and *Convolvulus arvensis* with (0.33), *Amaranthus viridis* and *Cichorium endivia* with (0.67), *Rumex dentatus* with (1), *Ammi majus* and *Malva parviflora* with (1.33) and *Sonchus oleraceus* with (1.67). While, hand hoeing at 60 days, the minimum decreased significant density was recorded in *Convolvulus arvensis* with (3.33), *Plantago major* with (3.67), *Silybium marianum* with (4), *Chenopodium ambrosioides* with (4.33), *Cichorium endivia* with (4.67), *Ammi majus* with (5.67), *Malva parviflora* with (5.67), *Rumex dentatus* with (5.67), *Sonchus oleraceus* with (5.67), *Amaranthus viridis* with (6).

**Effect of oxyfluorfen herbicides on broadleaf weed density in 2015/2016 season:**

As showed in Table 2, At 30 days after oxyfluorfen (270 a.i g/fed) application, the minimum decreased significant density was recorded in *P. major* with (0.67), *A. majus* with (0.67), *A. viridis* with (1), *C. endivia* with (1), *M. parviflora* with (1), *S. marianum* with (1), *C. ambrosioides* with (1.33), *R. dentatus* with (1.33), *S. oleraceus* with (1.33) and *C. arvensis* with (1.33). At 60 days after oxyfluorfen (270 a.i g/fed) application, the minimum decreased significant density was recorded in *A. majus* with (4), *C. ambrosioides* with (4.67), *C. endivia* with (5), *S. marianum* with (5), *C. arvensis* with (5), *R. dentatus* with (5.67), *A. viridis* with (6), *P. major* with (6), *M. parviflora* with (7.33) and *S. oleraceus* with (7.33). At 30 days after oxyfluorfen (180 a.i g/fed) application, the minimum decreased significant density was recorded in *A. majus* with (1), *C. endivia* with (1), *M. parviflora* with (1), *P. major* with (1), *C. arvensis* with (1), *R. dentatus* with (1.33), *S. marianum* with (1.33), *S. oleraceus* with (1.33), *A. viridis* with (1.67) and *C. ambrosioides* with (1.67). At 60 days after oxyfluorfen (180 a.i g/fed) application, the minimum decreased significant density was recorded in *C. endivia* with (6.67), *C. ambrosioides* with (7.67), *C. arvensis* with (8.33), *A. viridis* with (8.67), *R. dentatus* with (8.67), *A. majus* with (8.67), *S. marianum* with (9), *M. parviflora* with (9.33), *P. major* with (9.67) and *S. oleraceus* with (11).
Table 1. Effect of herbicide treatments on broadleaf weeds density (m\(^2\)) at 30 and 60 DAT during 2014/2015 season.

| Weed species | Oxyfluorfen | Hand hoeing | Control % |
|--------------|-------------|-------------|-----------|
|              | 270 (a.i g/fed) | 180 (a.i g/fed) | 90 (a.i g/fed) |
|              | 30 DAT 60 DAT | 30 DAT 60 DAT | 30 DAT 60 DAT | 30 DAT 60 DAT | 30 DAT 60 DAT |
| A. viridis   | 1.00 4.00 2.00 6.67 10.67 19.33 | 0.67 6.00 16.66 45.66 |
| A. majus     | 0.67 2.67 1.33 6.00 16.00 22.00 | 1.33 5.67 26.00 37.33 |
| C. ambrosioides | 1.67 3.00 1.33 5.67 9.00 13.33 | 0.33 4.33 7.33 32.00 |
| C. endivia   | 0.67 3.67 1.00 6.00 4.33 9.67 | 0.67 4.67 8.33 30.33 |
| M. parviflora | 1.00 5.33 1.33 8.33 15.00 22.00 | 1.33 5.67 26.66 41.33 |
| P. major     | 0.67 3.67 1.00 7.67 5.33 11.33 | 0.33 3.67 6.66 21.33 |
| R. dentatus  | 1.33 3.33 1.33 5.33 10.33 14.67 | 1.00 5.67 16.33 29.66 |
| S. marianumt | 1.00 3.33 1.00 8.00 4.33 11.33 | 0.33 4.00 7.00 25.00 |
| S. oleraceus | 1.67 5.33 1.33 9.33 14.00 19.00 | 1.67 5.67 25.00 40.33 |
| C. arvensis  | 1.00 3.33 1.00 6.00 5.33 10.33 | 0.33 3.33 6.33 21.00 |
| LSD 0.05     | 0.214 0.354 0.254 19.061 6.346 | 0.932 0.014 11.354 1.369 |

Table 2. Effect of herbicide treatments on broadleaf weeds density (m\(^2\)) at 30 and 60 DAT during 2015/2016 season.

| Weed species | Oxyfluorfen | Hand hoeing | Control % |
|--------------|-------------|-------------|-----------|
|              | 270 (a.i g/fed) | 180 (a.i g/fed) | 90 (a.i g/fed) |
|              | 30 DAT 60 DAT | 30 DAT 60 DAT | 30 DAT 60 DAT | 30 DAT 60 DAT | 30 DAT 60 DAT |
| A. viridis   | 1.00 6.00 1.67 8.67 11.33 22.67 | 1.67 7.33 17.00 50.00 |
| A. majus     | 0.67 4.00 1.00 8.67 13.33 25.00 | 1.67 7.00 27.00 43.33 |
| C. ambrosioides | 1.33 4.67 1.67 7.67 4.33 17.67 | 1.33 5.33 8.33 36.33 |
| C. endivia   | 1.00 5.00 1.00 6.67 5.00 12.33 | 1.33 5.67 8.00 39.00 |
| M. parviflora | 1.00 7.33 1.00 9.33 14.33 25.00 | 2.33 6.33 26.66 45.33 |
| P. major     | 0.67 6.00 1.00 9.67 5.00 16.00 | 0.67 5.33 8.00 28.33 |
| R. dentatus  | 1.33 5.67 1.33 8.67 11.00 21.00 | 2.00 6.33 18.00 40.33 |
| S. marianumt | 1.00 5.00 1.33 9.00 5.00 15.33 | 0.67 4.67 8.00 30.33 |
| S. oleraceus | 1.33 7.33 1.33 11.00 14.33 25.33 | 2.67 7.33 27.33 46.66 |
| C. arvensis  | 1.33 5.00 1.00 8.33 5.00 14.33 | 0.67 4.33 7.00 24.00 |
| LSD 0.05     | 0.770 0.458 0.362 2.358 28.245 7.821 | 0.827 1.530 23.821 57.304 |
Hand hoeing at 30 days, the minimum decreased significant density was recorded in *Plantago major* with (0.67), *Silybium marianum* with (0.67), *Convonvulus arvensis* with (0.67), *Chenopodium ambrosioides* with (1.33), *Cichorium endivia* with (1.33), *Amaranthus viridis* with (1.67), *Ammi majus* with (1.67), *Rumex dentatus* with (2), *Malva parviflora* with (2.33) and *Sonchus oleraceus* with (2.67). Oxyfluorfen, significantly reduced the weed population and increased onion yield to levels comparable to yields of weeded control (Sanjeev et al. 2003). While, hand hoeing at 60 days, the minimum decreased significant density was recorded in *Convonvulus arvensis* with (4.33), *Silybium marianum* with (4.67), *Chenopodium ambrosioides* with (5.33), *Plantago major* with (5.33), *Cichorium endivia* with (5.67), *Malva parviflora* with (6.33), *Rumex dentatus* with (6.67), *Ammi majus* with (7), *Amaranthus viridis* with (7.33) and *Sonchus oleraceus* with (7.33).

