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## THE EFFECTS OF DIFFERENT HERBICIDES AND THEIR APPLICATION SEASONS ON CONTROLLING OF *ASPHODELUS AESTIVUS*

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**Abstract:** Summer asphodel is widely found in Mediterranean Rangelands. For being poisonous, it also causes a negative impact on rangelands quality. Therefore, a study has been carried out in order to prevent the growth of this weed plant depending on the application of different herbicides at different seasons. The research was conducted in the Gerlengeç village of Biga District at Çanakkale Province in 2016. Since there is no selective and specific herbicide in the chemical control with this weed plant that is why this study was conducted by using the active ingredients of five different herbicides in order to determine the most appropriate herbicide and its application season. Those of chlorosulfuron, dicamba+triasulfuron and tribenuron methyl+thifensulfuron methyl herbicides are effective against broad leaves while metsulfuron methyl+iodosulfuron methyl is used for narrow leaves and glyphosate is used for all types of herbaceous weed plants as a total herbicide. In addition, the herbicides were applied in two different seasons i.e., spring (March 2015) and autumn (November 2015). The research was established according to the randomized complete block design using three replications. The total experimental area was 100 m<sup>2</sup> and each plot consisted of 3 m<sup>2</sup> of the area in the experiment. The growth of *Asphodelus aestivus* has been observed after the application of above mentioned herbicides during the experiment. According to overall results of this research, the applied herbicides and their application seasons have been statistically significant on the investigated characteristics (number of plants, plant height, number of leaves, leaf diameter and length) of this weed plant. Consequently, the significant achievements were obtained from the plant in terms of herbicides and their application seasons.

**Keywords:** *Asphodelus aestivus*, herbicide, plant growth.

## INTRODUCTION

In the world 11,6% of the productivity losses in agricultural production are due to diseases; 13,8% by the pests and 9,5% by weeds, although, it varies according to the level of development of the countries (Cramer, 1967). Weeds, in rangelands and pastures, cause approximately 1% coverage area and also 1% loss in production (Anonymous, 2014). Improper use of rangelands causes an increase in weed plants by decreasing the plants having high nutrient value. Particularly, the poisonous weeds compete with good rangeland plants to limit their development and also threaten the health of grazing animals.

The summer asphodel (*Asphodelus aestivus* Brot.) is one of the toxic and common weed plants found in rangelands, it is a perennial and tuberous weed that belongs to Liliaceae family, and it is one of the weeds that threaten the rangeland areas in recent years. Summer asphodel is a widespread geophyte commonly found in Mediterranean, and also in those rangelands where the Mediterranean climatic conditions are dominant (Diaz Lifante, 1996). This weed plant is in spreading and invasive position especially, in calcareous rangeland soils (Margaris, 1984). In Turkey, it has been spread in Aegean, Marmara, Mediterranean and Southeast Anatolian regions where the Mediterranean climate is dominant. These species have reached a huge ratio of 10–50% especially, in Aegean and Eastern Mediterranean rangeland vegetations (Bilgir, 1961; Önder and Karsavuran, 1986; Uygun et al., 1994). Even, the ratio of summer asphodel in the rangelands of Aegean region is up to 10 plants per square meter (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 and Hilmy, 1974; Ayyad, 1976; Le Houerou, 1981). This weed plant grows both with generative and vegetative methods of growing. But, the mature plants generally grow vegetatively (with tuber). This feature of the plant facilitates the plant resistance to unfavorable climatic conditions. Summer asphodel is with a 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. This weed is not grazed by animals, even in its green condition, because it is toxic to animals due to the presence of toxic glycosides (C glycoside) inside the plant (Birincioğlu et al., 2005).

Herbicides, an important tool in weed control which are cheaper, do not destroy the land, do not create erosion risk, as well as, provide more effective control (Altın et al., 2005). Herbicides such as 2,2-dichloropropionic acid sodium salt 85% and metsulfuron methyl+tribenuron methyl provide effective results in the chemical control of summer asphodel (Bilgir, 1961; Gökkuş and Alatürk, 2016).

