African Journal of Biotechnology Vol. 9(42), pp. 7037-7042, 18 October 2010
Available online at http://www.academicjournals.org/AJB
DOI: 10.5897/AJB10.1005
ISSN 1684–5315 ©2010 Academic Journals

Full Length Research Paper

Weeds of onion fields and effects of some herbicides on weeds in Cukurova region, Turkey

Sibel Uygur*, Ramazan Gürbüz and F. Nezihi Uygur

Department of Plant Protection, Faculty of Agriculture, Çukurova University, 01330 Adana/Türkiye.

Accepted 2 September, 2010

Weeds are one of the most important problems in onion (*Allium cepa* L.) production areas, since onion plants are poor competitors. This study was conducted in order to identify the weed species in onion fields in Cukurova Region, establish the effects of some herbicides on weeds and the yield of onion in reducing the existing phytotoxicity problem on onion plants between 2006 and 2007. A total of 105 weed species belonging to 30 families were identified in fifty onion fields that were surveyed. Top five species were found as *Medicago polymorpha* L., *Convolvulus arvensis* L., *Avena sterilis* L., *Chenopodium album* L. and *Sinapis arvensis* L. with 84, 74, 68, 66 and 66 frequencies (%), respectively. To determine the effects of herbicides on weeds and onion yield, the experiments were done in two different onion fields. Among the treatments, oxadiazon and oxyfluorfen provided a better control than pendimethalin and tepraloxydim on weed coverage and density, but oxyfluorfen caused phytotoxicicity on onion even at reduced doses. Weed-free plots gave the highest yield (16.2^{a} kg/m^{2}) and were followed by oxadiazon (11.9^{b} kg/m^{2}), oxyfluorfen (11.7^{b} kg/m^{2}), pendimethalin (10.0^{c} kg/m^{2}), tepraloxydim (9.6^{c} kg/m^{2}) and weedy check (9.1^{c} kg/m^{2}). Results, in which weed-free check caused 76.3% increase in the onion yields when compared with weedy checks, show that weed control is very important for onion production.

Key words: Weed, onion, oxadiazon, oxyfluorfen.

INTRODUCTION

Onion (*Allium cepa* L.) belongs to the bulb crops, a group that includes onions (dry and green) belonging to the family of Alliaceae. It is one of the most important vegetable crops in the world with a total production of about 61 million tonnes (FAO, 2006). It is a condiment crop consumed fresh and dry as a spice. According to Turkish Statistical Institute, onion was produced as dry (2 007 118 tons) and fresh (168 223 tons) in Turkey in 2008 (TurkStat, 2008).

Weeds are one of the main plant protection problems in onion fields. They compete with onions for light, nutrients, water, space and also host plants of several harmful insects and pathogens. Many researchers have reported that onion plants are poor competitors (Menges and Tamez, 1981; Dunan et al., 1996; Ozer et al., 1997; Kizilkaya et al., 2001; Ghosheh, 2004; Carlson and Kirby, 2005; Qasem, 2006; Smith et al., 2008). This poor competitive ability with its initial slow growth and lack of adequate foliage makes onions weak against weeds (Wicks et al., 1973). Due to their slow growth (shallow roots and thin canopy), onion seedlings are poor competitors with weeds. In addition, their cylindrical upright leaves do not shade the soil to block weed growth.

Weed management methods best suited for an individual grower will depend on several factors such as present weed species, crop variety, stage of growth of the crop, weed species, labor costs and availability (Bell and Boutwell, 2001); but weed control predominantly depend on herbicide use since onion has less competition ability and are susceptible to mechanical practices. One of the undesirable results of herbicide use is phytotoxicity on onion plants. This is a common problem in Turkey, just like many countries. Therefore, this study was planned to determine the weed species in onion production areas covering Adana, Hatay and Mersin provinces and to see how the three registered herbicides

*Corresponding author. E-mail: suygur@cu.edu.tr. Tel: ++90 533 212 34 64; Fax: ++90 322 338 63 69.