**Effect of clethodim herbicides on narrow leaves weed density in 2014/2015 and 2015/2016 seasons:**

Data in Tables 3 and 4 shows the effect of clethodim (93.75, and 62.5 a.i g/fed), herbicide with three rates on narrow leaves weed density in 2014/2015 season, weed density of was recorded at 30 and 60 days after application. At 30 days after clethodim (93.75a.i g/fed) application, the minimum decreased significant density was recorded in *L. temulentum* with (3), *A. fatua* with (4.33), *C. dactylm* with (5), *P. monspeliensis* with (5.33) and *C. rotundus* with (10). At 60 days after clethodim (93.75a.i g/fed) application, the minimum decreased significant density was recorded in *L. temulentum* with (6.33), *C. dactylm* with (6.67), *A. fatua* with (7.33), *P. monspeliensis* with (7.67) and *C. rotundus* with (14). At 30 days after clethodim (62.5 a.i g/fed) application, the minimum decreased significant density was recorded in *L. temulentum* with (4), *A. fatua* with (5.33), *P. monspeliensis* with (5.33), *C. dactylm* with (5.67) and *C. rotundus* with (9.33). At 60 days after clethodim (62.5 a.i g/fed) application, the minimum decreased significant density was recorded in *C. dactylm* with (8), *L. temulentum* with (10.33), *P. monspeliensis* with (11), *A. fatua* with (12.67) and *C. rotundus* with (15). At 30 days after clethodim (31.25 a.i g/fed) application, the minimum decreased significant density was recorded in *L. temulentum* with (6), *C. dactylm* with (8.67), *P. monspeliensis* with (9), *A. fatua* with (13.33) and *C. rotundus* with (19.33). At 60 days after clethodim (31.25 a.i g/fed) application, the minimum decreased significant density was recorded in *L. temulentum* with (11.67), *C. dactylm* with (12.67), *P. monspeliensis* with (16), *A. fatua* with (24.67) and *C. rotundus* with (29) compared with control.
Table 3. Effect of herbicide treatments on narrow leaved weeds density (m$^2$) at 30 and 60 DAT during 2014/2015 season.

| Weed species | Clethodim 93.75 (ai g/fed) | Clethodim 62.5 (ai g/fed) | Clethodim 31.25 (ai g/fed) | Hand hoeing | Control % |
|--------------|-----------------------------|---------------------------|-----------------------------|-------------|-----------|
|              | 30 DAT                      | 60 DAT                    | 30 DAT                      | 60 DAT      | 30 DAT    | 60 DAT    | 30 DAT    | 60 DAT |
| A. fatua     | 4.33                        | 7.33                      | 5.33                        | 12.67       | 13.33     | 24.67     | 1.33      | 5.00   | 19.33    | 41.66    |
| L. temulentum| 3.00                        | 6.33                      | 4.00                        | 10.33       | 6.00      | 11.67     | 1.66      | 4.33   | 7.66     | 27.66    |
| P. monspeliensis| 5.33                       | 7.67                      | 5.33                        | 11.00       | 9.00      | 16        | 0.67      | 5.00   | 12.66    | 38       |
| C. dactylm   | 5.00                        | 6.67                      | 5.67                        | 8.00        | 8.67      | 12.67     | 0.66      | 4.33   | 10.66    | 26.33    |
| C. rotundus  | 10.00                       | 14.00                     | 9.33                        | 15.00       | 19.33     | 29.00     | 1.67      | 5.33   | 35.66    | 49.00    |
| LSD 0.05     | 11.718                      | 7.621                     | 1.982                       | 3.071       | 7.251     | 3.871     | 2.760     | 22.521 | 11.341   | 12.831   |

Table 4. Effect of herbicide treatments on narrow leaved weeds density (m$^2$) at 30 and 60 DAT during 2015/2016 season.

| Weed species | Clethodim 93.75 (ai g/fed) | Clethodim 62.5 (ai g/fed) | Clethodim 31.25 (ai g/fed) | Hand hoeing | Control % |
|--------------|-----------------------------|---------------------------|-----------------------------|-------------|-----------|
|              | 30 DAT                      | 60 DAT                    | 30 DAT                      | 60 DAT      | 30 DAT    | 60 DAT    | 30 DAT    | 60 DAT |
| A. fatua     | 5.33                        | 10.67                     | 6.00                        | 14.67       | 14.00     | 27.00     | 1.67      | 6.00   | 21.66    | 44.66    |
| L. temulentum| 2.33                        | 6.67                      | 3.33                        | 12.67       | 5.33      | 14.33     | 1.33      | 5.67   | 6.66     | 31.33    |
| P. monspeliensis| 3.33                       | 8.67                      | 6.00                        | 12.67       | 6.67      | 19.33     | 0.67      | 5.33   | 10.33    | 41.66    |
| C. dactylm   | 5.00                        | 7.67                      | 5.33                        | 8.67        | 7.00      | 16.00     | 1.00      | 5.33   | 9.33     | 30.66    |
| C. rotundus  | 10.33                       | 13.67                     | 10.00                       | 16.00       | 20.33     | 31.67     | 1.67      | 5.33   | 35.00    | 53.00    |
| LSD 0.05     | 11.245                      | 7.931                     | 0.080                       | 0.007       | 13.812    | 22.381    | 0.854     | 1.330  | 5.824    | 7.338    |

