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DETERMINATION OF THE EFFECTS OF DIFFERENT HERBICIDES AND THEIR DOSES ON TUBER DEVELOPMENT OF *ASPHODELUS AESTIVUS*

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Abstract: This study has been conducted into the rangelands of Mediterranean climatic zone aim to control the commonly found *Asphodelus aestivus* Brot. weed plant having poisonous characteristics due to the presence of glycosides inside it. The research was carried out in Gerlengeç village of Biga District at Çanakkale Province, Turkey. Herbicide application was done in the month of April in 2015 while the tuber samples were collected in the month of April in 2016. The following five different herbicides were used in the control of *A. aestivus* due to the non-availability of any selective and specific herbicide that has being used in the chemical control of this weed species. In general; chlorosulfuron, dicamba+Triasulfuron and tribenuron methyl+thifensulfuron methyl herbicides affect the broad-leaved, metsulfuron methyl+lodosulfuron methyl is used in the control of narrow-leaved, while glyphosate is an all-rounder herbicide that is used in the control of broad as well as narrow-leaved weed plants. In addition, two different doses (applied and double) of the above mentioned herbicides were selected to apply. The research was established according to the randomized complete block design (RCBD) by using three replications. The effects of applied herbicides have been investigated on tuber characteristics of *A. aestivus* in this research. As a result, the applied herbicides showed significant effects on the weight, length, diameter and the number of tuber while the applied doses were found with significantly important effects only on the weight and number of tuber. It concluded that the most effective herbicides were chlorosulfuron and glyphosate, and the best effective dose was observed as the ‘double dose’ in the chemical control of summer asphodel.

Keywords: *Asphodelus aestivus*, herbicide, dose, number of tuber, tuber weight.

INTRODUCTION

Weeds found in rangelands and pasture cause an approximate of 1% coverage area and 1% loss in crop production (Anonymous, 2014). *Asphodelus aestivus* Brot. belongs to Liliaceae family, a perennial tuberous weed plant takes place at the top among the weed species and threatening the rangelands and pasture areas in recent years. Summer asphodel is a geophyte weed plant and widely spreads into the rangelands of the Mediterranean climatic zone. (Diaz Lifante, 1996; Polunin and Huxley, 1965). This weed plant is found in spreading as well as invasive position, particularly, in rangelands with calcareous soil structure (Margaris, 1984). In Turkey, this weed plant spreads in Aegean, Marmara, Mediterranean and Southeast Anatolia regions which are dominated with Mediterranean climatic conditions. These species reach to a ratio of 10–50%, especially, in Aegean and Eastern Mediterranean rangelands (Bilgir, 1961; Onder and Karsavuran, 1986; Uygun et al., 1994). Even, it is said that the ratio of summer asphodel is reach up to 10 m^{-2} in the rangelands of Aegean region (Eltez, 1995). These ecosystems, which are described as “Asphodel Deserts”, are defined as the stages of degradation of herbaceous vegetations in the Mediterranean region. (Ayyad, 1976; Ayyad and Hilmy, 1974; Le Houerou, 1981). Summer asphodel grows both with generative and vegetative method of growing. But, the mature plants generally grow vegetatively (with tuber). This feature facilitates the plant resistance to unfavorable climatic conditions. The plant is with the height of 50-170 cm having 12 cm long and 4 cm tubers in diameter. Tubers grow continuously if the environmental conditions are favorable and the plant is healthy. Tubers are used in making bread by boiling in water, and then add them into wheat or potato flour at certain ratios in some countries like Spain. In addition, the Persians dried and pulverized the tubers of summer asphodel, and then mixed them with cold water for the purpose of obtaining glue (Sawidis et al., 2005). However, this plant is toxic to animals due to the presence of toxic glycosides (C glycoside) and it is not grazed by animals since it is green (Birincioğlu et al., 2005).

This study has been conducted in the rangelands of Mediterranean climatic zone aim to reduce the development and growth of summer asphodel, applying different herbicides and their different application doses, which causes major problems in recent time and also thought to be the most problematic weed plant of this region in near future.