Abbreviations: F, Frequency; **GC,** general coverage; **SC,** special coverage; **GD,** general density; **SD,** special density.

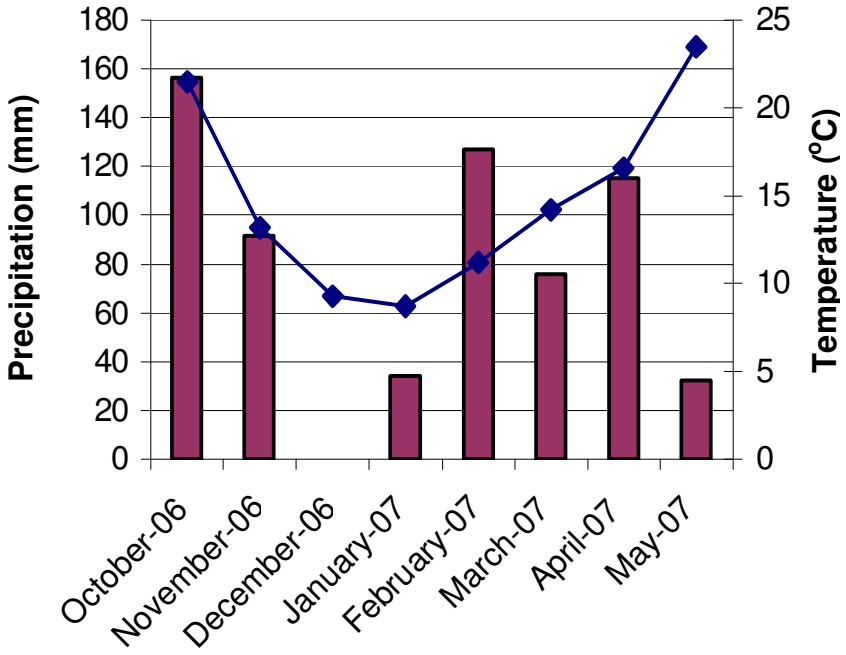

Figure 1. Climatic data during the field experiments in Adana.

and one unregistered herbicides, which are used in onion against weeds in Turkey, affect onion yield.

MATERIALS AND METHODS

Determination and identification of weed species

The surveys were conducted on the way of onion production areas to determine the weed species in Adana, Hatay and Mersin between April and May, 2007. Surveyed fields were chosen randomly by stopping at every 10 km. On each field, one m^2 quadrants were placed four times randomly, while all weed species in quadrants were counted and their percentage coverage was identified. Totally, 50 onion fields were sampled during the surveys. The weed species were identified by using Flora of Turkey (Davis, 1965 - 1989); the frequency (F), general coverage (GC), special coverage (SC), general density (GD) and special density (SD) of the weeds were individually calculated. The formulas were adapted from Odum (1971).

Frequency (%) (F) = Number of surveyed fields where a species occurred / number of total surveyed fields X 100

General coverage (%) (GC) = Coverage of a weed species in surveyed fields / number of total surveyed fields

Special coverage (%) (SC) = Coverage of a weed species where a species occurred / number of total surveyed fields

General density (plants/m^2) (GD) = Number of each weed species in m^2 / number of total surveyed fields

Special density (plants/m^2) (SD) = Number of each weed species where a species occurred in m^2/number of total surveyed fields.

Field experiment

Adana is the biggest province in Cukurova Delta and this delta is the main agricultural land in Turkey. The herbicide efficacy studies were conducted in Adana between 2006 and 2007. The experiments were done in two different onion fields, approximately 35 km apart from each other, to determine the effects of herbicides on the weeds and onion yield. The first one was conducted in Yuzbasi village and the second near Incirlik village in Adana. They were designed as six treatments and laid out in a completely randomized block design with four replicates. Mediterranean climate prevails in Adana, where mild rainy winters and hot dry summers are prevalent. However, the climatic datas were obtained from Turkish State Meteorological Service (Anonymous, 2007) (Figure 1).