Hand hoeing at 30 days, the minimum decreased significant density was recorded in *Cynodon dactylm* with (0.66), *Polypogon monspeliensis* with (0.67), *Avena fatua* with (1.33), *Lolium temulentum* with (1.66) and *Cyperus rotundus* with (1.67). While, at 30 days, the minimum decreased significant density was recorded in *Lolium temulentum* with (4.33), *Cynodon dactylm* with (4.33), *Avena fatua* with (5), *Polypogon monspeliensis* with (5) and *Cyperus rotundus* with (5.33). Data in table () shows the effect of clethodim (93.75, and 62.5 a.i g/fed), herbicides with three rates on narrow leaves weed density in 2015/2016 season, weed density of was recorded at 30 and 60 days after application. At 30 days after clethodim (93.75a.i g/fed) application, the minimum decreased significant density was recorded in *L. temulentum* with (2.33), *P. monspeliensis* with (3.33), *C. dactylm* with (5), *A. fatua* with (5.33), *C. rotundus* with (10.33). At
60 days after clethodim (93.75 a.i g/fed) application, the minimum decreased significant density was recorded in L. temulentum with (6.67), C. dactylm with (7.67), P. monspeliensis with (8.67), A. fatua with (10.67), C. rotundus with (13.67). At 30 days after clethodim (62.5 a.i g/fed) application, the minimum decreased significant density was recorded in L. temulentum with (3.33), C. dactylm with (5.33), A. fatua with (6), P. monspeliensis with (6) and C. rotundus with (10). At 60 days after clethodim (62.5 a.i g/fed) application, the minimum decreased significant density was recorded in L. temulentum with (12.67), P. monspeliensis with (12.67), C. dactylm with (8.67), A. fatua with (14.67) and C. rotundus with (16) compared with control.

Hand hoeing at 30 days, the minimum decreased significant density was recorded in Polypogon monspeliensis with (0.67), Cynodon dactylm with (1), Lolium temulentum with (1.33), Avena fatua with (1.67) and Cyperus rotundus with (1.67). While, at 30 days, the minimum decreased significant density was recorded in Polypogon monspeliensis with (5.33), Cynodon dactylm with (5.33), Cyperus rotundus with (5.33), Lolium temulentum with (5.67) and Avena fatua with (6).

**Effect of oxyfluorfen+clethodim herbicide combinations on broadleaf and narrow leaves weed density in 2014/2015 and 2015/2016 seasons:**

As showed in Tables 5 and 6, at 30 days after oxyfluorfen+clethodim (270+93.75 a.i g/fed) application, the minimum decreased significant density was recorded in A. viridis with (0), L. temulentum with (0) A. majus with (0), C. ambrosioides with (0), C. endivia with (0), M. parviflora with (0), P. major with (0), R. dentatus with (0), S. oleraceus with (0), A. fatua with (0.33), P. monspeliensis with (0.33), C. arvensis with (0.33), S. marianumt with (0.33), S. oleraceus with (0.33), A. fatua with (0.33), P. monspeliensis with (0.33), C. dactylm with (0.67), C. rotundus with (0.67). At 60 days after oxyfluorfen+clethodim (270+93.75 a.i g/fed) application, the minimum decreased significant density was recorded in P. major with (1), M. parviflora with (1), S. marianumt with (1.33), C. endivia with (1.33), A. viridis with (1.33), C. ambrosioides with (1.33), C. dactylm with (1.67), C. arvensis with (1.67), L. temulentum with (2), P. monspeliensis with (2), A. majus with (2), R. dentatus with (2.67), A. fatua with (3), S. oleraceus with (3) and C. rotundus with (3.33).

At 30 days after oxyfluorfen+clethodim (180+62.5 a.i g/fed) application, the minimum decreased significant density was recorded in A. viridis with (0), C. endivia with (0), M. parviflora with (0), P. major with (0), S. oleraceus with (0), A. fatua with (0.33), L. temulentum with (0.33), Polypogon, monspeliensis with (0.33), C. dactylm with (0.33), C. rotundus with (0.33), A. majus with (0.33), C. ambrosioides with (0.33), R. dentatus with (0.33), S. marianumt with (0.33) and C. arvensis with (0.33). At 60 days after oxyfluorfen+clethodim (180+62.5 a.i g/fed) application, the minimum decreased significant density was recorded in C. arvensis with (3.33), S. marianumt with (4), M. parviflora with (4), P. major with (4), C. endivia with (4.33), C.
ambrosioides with (4.67), A. fatua with (5), C. dactylm with (5), R. dentatus with (5), L. temulentum with (5.33), C. rotundus with (6), P. monspeliensis with (6.33), A. majus with (6.33), A. viridis with (7) and S. oleraceus with (7).

Hand hoeing at 30 days, the minimum decreased significant density was recorded in Chenopodium ambrosioides with (0.33), Plantago major with (0.33), Silybium marianumt with (0.33), Convolvulus arvensis with (0.33), Cynodon dactylm with (0.66), Amaranthus viridis with (0.67), Cichorium endivia with (0.67), Polypogon monspeliensis with (0.67), Rumex dentatus with (1), Avena fatua with (1.33), Anmmi majus with (1.33), Malva parviflora with (1.33), Lolium temulentum with (1.66), Sonchus oleraceus with (1.67), Cyperus rotundus with (1.67). Hand hoeing at 60 days, the minimum decreased significant density was recorded in Convolvulus arvensis with (3.33), Plantago major with (3.67), Silybium marianumt with (4), Cynodon dactylm with (4.33), Chenopodium ambrosioides with (4.33), Lolium temulentum with (4.33), Cichorium endivia with (4.67), Avena fatua with (5), Polypogon monspeliensis with (5), Cyperus rotundus with (5.33), Ammi majus with (5.67), Malva parviflora with (5.67), Rumex dentatus with (5.67), Sonchus oleraceus with (5.67), Amaranthus viridis with (6).