MATERIALS AND METHOD

The experiment has been carried out in 2016 into the rangeland areas of Gerlengeç village situated in Biga District of Çanakkale Province in Turkey. The research area is heavily covered with the weed plant namely, summer asphodel (*Asphodelus aestivus* Brot.). The population density of summer asphodel varied between 20-30 plants/m^2 during the count that has been done before the experimental trials. The soil of rangelands, where this research was conducted, is predominantly clayey with medium organic matter contents (2,41%), neutral (pH: 7,09), lesser lime (2,14%) and salt free (0,99 mS/cm). Less soluble P (2,53 kg/da) and Zn (0,22 ppm); adequate amount of K (44,65 kg/da), Cu (1,74 ppm), Fe (14,74 ppm) and Mn (22,84 ppm); and excessive amount of Ca (7742,2 ppm) and Mg (662,6 ppm) are found in the soil of research area. This research was established according to the randomized complete block design (RCBD) by using three replications. A total of five different herbicides having the active ingredients namely; chlorosulfuron, glyphosate, dicamba+triasulfuron, metsulfuron methyl+lodosulfuron methyl and tribenuron methyl+thifensulfuron methyl along with their doses (applied and double) were used in the chemical control of *A. aestivus*. The total number of experimental plots were 30 (5 herbicides x 2 doses x 3 replications) and each plot was consisted with an area of 3 m^2 in the research. The herbicide application was done in spring at the time of newly re-emerging twigs of summer asphodel in April 15, 2015. In the

experiment, the number of tubers/m^2, tuber weight/plant, average single tuber weight, tuber diameter and tuber length were examined. The data obtained from the study were statistically analyzed by using the JMP 11 statistical package program.

RESULTS AND DISCUSSION

Number of tubers: There was a significant decrease found in the number of tubers of *A. aestivus* but their interactions were not found significantly due to the application of different herbicides and their different doses. The highest number of tubers was 19,14 in applied dose application, but it decreased to 15,05 in double dose application of different herbicides. The average number of tubers which were 29,07 in control plots, decreased significantly between 9,00–21,42 with the application of herbicides (Table 1).

Table 1. Number of tubers of *A. aestivus* according to different herbicides and doses (number)

Treatments	Doses		Mean
	Applied	Double	
Chlorosulfuron (C)	9,92	8,08	9,00 **D**
Glyphosate (G)	17,61	10,33	13,97 **CD**
Dicamba+Triasulfuron (DT)	23,58	19,25	21,42 **B**
Metsulfuron Methyl+Lodosulfuron Methyl (ML)	19,25	11,50	15,36 **C**
Tribenuron Methyl +Thifensulfuron Methyl (TT)	14,50	13,00	13,75 **CD**
Control	30,00	28,13	29,07 **A**
Mean	19,14 **A**	15,05 **B**	
Pherbicide: <.0001*, Pdose: 0,0140, Pherbicide*dose: 0,5955			

Tuber weight: The effect of different herbicides and their doses on tuber weights of summer asphodel was important, but their interaction was not found significant. The tuber weight was measured as 978,3 g in case of double dose application, but it increased to 1214,.2 g in applied dose. A significant reduction has been observed in tuber weights with herbicide application. The lightest tubers (425,8 g) were identified in the plots treated with C. Tuber weights were determined in between 702,9–1158,6 g according to other herbicide applications. While the highest tuber weight (2734,8 g) has been determined in control (no herbicide application) plots (Table 2).

Table 2. Tuber weight of *A. aestivus* according to different herbicides and their doses (g)

Treatments	Doses		Mean
	Applied	Double	
Chlorosulfuron (C)	412,5	439,2	425,8 **D**
Glyphosate (G)	912,5	493,4	702,9 **CD**
Dicamba+Triasulfuron (DT)	1298,8	1018,4	1158,6 **B**
Metsulfuron Methyl+Lodosulfuron Methyl (ML)	1018,3	549,9	784,1 **C**
Tribenuron Methyl +Thifensulfuron Methyl (TT)	883,9	657,9	770,9 **CD**
Control	2758,8	2710,8	2734,8 **A**
Mean	1214,2 **A**	978,3 **B**	
Pherbicide: <.0001*, Pdose: 0,0293, Pherbicide*dose: 0,6529			

Single tuber weight: The average single tuber weight of *A. aestivus* has only varied statistically with respect to the applied herbicides, but showed non-significant importance in accordance to dose and herbicide*dose interactions. The highest tuber weight (78,59 g) has been determined in control plots followed by DT and ML treated plots with 45,85 g and 42,57 g, respectively. The lowest single tuber weight has been recorded in C (21,30 g) and G (30,65 g) treated plots (Table 3).