Summer drought places a great deal of stress on the local vegetation, with an average annual precipitation of 647 mm. Rainfall at those sites was inadequate for successful onion production. In extremity, there was no rainfall in December 2006, so in both experimental sites, sprinkler irrigation was practiced. The onion plots of 2 x 3 m^2 were separated by one meter buffer area. The onion seeds of “Aki” cultivar at a seed rate of 1 kg/da were planted on November 10, 2006. Pest and disease control and fertilizer applications were performed as recommended. However, the experiments were completed on 24 May 2007, in both sites.

The experiment treatments were weedy check (untreated until harvest), weed-free check (hand weeded continuously during the growing season until harvest) and four herbicides. All herbicides were applied post-emergence when onions were 3- to 5-true leaved stage in both locations. Oxadiazon is an unregistered herbicide for onion in Turkey, but is used in many countries. The application rate was 150 ml/da dose of commercial preparate. However, oxyfluorfene, pendimethalin and tepraloxydim are registered herbicides in Turkey. Oxyfluorfene was applied as 20+20 ml/da (two applications with two weeks interval), while pendimethalin (300 ml/da) and tepraloxydim (100 ml/da) as commercial doses. All herbicides were applied using a pressurized CO_2 pack back sprayer equipped with a hand hold boom with four flat fan 8002 nozzle tips.

Table 1. Weed species, their frequencies and densities in onion fields of Cukurova (more than 20% frequencies were presented).

Weed species	Frequency (%)	GC (%)	SC (%)	GD (plant/m^2)	SD (plant/m^2)
Medicago polymorpha L.	84.00	2.14	2.55	0.35	0.72
Convolvulus arvensis L.	74.00	1.76	2.38	0.51	0.97
Avena sterilis L.	68.00	1.74	2.56	2.38	5.40
Chenopodium album L.	66.00	1.40	2.12	0.48	1.09
Sinapis arvensis L.	66.00	2.24	3.39	0.16	0.50
Cyperus rotundus L.	48.00	0.64	1.33	0.54	3.00
Amaranthus retroflexus L.	46.00	0.72	1.57	0.69	2.46
Silybum marianum (L.) Gaertn.	44.00	0.70	1.59	0.02	0.25
Matricaria chamomilla L.	42.00	0.52	1.24	0.06	0.75
Lolium perenne L.	38.00	0.46	1.21	0.48	3.39
Capsellabursa-pastoris (L.)Medik.	34.00	0.40	1.18	0.06	0.50
Anagallis arvensis L.	32.00	0.42	1.31	0.09	0.90
Xantium strumarium L.	32.00	0.40	1.25	0.28	1.40
Fumaria officinalis L.	30.00	0.36	1.20	0.08	0.75
Malva sylvestris L.	30.00	0.50	1.67	0.04	0.35
Polygonum aviculare L.	30.00	0.32	1.07	0.09	0.85
Stelleria media (L.) Vill.	30.00	1.00	3.33	0.08	0.54
Poa annua L.	28.00	0.28	1.00	0.12	2.88
Solanum nigrum L.	28.00	0.74	2.64	0.68	3.40
Sonchus asper (L.) Hill.	28.00	0.38	1.36	0.02	0.38
Galium aparine L.	26.00	0.46	1.77	0.04	0.67
Vicia sativa L.	26.00	0.44	1.69	0.07	0.65
Digitaria sanguinalis L.	24.00	0.24	1.00	0.08	3.75
Papaver rhoeas L.	24.00	0.36	1.50	0.03	0.63
Sorghum halepense L.	24.00	0.34	1.42	0.43	3.04
Carduus nutans L.	22.00	0.24	1.09	0.01	0.25
Chenopodium murale L.	22.00	0.38	1.73	0.29	2.85
Lactuca serriola L.	22.00	0.22	1.00	0.01	0.25
Amaranthus hybridus L.	20.00	0.20	1.00	0.05	0.63
Rumex crispus L.	20.00	0.22	1.10	0.01	0.25
Senecio vernalis Waldst. & Kit.	20.00	0.22	1.10	0.01	0.25
Sonchus oleraceus L.	20.00	0.22	1.10	0.01	0.25

GC: General coverage, SC: special coverage, GD: geneal density, SD: special density.