In 2015/2016 season at 30 days after oxyfluorfen+clethodim (270+93.75 a.i g/fed) application, the minimum decreased significant density was recorded in P. monspeliensis with (0), A. viridis with (0), A. majus with (0), L. temulentum with (0), C. ambrosioides with (0), C. endivia with (0), M. parviflora with (0), P. major with (0), R. dentatus with (0), S. oleraceus with (0), A. fatua with (0.33), S. marianumt with (0.33), C. arvensis with (0.33), C. dactylm with (0.67) and C. rotundus with (0.67). At 60 days after oxyfluorfen+clethodim (270+93.75 a.i g/fed) application, the minimum decreased significant density was recorded in C. endivia with (1.67), C. dactylm with (2), M. parviflora with (2.33), S. marianumt with (2.33), A. viridis with (2.33), C. ambrosioides with (2.33), C. arvensis with (2.67), P. monspeliensis with (2.67), L. temulentum with (2.67), A. majus with (2.67), P. major with (3), A. fatua with (3.67), C. rotundus with (4), R. dentatus with (4) and S. oleraceus with (4.33). At 30 days after oxyfluorfen+clethodim (180+62.5 a.i g/fed) application, the minimum decreased significant density was recorded in C. endivia with (0), A. viridis with (0), A. fatua with (0.33), L. temulentum with (0.33), P. monspeliensis with (0.33), C. dactylm with (0.33), C. rotundus with (0.33), A. majus with (0.33), M. parviflora with (0.33), P. major with (0.33), R. dentatus with (0.33), S. marianumt with (0.33), S. oleraceus with (0.33), C. arvensis with (0.33) and C. ambrosioides with (0.67). At 60 days after oxyfluorfen+clethodim (180+62.5 a.i g/fed) application, the minimum decreased significant density was recorded in C. arvensis with (4), P. major with (5.33), R. dentatus with (5.67), C. endivia with (5.67), A. fatua with (6.67), M. parviflora with (6), C. ambrosioides with (6.33), S. marianumt with (6.33), C. dactylm with (6.67), A. majus with (7.33), P. monspeliensis with (7.67), L. temulentum with (8), C. rotundus with (8.33), A. viridis with (8.33) and S. oleraceus with (9.33)
compared with control. Hand hoeing at 30 days, the minimum decreased significant density was recorded in *Plantago major* with (0.67), *Convolvulus arvensis* with (0.67), *Silybum marianum* with (0.67), *Polypogon monspeliensis* with (0.67), *Cynodon dactylin* with (1), *Cichorium endivia* with (1.33), *Lolium temulentum* with (1.33), *Chenopodium ambrosioides* with (1.33), *Avena fatua* with (1.67), *Cyperus rotundus* with (1.67), *Amaranthus viridis* with (1.67), *Ammi majus* with (1.67), *Rumex dentatus* with (2), *Malva parviflora* with (2.33) and *Sonchus oleraceus* with (2.67).

Hand hoeing at 60 days, the minimum decreased significant density was recorded in *Convolvulus arvensis* with (4.33), *Silybum marianum* with (4.67), *Polypogon monspeliensis* with (5.33), *Cynodon dactylin* with (5.33), *Cyperus rotundus* with (5.33), *Chenopodium ambrosioides* with (5.33), *Plantago major* with (5.33), *Lolium temulentum* with (5.67), *Cichorium endivia* with (5.67), *Avena fatua* with (6), *Malva parviflora* with (6.33), *Rumex dentatus* with (6.33), *Ammi majus* with (7), *Amaranthus viridis* with (7.33) and *Sonchus oleraceus* with (7.33).

**Table 5.** Effect of herbicide combinations treatments on broadleaf and narrow leaved weeds density (m$^{-2}$) at 30 and 60 DAT during 2014/2015 season.

| Weed species          | Oxyfluorfen + Clethodim | Hand hoeing | Control % |
|-----------------------|--------------------------|-------------|-----------|
|                        | 270+93.75 (a.i g/fed) | 180+62.5 (a.i g/fed) | 90+31.25 (a.i g/fed) | 30 DAT | 60 DAT | 30 DAT | 60 DAT | 30 DAT | 60 DAT | 30 DAT | 60 DAT | 30 DAT | 60 DAT |
| *A. fatua*             | 0.33 | 3.00  | 0.33  | 5.00  | 12.33 | 13.67 | 1.33 | 5.00  | 19.33 | 41.66 |
| *L. temulentum*        | 0.00 | 2.00  | 0.33  | 5.33  | 7.00  | 7.67  | 1.66 | 4.33  | 7.66  | 27.66 |
| *P. monspeliensis*     | 0.33 | 2.00  | 0.33  | 6.33  | 8.67  | 10.67 | 0.67 | 5.00  | 12.66 | 38.00 |
| *C. dactylin*          | 0.67 | 1.67  | 0.33  | 5.00  | 9.33  | 7.00  | 0.66 | 4.33  | 10.66 | 26.33 |
| *C. rotundus*          | 0.67 | 3.33  | 0.33  | 6.00  | 15.00 | 15.33 | 1.67 | 5.33  | 35.66 | 49    |
| *A. viridis*           | 0.00 | 1.33  | 0    | 7.00  | 8.00  | 14.33 | 0.67 | 6.00  | 16.66 | 45.66 |
| *A. majus*             | 0.00 | 2.00  | 0.33  | 6.33  | 13.33 | 12.00 | 1.33 | 5.67  | 26.00 | 37.33 |
| *C. ambrosioides*      | 0.00 | 1.33  | 0.33  | 4.67  | 5.00  | 12.33 | 0.33 | 4.33  | 7.33  | 32.00 |
| *C. endivia*           | 0.00 | 1.33  | 0.00  | 4.33  | 6.67  | 8.33  | 0.667 | 4.67  | 8.33  | 30.33 |
| *M. parviflora*        | 0.00 | 1.00  | 0.00  | 4.00  | 13.00 | 18.00 | 1.33 | 5.67  | 26.66 | 41.33 |
| *P. major*             | 0.00 | 1.00  | 0.00  | 4.00  | 4.00  | 9.00  | 0.33 | 3.67  | 6.66  | 21.33 |
| *R. dentatus*          | 0.00 | 2.67  | 0.33  | 5.00  | 13.00 | 12.67 | 1.00 | 5.67  | 16.33 | 29.66 |
| *S. marianum*          | 0.33 | 1.33  | 0.33  | 4.00  | 5.33  | 8.00  | 0.33 | 4.00  | 7.00  | 25.00 |
| *S. oleraceus*         | 0.00 | 3.00  | 0.00  | 7.00  | 12.33 | 18.33 | 1.67 | 5.67  | 25.00 | 40.33 |
| *C. arvensis*          | 0.33 | 1.67  | 0.33  | 3.33  | 5.00  | 7.33  | 0.33 | 3.33  | 6.33  | 21.00 |
| LSD 0.05               | 0.652 | 2.821 | 1.335 | 1.358 | 13.864 | 4.526 | 2.714 | 1.770 | 18.932 | 7.380 |
Table 6. Effect of herbicide combinations treatments on broadleaf and narrow leaved weeds density (m²) at 30 and 60 DAT during 2015/2016 season.