This study was conducted aim to control the summer asphodel, using different herbicides and their application in different seasons, which causes major problems in the rangelands where the Mediterranean climatic conditions are dominant.

## MATERIALS AND METHOD

The experiment has been carried out in the rangelands of the Gerlengeç Village of Biga District of Çanakkale Province Turkey in the years 2015–2016. The research area is heavily covered with summer asphodel (*Asphodelus aestivus* Brot.). The density of this weed plant has been varied between 20–30 plants/m<sup>2</sup> according to the counting done before starting the experiment. The average temperature was noted around 15.3–15.8°C during the study period. The highest temperatures have been observed in the months of July–August while the minimum temperatures in December–January. The total annual precipitation has been recorded as 650–658 mm. The large amount of the precipitation falls in the months of January–February, while the least rainfall occurred in July.

Soil of the research rangelands was found clayey. The content of organic matter is moderate (2,41%), neutral (pH: 7,09), low in lime (2,14%) and salt free (0,99 mS/cm). The amount of receivable P (2,53 kg/da) is less, K (44,65 kg/da) is sufficient, Ca (7 742,2 ppm) and Mg (662,6 ppm) are excessive in the soil.

The research was established according to the randomized complete block design by using three replications. Five different herbicides having the active ingredients of chlorosulfuron (C), glyphosate (G), dicamba+triasulfuron (DT), metsulfuron methyl+lodosulfuron methyl (ML) and tribenuron methyl+thifensulfuron methyl (TT) were applied in two different seasons (spring and fall). The total number of experimental plots were 30 (5 herbicides x 2 seasons x 3 replications), and each plot has been established with an area of 3 m<sup>2</sup> in the research. Herbicides were sprayed in the months of April and November in 2015. In this research, per m<sup>2</sup> number of plant, plant height, number of leaf, leaf diameter and leaf length have been examined. Finally, the obtained data were statistically analyzed by using the JMP 11 statistical package program.

## RESULT AND DISCUSSION

**Number of plant:** There has been a significant change in the number of summer asphodel plants depending on herbicides and their application seasons. All herbicides have reduced the number of summer asphodel plant. An extreme reduction has been recorded in the experimental plots treated with ML (4,61 number/m<sup>2</sup>), TT (6,69 number/m<sup>2</sup>) and C (6,89 number/m<sup>2</sup>). There were also significant differences among seasons, in which the herbicides were applied, in term of the number of plants. A fewer summer asphodels left in the plots in which the herbicides were applied in spring (from 16,52 number of plants/m<sup>2</sup> to 8,24 number of plants/m<sup>2</sup>) shown in Table 1.

**Table 1.** Number and height of summer asphodel plant of different herbicide treated plots in spring and fall seasons

Herbicides	Spring	Fall	Mean
	<i>Number of plant (No./m<sup>2</sup>)</i>		
Chlorosulfuron	1,44 fg	12,33 c	6,89 CD
Glyphosate	7,33 de	18,89 b	13,11 B
Dicamba+triasulfuron	4,44 ef	11,61 c	8,03 C
Metsulfuron methyl +lodosulfuron methyl	1,06 fg	8,17 d	4,61 D
Tribenuron methyl +thifensulfuron methyl	0,50 g	12,89 c	6,69 CD
<b>Herbicide mean</b>	<b>2,95</b>	<b>12,78</b>	<b>7,87</b>
Control	34,67 a	35,22 a	34,94 A
Mean	8,24 B	16,52 A	
	<i>Plant height (cm)</i>		
Chlorosulfuron	12,21 e	20,88 d	16,54 CD
Glyphosate	19,47 d	30,53 bc	25,00 B
Dicamba+triasulfuron	24,92 cd	22,33 d	23,63 B
Metsulfuron methyl +lodosulfuron methyl	19,21 d	23,06 d	21,14 BC
Tribenuron methyl +thifensulfuron methyl	11,28 e	19,92 d	15,60 D
<b>Herbicide mean</b>	<b>17,42</b>	<b>23,34</b>	<b>20,38</b>
Control	39,59 a	37,99 ab	38,79 A
Mean	21,11 B	25,79 A	