The herbicides were applied with 30 litres of water per da, in which they were pressurized to 30 psi. The weather conditions at the time of applications were clear skies with no wind and air temperature at 20°C.

Visual weed and crop injury observation were recorded after treatment applications at various intervals. During experiments, weed numbers were counted as one m^2 permanent quadrates per plot. Onions were harvested by hand using a small hand-hoe. Fresh weights of onion bulbs were recorded after harvest for a four m^2 quadrate from each plot. Data on onions and weed growth were recorded and subjected to an analysis of variance (ANOVA), and mean separation was done using Duncan at $P \leq 0.05$.

RESULTS

Weed species in onion fields

The surveys resulted in 105 weed species belonging to 30 families in onion fields. According to the weed species included, the top three largest families were found to be Asteraceae (17), Poaceae (14) and Fabaceae (9). Of all these species, 57 were displayed with a frequency of more than 20% (Table 1). The top five species were found as *Medicago polymorpha* L., *Convolvulus arvensis* L., *Avena sterilis* L., *Chenopodium album* L. and *Sinapis arvensis* L. with 84, 74, 68, 66 and 66 observation frequencies (%), respectively.

Based on the general coverage, the top five weed species were found as: *S. arvensis* L. (2.24%), *Medicago sativa* L. (2.14%), *C. arvensis* L. (1.76%), *A. sterilis* L. (1.74%) and *C. album* L. (1.40%), while based on the special coverage, the top five weed species were found as: *Phalaris paradoxa L.* (4.43%), *Phalaris minor* Retz (3.50%), *S. arvensis* L. (3.39%) *Stelleria media* (3.33%) and *Solanum nigrum* L. (2.64%) (Table 1). Both

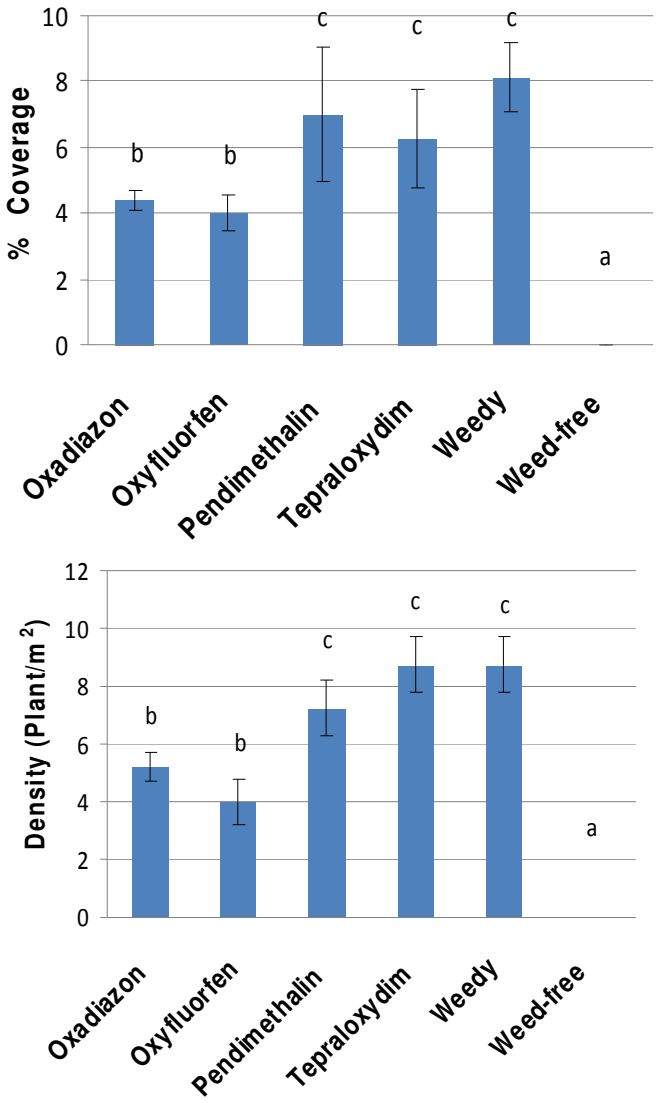

Figure 2. Effects of herbicides on weed cover (left) and density (right) in the first experimental area (Yuzbasi Village).