| Weed species          | Oxyfluorfen + Clethodim (270+93.75) (a.i g/fed) | 30 DAT | 60 DAT | 30 DAT | 60 DAT | 30 DAT | 60 DAT | 30 DAT | 60 DAT | 30 DAT | 60 DAT |
|-----------------------|-----------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|                       | (180+62.5) (a.i g/fed)                        |        |        |        |        |        |        |        |        |        |        |
|                       | (90+31.25) (a.i g/fed)                        |        |        |        |        |        |        |        |        |        |        |
| H.hoeing              | Control %                                     |        |        |        |        |        |        |        |        |        |        |
| A. fatua              | 0.33                                          | 3.67   | 0.33   | 6.67   | 11.67  | 16.33  | 1.67   | 6.00   | 21.66  | 44.66  |        |
| L. temulentum         | 0.00                                          | 2.67   | 0.33   | 8.00   | 7.00   | 10.33  | 1.33   | 5.67   | 6.66   | 31.33  |        |
| P. monspeliensis      | 0.00                                          | 2.67   | 0.33   | 7.67   | 10.67  | 13.67  | 0.67   | 5.33   | 10.33  | 41.66  |        |
| C. dactylm            | 0.67                                          | 2.00   | 0.33   | 6.67   | 8.00   | 9.00   | 1.00   | 5.33   | 9.33   | 30.66  |        |
| C. rotundus           | 0.67                                          | 4.00   | 0.33   | 8.33   | 15     | 19.67  | 1.67   | 5.33   | 35.00  | 53.00  |        |
| A. viridis            | 0.00                                          | 2.33   | 0.00   | 8.33   | 8.33   | 19.67  | 1.67   | 7.33   | 17.00  | 50.00  |        |
| A. majus              | 0.00                                          | 2.67   | 0.33   | 7.33   | 12.67  | 17.33  | 1.67   | 7.00   | 27.00  | 43.33  |        |
| C. ambrosioides       | 0.00                                          | 2.33   | 0.67   | 6.33   | 6.00   | 16.33  | 1.33   | 5.33   | 8.33   | 36.33  |        |
| C. endivia            | 0.00                                          | 1.67   | 0.00   | 5.67   | 5.67   | 12.67  | 1.33   | 5.67   | 8.00   | 39.00  |        |
| M. parviflora         | 0.00                                          | 2.33   | 0.33   | 6.00   | 15.00  | 20.67  | 2.33   | 6.33   | 26.66  | 45.33  |        |
| P. major              | 0.00                                          | 3.00   | 0.00   | 5.33   | 5.67   | 17.33  | 0.67   | 5.33   | 8.00   | 28.33  |        |
| R. dentatus           | 0.00                                          | 4.00   | 0.33   | 5.67   | 13.33  | 18.00  | 2.00   | 6.33   | 18.00  | 40.33  |        |
| S. marianumt          | 0.33                                          | 2.33   | 0.33   | 6.33   | 5.00   | 13.00  | 0.67   | 4.67   | 8.00   | 30.33  |        |
| S. oleraceus          | 0.00                                          | 4.33   | 0.33   | 9.33   | 14.67  | 22.67  | 2.67   | 7.33   | 27.33  | 46.66  |        |
| C. arvensis           | 0.33                                          | 2.67   | 0.33   | 4.00   | 4.00   | 10.00  | 0.67   | 4.33   | 7.00   | 24.00  |        |
| LSD 0.05              | 0.234                                         | 0.335  | 3.731  | 1.320  | 7.521  | 23.527 | 0.329  | 1.821  | 22.328 | 7.328  |        |

**Total dry weight of weeds:**

Data in Table 7 and 8 showed total dry weight per one meter square area of onion recorded at 30 and 60 DAT was significantly affected by different weed control treatments; all treatments caused significant reduction in dry matter of weeds as compared to control.

**Effect of herbicides on total dry weight broadleaf weeds:**

At 30 days after treatment in season 2014/2015 the minimum dry weight recorded in (1.86) was under oxyfluorfen (270 a.i g/fed) treatment and followed with (2.22) by oxyfluorfen (180 a.i g/fed) treatment compared with control (37.95). While in season 2015/2016 the minimum dry weight recorded in (2.1) was under oxyfluorfen (270 a.i g/fed) treatment and followed with (2.62) by oxyfluorfen (180 a.i g/fed) treatment compared with control (37.08) at all herbicides used for controlling broad leaves weed. At 60 days treatments in season 2014/2015 the minimum dry weight recorded in (15.99) was under hand hoeing treatment and followed with (20.57) by oxyfluorfen (270 a.i g/fed) treatment compared with control (142.03). While in season 2015/2016 the minimum dry weight recorded in (23.66) was under hand hoeing treatment and followed with (29.43) by oxyfluorfen (270 a.i g/fed) treatment compared with control (156.49). at all herbicides used for controlling broad leaves weed *Amaranthus viridis, Ammi majus, Chenopodium ambrosioides, C. endivia, M. parviflora, P. major, R. dentatus, Silybium marianumt, S. oleraceus, and C. arvensis*. Treatment of Oxyfluorfen herbicide caused to the
highest percent of reduction in weeds dry weight and there were no significant differences between treatments of oxadiazon herbicide (Mirshekari and Karimi, 2015).