Table 3. Single tuber weight of *A. aestivus* according to different herbicides and doses (g)

Treatments	Doses		Mean
	Applied	Double	
Chlorosulfuron (C)	20,35	22,24	21,30 **E**
Glyphosate (G)	36,46	24,83	30,65 **DE**
Dicamba+Triasulfuron (DT)	49,57	42,13	45,85 **B**
Metsulfuron Methyl+Lodosulfuron Methyl (ML)	45,92	39,21	42,57 **BC**
Tribenuron Methyl +Thifensulfuron Methyl (TT)	33,23	31,91	32,57 **CD**
Control	80,59	76,59	78,59 **A**
Mean	44,35	39,49	
Pherbicide: <.0001*, Pdose: 0,1807, Pherbicide*dose: 0,8051			

Tuber diameter: The diameter of the tubers of summer asphodel has been changed significantly with respect to treated herbicides, but did not show any significant change in accordance to dose and herbicide*dose interactions. The highest tuber diameter (13,95 mm) has been measured in control (no herbicide treated) plots followed by DT and ML treated plots with 13,08 mm and 12,49 mm, respectively. The lowest tuber diameters (6,76; 9,17 and 9,31 mm) have been observed in C, TT and G treated plots (Table 4).

Table 4. Tuber diameter of *A. aestivus* according to different herbicides and their doses (mm)

Treatments	Doses		Mean
	Applied	Double	
Chlorosulfuron (C)	6,53	7,03	6,76 **D**
Glyphosate (G)	11,28	7,34	9,31 **C**
Dicamba+Triasulfuron (DT)	13,92	12,23	13,08 **AB**
Metsulfuron Methyl+Lodosulfuron Methyl (ML)	13,58	11,40	12,49 **B**
Tribenuron Methyl +Thifensulfuron Methyl (TT)	9,14	9,19	9,17 **C**
Control	15,45	12,45	13,95 **A**
Mean	11,65	9,10	
Pherbicide: <.0001*, Pdose: 0,0840, Pherbicide*dose: 0,4182			

Tuber length: According to different herbicide applications, significant differences have been found between tuber lengths, but the difference was non-significant in accordance to dose*herbicide interaction. The longest tuber length has been recorded in control (non-treated) plots with 7,65 cm followed by DT and ML treated plots as 7,11 cm and 6,60 cm, respectively. The shortest tubers were determined in C (3,56 cm), G (4,71 cm) and TT (4,90 cm) herbicides treated plots (Table 5).

Table 5. Tuber lengths of *A. aestivus* according to different herbicides and their doses (cm)

Treatments	Doses		Mean
	Applied	Double	
Chlorosulfuron (C)	3,63	3,50	3,56 **D**
Glyphosate (G)	5,78	3,63	4,71 **CD**
Dicamba+Triasulfuron (DT)	7,23	6,99	7,11 **AB**
Metsulfuron Methyl+Lodosulfuron Methyl (ML)	7,12	6,08	6,60 **B**
Tribenuron Methyl +Thifensulfuron Methyl (TT)	4,92	4,88	4,90 **C**
Control	8,17	7,12	7,65 **A**
Mean	6,14	5,37	
Pherbicide: <.0001*, Pdose: 0,1165, Pherbicide*dose: 0,5205			

In this study, the herbicides used to prevent the growth of tubers of summer asphodel caused 37-255% decrease in growth and development of tubers as compared to the tubers found in control (non-treated) plots. Another way of slowing or stopping the growth of tuber is done through slowing or eliminating the growth in soil surface plant parts. In another similar evaluation, the effects of five different herbicides along with their two different doses were investigated on the number of plants, plant height, number of leaves, leaf diameter and leaf length. Consequently, it has been found that herbicide application caused a decrease in the vegetative growth by 6,4-111,5% (Alatürk et al., 2017). Different improvement methods like pulling, pulling+seeding, mowing, mowing+seeding, herbicide application, herbicide application+seeding, fertilization, fertilization+seeding, control and control+seeding have been applied in the same region for the control of summer asphodel, and it is concluded that the most effective results would be obtained by applying herbicide for the control of this plant (Gökkuş and Alatürk, 2016).

CONCLUSION

Summer asphodel is not only poisonous, but also reduces the usage of rangelands and the quality of herbage because it spreads very quickly. Therefore, this study was carried out in order to suppress or to keep under control the plant population in rangeland vegetation. For this purpose, five different herbicides and their two different doses were used to observe the subsoil (tuber) development of this weed plant. According to the overall results of this study, the effect of applied herbicides on all tested characteristics of tuber was found statistically significant while the applied doses showed a significant level of effect only on weight and number of tubers. It is concluded that chlorosulfuron was the most effective herbicide.

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