experimental fields were mostly infested with broadleaf weeds. The weeds recorded in the first experimental field were *Amaranthus retroflexus* L., *Xanthium strumarium* L., *S. media* (L.) Vill. and *Lamium amplexicaule* L.; and in the second experimental field, *Silybum marianum* (L.) Gaertner, *S. arvensis* L., *S. nigrum* L. and *Setaria verticillata* (L.) P.B. were observed as the most dominant weed species.

Effects of some herbicides on onion yield

S. nigrum and *S. verticillata* were recorded as the dominant weed species in the first experimental area (Yuzbasi village) and *X. strumarium, S. media* and *L. amplexicaule* were common in the second experimental area (Incirlik village) before herbicide application.

Eight weeks after herbicide application, the data (May 30th, 2007) were recorded and evaluated to see the effects of herbicides on weed cover and density in permanent quadrates in each plot of the onion fields. In the first experimental area (Yuzbasi village), weedy check had the most weed cover as expected. Oxadiazon and oxyfluorfen showed the best effects on weed cover and density (Figure 2). There was no statistical difference between the two herbicides; however, phendimethalin and tepraloxydim were not different in statistical mean.

The data belonging to eight weeks after herbicide application (May 30th, 2007), showed similar effects. In the second experimental area (Incirlik village), oxyfluorfen was the best herbicide controlled weeds (Figure 3). Oxadiazon provided adequate weed control following oxyfluorfen and they were not statistically different in terms of weed cover.

The comparison of the yields obtained from the different herbicides (weedy check and weed-free controls) are presented in Table 2.

The best control resulted from the weed-free (16.2^{a} kg/m^2) plot followed by oxadiazon (11.9^{b} kg/m^2) and oxyfluorfen (11.7^{b} kg/m^2). However, other two herbicides treatments did not provide adequate weed control and thus, had reduced yields due to weed competition. Results, in which weed-free check caused 76.3% increase in the onion yields when compared with weedy checks, followed by oxadiazon (30.1%), oxyfluorfen (27.8%), pendimethalin (9.3%) and tepraloxydim (4.6%), showed that weed control is very important for onion production.

DISCUSSION

Onion is one of the most sensitive crops to weed competition. In onion growing areas in Cukurova Region, 105 weed species belonging to 30 families in onion fields were recorded. Mennan and Isık (2003) reported invasive weeds (23 species in the first survey and 87 species in the second survey) in onion and compared the last 25 years survey results in Amasya province in Turkey. These results indicated that weeds are one of the most important plant protection problems in onion fields of Turkey. Family Asteraceae, Poaceae and Leguminosae are found to be the largest families in this study. These three families already contain too many weed species in Turkey. Depending on agricultural practices and abiotic factors, weed flora can be changed in the future, since it is dynamic.

Mainly, chemical control is applied against weeds in onion producing areas in Turkey, but possible phytotoxicity on onion is also a main problem in Turkey. In this study, commercially recommended dose of herbicides were applied to two different onion fields. Reduced dose of oxyfluorfen provided a good weed control, but also was phytotoxic to onion. As a result, commercial dose of oxyfluorfen should be revised to reduce phytotoxicity. Oxadizon is the second herbicide that can be