**Table 7.** Effect of herbicides and their combinations on total means of dry weight during 2014/2015 and 2015/2016 seasons.

| Herbicide treatments       | Rate (a.i g/fed) | 2014/2015 | 2015/2016 | 2014/2015 | 2015/2016 |
|---------------------------|------------------|-----------|-----------|-----------|-----------|
|                           |                  | 30 DAT    | 60 DAT    | 30 DAT    | 60 DAT    |
| Oxyfluorfen               | 270              | 1.86      | 20.57     | 2.1       | 29.43     |
| Oxyfluorfen               | 180              | 2.22      | 36.42     | 2.62      | 53.11     |
| Hand hoeing               | -                | 3.26      | 15.99     | 3.41      | 23.66     |
| Control                   | -                | 37.95     | 142.03    | 37.08     | 156.49    |
| Clethodim                 | 93.75            | 4.56      | 8.98      | 4.73      | 10.23     |
| Clethodim                 | 62.5             | 3.97      | 12.38     | 4.24      | 15.16     |
| Hand hoeing               | -                | 0.97      | 8.08      | 1.16      | 10.04     |
| Control                   | -                | 19.63     | 53.43     | 20.36     | 60.88     |
| Oxyfluorfen + Clethodim   | 270+93.75        | 0.11      | 9.79      | 0.14      | 13.7      |
| Oxyfluorfen + Clethodim   | 180+62.5         | 0.29      | 26.56     | 0.80      | 38.75     |
| Hand hoeing               | -                | 4.23      | 24.07     | 4.57      | 33.7      |
| Control                   | -                | 57.58     | 195.46    | 57.44     | 217.37    |

**Effect of herbicides on total dry weight narrow leaves weeds:**

At 30 days treatment in season 2014/2015 the minimum dry weight recorded in (0.97) was under hand hoeing treatment and followed with (3.97) by clethodim (62.5 a.i g/fed) treatment compared with control (19.63). While in season 2015/2016 the minimum dry weight recorded in (1.16) was under hand hoeing treatment and followed with (4.24) by clethodim (62.5 a.i g/fed) treatment compared with control (20.36) at all herbicides used for controlling broad leaves weed. At 60 days treatment in season 2014/2015 the minimum dry weight recorded in (8.08) was under hand hoeing treatment and followed with (8.98) by clethodim (93.75 a.i g/fed) treatment compared with control (53.43). While in season 2015/2016 the minimum dry weight recorded in (10.04) was under hand hoeing treatment and followed with (10.23) by clethodim (93.75 a.i g/fed) treatment compared with control (60.88) at all herbicides used for controlling narrow leaves weed A. fatua, L. temulentum, P. monspeliensis, C. dactylm and C. rotundus.

**Table 8.** Effect of herbicides and their combinations on total weed control efficiency during 2014/2015 and 2015/2016 seasons.

| Herbicide treatments        | Rate (a.i g/fed) | 2014/2015 | 2015/2016 | 2014/2015 | 2015/2016 |
|-----------------------------|------------------|-----------|-----------|-----------|-----------|
|                            |                  | 30 DAT    | 60 DAT    | 30 DAT    | 60 DAT    |
| Oxyfluorfen                 | 270              | 90.19     | 87.89     | 90.73     | 84.87     |
| Oxyfluorfen                 | 180              | 88.92     | 77.4      | 89.45     | 76.03     |
| Hand hoeing                 | -                | 94.57     | 84.68     | 89.55     | 84.24     |
| Clethodim                   | 93.75            | 64.28     | 77.09     | 65.01     | 76.64     |
| Clethodim                   | 62.5             | 59.75     | 68.46     | 55.7      | 67.57     |
| Hand hoeing                 | -                | 91.06     | 86.37     | 90.07     | 85.65     |
| Oxyfluorfen + Clethodim     | 270+93.75        | 98.51     | 94.24     | 98.70     | 92.5      |
| Oxyfluorfen + Clethodim     | 180+62.5         | 97.98     | 84.34     | 97.57     | 82.3      |
| Hand hoeing                 | -                | 93.4      | 85.24     | 89.72     | 84.71     |
Effect of herbicides combinations on total dry weight weeds

At 30 days treatment in season 2014/2015 the minimum dry weight recorded in (0.11) was under oxyfluorfen+clethodim (270+93.75 a.i g/fed) treatment and followed with (0.29) by oxyfluorfen+clethodim (180+62.5 a.i g/fed) treatment compared with control (57.58). While in season 2015/2016 the minimum dry weight recorded in (0.14) was under oxyfluorfen+clethodim (270+93.75 a.i g/fed) treatment and followed with (0.8) by oxyfluorfen+clethodim (180+62.5 a.i g/fed) treatment compared with control (57.44) at all herbicides used for controlling onion weeds. At 60 days treatment in season 2014/2015 the minimum dry weight recorded in (9.79) was under oxyfluorfen+ clethodim (270+93.75 a.i g/fed) treatment and followed with (24.07) by hand hoeing treatment compared with control (195.46). While in season 2015/2016 the minimum dry weight recorded in (13.7) was under oxyfluorfen+ clethodim (270+93.75 a.i g/fed) treatment and followed with (33.7) by hand hoeing treatment compared with control (217.37) at all herbicides used for controlling onion weeds Avena fatua, Lolium temulentum, Polypogon monspeliensis, Cynodon dactylm, Cyperus rotundus, Amaranthus viridis, Ammi majus, Chenopodium ambrosioides, Cichorium endivia, Malva parviflora, Plantago major, Rumex dentatus, Silybium marianumt, Sonchus oleraceus and Convonvulus arvensis.

Weed control efficiency (WCE %)