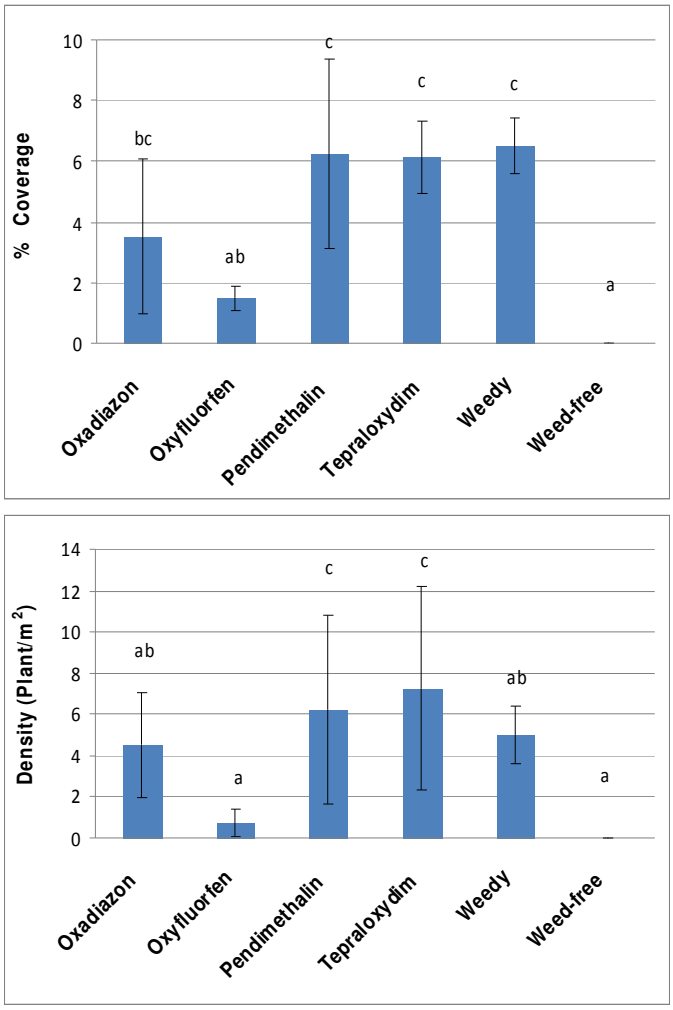

Figure 3. Effects of herbicides on weed cover (left) and density (right) in the second experimental area (Incirlik Village).

Table 2. Onion bulb yields in the experiments.

Treatment	The first experiment (Yuzbasi) (ton/da)	The second experiment (Incirlik) (ton/da)	Average (ton/da)
Oxadiazon	12.59 ± 0.954	11.26 ± 0.905	11.93 ± 0.937b
Oxyfluorfen	12.98 ± 0.758	10.47 ± 0.916	11.72 ± 1.777b
Pendimethalin	10.92 ± 0.566	9.11 ± 0.617	10.01 ± 1.278c
Tepraloxydim	10.36 ± 0.850	8.81 ± 0.219	9.58 ± 1.096c
Weedy check	9.88 ± 0.444	8.46 ± 0.681	9.17 ± 0.999c
Weed-free	16.40 ± 0.613	15.94 ± 0.429	16.16 ± 0.323a

*The data in a column followed by the same lower case letter are not significantly different, P ≤ 0.05, ANOVA with Duncan's multiple-range test.

recommended, because the other herbicides used in experimental fields caused no phytotoxicity on onion plants. Similarly, Ahmed et al. (1994), Ghaffoor (2004) and Khohlar et al. (2006) reported that oxadiazon and pendimethalin did not produce any crop reaction on onion seedlings. Zubair et al. (2009) recommended phendimethalin as pre-emergence to control weeds.

The best recommendation for onion weeds was

integrated in weed management methods, because in small scale onion fields, weeds could be removed by hand weeding. Also, crop rotation, proper herbicide application and herbicide rotation should be used in onion fields.

ACKNOWLEDGEMENT

This study was supported by the Academic Research Project Unit (Project No: ZF2006YL79) of Cukurova University.