The total broad leaved weed density was significantly altered by different weed control treatments are presented in (Table 9). At 30 DAT during 2014/2015 season, among the different herbicide treatments of weed control efficiency was found the highest weed control efficiency (94.57%) was registered under hand hoeing treatment followed by (90.19%) under oxyfluorfen (270 a.i g/fed) treatment. At 60 DAT, the highest weed control efficiency (87.89%) was registered under oxyfluorfen (270 a.i g/fed) treatment followed by (84.68%) under hand hoeing treatment. The most effective treatments against broad leaf weeds were oxyfluorfen and hand hoeing (Ghalwash et al. 2008). Oxyfluorfen at the 3-4 leaf stage resulted in the best effect against weed infestation and led to high yields (Qasem, 2005). Oxyfluorfen herbicide caused to the highest percent of reduction in weeds dry weight (Mirshekari and Karimi, 2015). In 2015/2016 season at 30 DAT, the highest weed control efficiency (90.73 %) was registered under oxyfluorfen (270 a.i g/fed) treatment followed by (89.55%) under hand hoeing treatment. At 60 DAT, the highest weed control efficiency (84.87%) was registered under oxyfluorfen (270 a.i g/fed) treatment followed by (84.24%) under hand hoeing treatment. Soil structure is important; in rough soil weeds may continue to grow in the lumps of soil lifted by the hoe (Mattsson et al. 1990).
Desiccation on the soil surface is a critical factor in preventing weed regeneration, and wet conditions after hoeing can decrease the level of control (Böhrnsen, 1993). Weed control efficiency of different hoeing treatments were more at 30 DAP than 60 and 90 DAP. The percent weed control efficiency was significantly more in pre emergence application of oxyfluorfen 0.25 kg a.i. ha\(^{-1}\) at 30, 60 and 90 days after planting (Kolse et al. 2010). The weed control efficiency was also significantly higher when coupled with hand weeding at 30 DAP by the same treatments at 60 and 90 days after planting (Kolhe, 2001). The per cent of weed control efficiency was more at early stage of weed growth by the application of herbicides alone; the weed control efficiency was more at early stage (Kolse et al. 2010). The total narrow leaved weed density was significantly altered by different weed control treatments at 30 DAT during 2014/2015 season, among the different herbicide treatments of weed control efficiency was found the highest weed control efficiency (91.06%) was registered under hand hoeing treatment followed by (64.28 %) under clethodim (93.75 a.i g/fed) treatment. At 60 DAT the highest weed control efficiency (86.37%) was registered under hand hoeing treatment followed by (77.09%) under clethodim (93.75 a.i g/fed) treatment. At 30 DAT during 2015/2016 season, among the different herbicide treatments of weed control efficiency was found the highest weed control efficiency (90.07%) was registered under hand hoeing treatment followed by (65.01%) under clethodim (93.75 a.i g/fed) treatment. At 60 DAT, the highest weed control efficiency (85.65%) was registered under hand hoeing treatment followed by (76.64%) under clethodim (93.75 a.i g/fed) treatment. All the chemical treatments and two hand weeding at 20 and 40 days after sowing had Recorded significantly lower weed population as compared to weedy check. Application of clethodim 24 % EC 60 g a.i. ha\(^{-1}\) along with NIS + AMS recorded the lowest monocot, sedge, dicot and total weed population (0.6, 7.4, 10.1 and 18.1 /0.25 m\(^{2}\)) respectively, and was on par with the application of clethodim 24 % EC 48 g a.i. ha\(^{-1}\) along with NIS + AMS monocot, sedge, dicot and total weeds (1.5, 7.7, 10.2 and 19.4 /0.25 m\(^{2}\)), respectively, at all the stages of the crop growth (Sudhakara et al. 2014). The total broad and

### Table 9. Effect of herbicides and their combinations on total weed control efficiency (WCE %) in 2014/2015 and 2015/2016 seasons

| Herbicide treatments                        | Rate (g a.i./fed) | 2014/2015     | 2015/2016     |
|--------------------------------------------|-------------------|---------------|---------------|
|                                            |                   | 30 DAT | 60 DAT | 30 DAT | 60 DAT |
| Oxyfluorfen                                | 270               | 90.19 | 87.89 | 90.73 | 84.87 |
| Oxyfluorfen                                | 180               | 88.92 | 77.4  | 89.45 | 76.03 |
| Hand hoeing                                | -                 | 94.57 | 84.68 | 89.55 | 84.24 |
| Clethodim                                  | 93.75             | 64.28 | 77.09 | 65.01 | 76.64 |
| Clethodim                                  | 62.5              | 59.75 | 68.46 | 55.7  | 67.57 |
| Hand hoeing                                | -                 | 91.06 | 86.37 | 90.07 | 85.65 |
| Oxyfluorfen + Clethodim                    | 270+93.75         | 98.51 | 94.24 | 98.7  | 92.5  |
| Oxyfluorfen + Clethodim                    | 180+62.5          | 97.98 | 84.34 | 97.57 | 82.3  |
| Hand hoeing                                | -                 | 93.4  | 85.24 | 89.72 | 84.71 |
narrow leaved weed density was significantly altered by different weed control treatments are presented in Tables at 30 DAT during 2014/2015 season, among the different herbicide combinations treatments of weed control efficiency was found the highest weed control efficiency (98.51%) was registered under oxyfluorfen + clethodim (270+93.75 a.i g/fed) treatment followed by (97.98%) under oxyfluorfen+clethodim (180+62.5 a.i g/fed) treatment.

Table 10. Effect of herbicides and their combinations treatments on plant height (cm), Number of leaves, bulb diameter and total yield at harvesting in 2014/2015 and 2015/2016 seasons.

| Herbicide treatments | Rate (g a.i./fed) | plant height (cm) | Number of leaves | Bulb Diameter (cm) | Total yield Ton/fed |
|----------------------|------------------|-------------------|-----------------|-------------------|-------------------|
|                      | 2014/2015       | 2015/2016       | 2014/2015       | 2015/2016       | 2014/2015       | 2015/2016       | 2014/2015       | 2015/2016       |
|                      | 70 DAT          | 120 DAT         | 70 DAT          | 120 DAT         | 70 DAT          | 120 DAT         | 70 DAT          | 120 DAT         |
| Oxyfluorfen          | 270             | 31.7             | 60.9            | 33.8            | 63.6            | 4.33             | 5               | 4.67             | 5               | 6.8             | 6.93             | 10.594          | 10.8             |
| Oxyfluorfen          | 180             | 34.8             | 73.9            | 37.5            | 72.4            | 4.67             | 7.33            | 4.76             | 7.6             | 7.7             | 7.6              | 11.405          | 11.8             |
| Clethodim            | 93.75           | 34.2             | 52.3            | 36.5            | 55.5            | 3.33             | 3.67            | 3.67             | 4.3             | 5               | 4.93             | 10.137          | 10.3             |
| Clethodim            | 62.5            | 40               | 58.1            | 38.5            | 58.7            | 3.67             | 4.67            | 4.33             | 4.6             | 6.2             | 6.1              | 11.209          | 11.5             |
| Oxyfluorfen + Clethodim | 270+93.75     | 32.9             | 65.3            | 33.8            | 68.2            | 4.33             | 3.67            | 3.33             | 3.6             | 6.2             | 6.1              | 10.8            | 10.8             |
| Oxyfluorfen + Clethodim | 180+62.5      | 37.7             | 71.2            | 38.7            | 75.7            | 3.67             | 5.00            | 3.67             | 4.6             | 7.8             | 7.77             | 11.656          | 11.7             |
| Hand hoeing          | ------          | 33.9             | 63.4            | 36.3            | 64.9            | 4.67             | 7.67            | 4.67             | 7.3             | 6.2             | 6.2              | 11.802          | 12               |
| Control              | ------          | 23               | 47.8            | 24.1            | 51.4            | 3.33             | 4.67            | 3.67             | 4.6             | 4.9             | 4.57             | 4.909           | 5.1              |