REFERENCES

Ahmed Z, Baloch J, Munir M, Nawaz Q (1994). Comparative efficacy of different herbicides and their time of application against weeds and yield of bulb onion. Pak. J. Weed Sci. Res. 7(1-2): 18-24.

Anonymous (2007). Devlet Meteoroloji Isleri Genel Mudurlugu, Adana Meteoroloji Bolge Mudurlugu, Merkez Klima Istasyonu (Turkish State Meteorological Service, Adana Meteorology Regional Directorate, Central Station).

Bell CE, Boutwell BE (2001). Combining Bensulide and Pendimethalin Controls Weeds in Onions. California Agriculture, January-February, pp. 35-38.

Carlson HL, Kirby D (2005). Effect of Herbicide Rate and Application Timing on Weed Control in Dehydrator Onions. University of Florida, Intermountain Research and Extension Center, Number, 115: p. 4.

Davis PH (1965-1989). Flora of Turkey and the East Aegean Islands Edinburgh University Press, Edinburgh. Vol. 1-10.

Dunan CM, Westra P, Moore F, Chapman P (1996). Modelling of the effects of duration of weed competition, weed density and weed competitors on seeded irrigated Onion. Weed Res. 36(3): 259-269.

FAO (2006). FAO Statistics Division, http://faostat.fao.org/default.aspx

Ghaffoor A (2004). Integrated weed management in different varieties of onion (*Allium cepa* L.). Pak. J. Weed Sci. Res. 10(1-2): 55-62.

Ghosheh HZ (2004). Single Herbicide Treatments for Control of Broadleaved Weeds in Onion (*Allium cepa*). Crop Prot. 23: 539-542.

Khohlar KM, Mahmood T, Shakeel M, Chaudhry MF (2006). Evaluation of Integrated Weed Management Practices for Onion in Pakistan. Crop Prot. 25: 968-972.

Kizilkaya A, Onen H, Ozer Z (2001). Sogan Verimine Yabancı Ot Rekabetinin Etkileri Üzerine Araştırmalar (Researches on the Effects of Weed Competition on Onion Yield). Türkiye Herboloji Dergisi, J. Turk. Weed Sci. 4(2): 58-65.

Menges RM Tamez S (1981). Response of onion (*Allium cepa*) to annual weeds and post-emergence herbicides. Weed Sci. 29(1): 74-79.

Mennan H, Isık D (2003). Invasive Weed Species in Onion Production Systems. During The Last 25 Years in Amasya, Turkey. Pak. J. Bot. 35(2): 155-160.

Odum EP (1971). Fundamentals of ecology. W.B. Saunders Company, Philadelphia, p. 574.

Ozer Z, Kadioglu İ, Onen H, Tursun N (1997). Herboloji (Yabancı ot Bilimi), (Weed Science) Gaziosmanpaşa Üniversitesi, Ziraat Fakültesi Yayınları NoKitaplar Serisi, 20(10): p. 388.

Qasem JR (2006). Chemical Weed Control in Seedbed Sown Onion (*Allium cepa* L.). Crop Prot. 25: 618-622.

Smith R, Fennimore SA, Orloff S, Poole GJ (2008). Bell, CE., Cudney, DW., Fennimore, SA, Orloff, S (2002). Weeds (Flint ML editor). UC IPM Pest Management Guidelines: Onion and Garlic. University of California, Agriculture and Natural Resources, Publication, p. 3453.

TurkStat (2008). Turkish Statistical Institute, Crop Production Statistics.

Wicks GA, Johnston DN, Nuland DS, Kinbacher EJ (1973). Competition between annual weeds and sweet Spanish onions. Weed Sci. 21: 436-439.

Zubair M, Rahman H, Jilani MS, Kiran M, Waseem MK, Khattak AM, Rahim A, Khan AA, Quayyum A, Wahab A (2009). Comparison of Different Weed Management Practices in Onion (*Allium cepa* L.) Under Agroclimatic Conditions of Dera Ismail Khan, Pakistan. Pak. J. Weed Sci. Res. 15(1): 45-51.