While at 60 DAT, the highest weed control efficiency (94.24%) was registered under oxyfluorfen + clethodim (270+93.75 a.i g/fed) treatment followed by (85.24%) under hand hoeing treatment. At 30 DAT during 2015/2016 season, among the different herbicide combinations treatments of weed control efficiency was found the highest weed control efficiency (98.7%) was registered under oxyfluorfen + clethodim (270+93.75 a.i g/fed) treatment followed by (97.57%) under oxyfluorfen+clethodim (180+62.5 a.i g/fed) treatment. While at 60 DAT, the highest weed control efficiency (92.5%) was registered under oxyfluorfen+clethodim (270+93.75 a.i g/fed) treatment followed by (84.71%) under hand hoeing treatment. Evaluate the efficacy of grass killers in different crop ecosystems. It is also necessary to work out the efficacy of newer herbicides whenever developed in terms of their effect on weed flora, phytotoxicity to the main crop as well as on the succeeding crops under varied agro-climatic situations before recommending them to the farming community (Sudhakara et al. 2014).

Effect of herbicides and their combinations on plant height (cm):

As showed in Table 10, in season 2014/2015 refer to significant among the different treatments and showed that mean plant height under different treatments of herbicides is given the highest plant at 70 day was recorded at Clethodim (62.5 a.i g/fed) with (40.03) cm followed by Oxyfluorfen+Clethodim (180+62.5 a.i g/fed) with (37.73) cm compared with control (23.07) cm. The highest plant at 120 day was recorded at Oxyfluorfen (180 a.i g/fed) with (73.97) cm.
followed by Oxyfluorfen+Clethodim (180+62.5 a.i g/fed) with (71.2) cm compared with control (47.8) cm. In season 2015/2016 refer to significant among the different treatments and showed that mean plant height under different treatments of herbicides is given the highest Plant at 70 day was recorded at Oxyfluorfen+Clethodim (180+62.5 a.i g/fed) with (38.77) cm followed by Clethodim (62.5 a.i g/fed) with (38.57) cm. The highest Plant at 120 day was recorded at Oxyfluorfen +Clethodim (180+62.5 a.i g/fed) with (75.73) cm followed by Oxyfluorfen +Clethodim (90+31.25 a.i g/fed) with (72.53) cm compared with control (51.47).

**Effect of herbicides and their combinations on number of leaves:**

As showed in Table 10, in season 2014/2015 number of leaves per plant increased significantly with the different herbicides and their combinations treatments and hand hoeing at 70 day, maximum number of leaves per plant was recorded with application of oxyfluorfen+clethodim (180+62.5 a.i g/fed) and hand hoeing with (4.67) compared with control (3.33). At 120 day, maximum number of leaves per plant was recorded with application of Oxyfluorfen+Clethodim (270+93.75 a.i g/fed) and hand hoeing with (7.67) compared with control (4.67). The number of leaves per plant and bulb diameter were highest in oxyfluorfen applied at 0.37 a.i. kg/ha and 0.25 a.i. kg/ha + hand weeding at 40 DAT, respectively (Singh et al. 2001). In season 2015/2016 number of leaves per plant at 70 DAT, at 70 day, maximum number of leaves per plant was recorded with application of Oxyfluorfen+Clethodim (270+93.75 a.i g/fed), oxyfluorfen+clethodim (180+62.5 a.i g/fed) and hand hoeing with (4.67) compared with control (3.67). At 120 day, maximum number of leaves per plant was recorded with application of Oxyfluorfen+Clethodim (270+93.75 a.i g/fed) and hand hoeing with (7.67) compared with control (4.67).

**Effect of herbicides and their combinations on Bulb diameter (cm):**

Data for various herbicide and their combinations treatments with respect to the bulb diameter are summarized in (Table 10) in season 2014/2015, the maximum bulb diameter (7.8) cm was recorded under the treatment Oxyfluorfen+Clethodim (180+62.5a.i g/fed), followed by Oxyfluorfen (180 a.i g/fed) treatment with (7.7) cm compared with control treatment (4.93) cm. In season 2015/2016, the maximum bulb diameter (7.77) cm was recorded under the treatment Oxyfluorfen+ Clethodim (180+62.5a.i g/fed), followed by Oxyfluorfen (180 a.i g/fed) treatment with (7.6) cm compared with control treatment (4.57) cm.

**Effect of herbicides and their combinations on Total Yield ton/fed:**

Data in (Table 10) Shows the effect of different herbicides and their combinations treatments on the total yield (ton/fed) and the data depicted that the total yield increased significantly in response to applied herbicides and their combinations. In season 2014/2015, significantly highest bulb yield (11.802) ton/fed was observed in hand hoeing followed by
oxyfluorfen+clethodim (180+62.5 a.i g/fed) treatment with (11.656) ton/fed compared with control (4.989). While in season 2015/2016, significantly highest bulb yield (12.002) ton/fed was observed in hand hoeing followed by oxyfluorfen+clethodim (180+62.5 a.i g/fed) treatment with (11.803) ton/fed compared with control (5.109). Uncontrolled weed growth caused 49-86 percent reduction in bulb yield compared with the best herbicidal treatment (James and Harlen. 2010). The higher onion bulb yield of 38.3 t ha\(^{-1}\) due to lesser weed population and weed growth from initial crop growth (Patel et al. 2011). hand weeding throughout the growing season controlled all weeds and resulted in higher onion bulb yield (Rahman et al. 2011). Increase in bulb yield with these treatments was because of the fact that the weed population and weed growth remain low during the entire crop growth period, which leads to increase in various growth characters of crop (Kalhapure et al. 2013).

**Conflicts of Interest**

The authors declare that there is no conflict of interests regarding the publication of this paper.

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