No. of plant: P<sub>herbicide</sub>: 0,0001, P<sub>season</sub>: 0,0001, P<sub>herbicide\*season</sub>: 0,0011

Plant height: P<sub>herbicide</sub>: 0,0001\*, P<sub>season</sub>: 0,0020, P<sub>herbicide\*season</sub>: 0,0313

**Plant height:** All of the applied herbicides significantly reduced the height of summer asphodel plants. The shortest weed plants have been measured in TT (15,60 cm) and C

(16,54 cm) treated plots. The overall application of herbicides in spring (21,11 cm) became more effective on plant height of *Asphodelus aestivus* shown in Table 1.

**Number of leaf:** The number of summer asphodel leaves reduced significantly in those experimental plots which were sprayed with herbicides. Plants produced least number of leaves particularly, in TT (8,89 No. leaf/plant) and C (9,69 No. leaf/plant) treated plots. The plants of summer asphodel formed least number of leaves in case the herbicides were applied in spring season (13,19 No. leaf/plant), shown in Table 2.

**Leaf diameter:** The application of herbicides to control this weed plant in rangelands has led to the formation of narrower leaves. The average leaf diameter of plants in the control plot was recorded as 2,33 cm, while this ratio has been varied from 0.60 to 1.08 cm in case of herbicide applied plots. The diameter of leaf did not show any significant change according to the season of herbicide application (Table 2).

**Leaf length:** The leaves of *A. aestivus* were considerably shortened as the result of different herbicides application. Plants with shortest leaves were observed into the experimental plots which treated with TT, C and ML herbicides having the size of 10,12, 10,90 and 11,94 cm, respectively. The application of herbicides in spring caused a considerable shortening of the leaves as compared to fall season application (Table 2).

**Table 2.** Diameter, number and length of leaf of summer asphodel of different herbicide treated plots in spring and fall seasons

Herbicides	Spring	Fall	Mean
<i>Number of leaf (No./plant)</i>			
Chlorosulfuron	7,89	11,50	9,69 C
Glyphosate	13,61	16,17	14,89 B
Dicamba+triasulfuron	12,33	13,44	12,89 B
Metsulfuron methyl +Iodosulfuron methyl	12,33	14,00	13,17 B
Tribenuron methyl +thifensulfuron methyl	6,28	11,50	8,89 C
<b>Herbicide mean</b>	<b>10,49</b>	<b>13,32</b>	<b>11,91</b>
Control	26,67	27,56	27,11 A
Mean	13,19 B	15,69 A	
<i>Leaf diameter (cm)</i>			
Chlorosulfuron	0,42 e	0,78 d	0,60 D
Glyphosate	0,91 bcd	0,88 cd	0,89 C
Dicamba+triasulfuron	1,12 b	1,04 bc	1,08 B
Metsulfuron methyl +Iodosulfuron methyl	0,87 cd	0,81 d	0,84 C
Tribenuron methyl +thifensulfuron methyl	0,50 e	0,82 cd	0,66 D
<b>Herbicide mean</b>	<b>0,76</b>	<b>0,87</b>	<b>0,81</b>
Control	2,39 a	2,26 a	2,33 A
Mean	1,04	1,10	
<i>Leaf length (cm)</i>			
Chlorosulfuron	3,76 h	18,04 bcd	10,90 D
Glyphosate	11,76 fg	18,81 bc	15,28 C
Dicamba+triasulfuron	16,56 cde	19,89 b	18,23 B
Metsulfuron methyl +Iodosulfuron methyl	9,22 g	14,66 ef	11,94 D
Tribenuron methyl +thifensulfuron methyl	4,74 h	15,49 de	10,12 D
<b>Herbicide mean</b>	<b>9,21</b>	<b>17,38</b>	<b>13,29</b>
Control	34,78 a	31,78 a	33,28 A
Mean	13,47 B	19,78 A	
No. of leaf: P <sub>herbicide</sub> : 0,0001*, P <sub>season</sub> : 0,0071, P <sub>herbicide*season</sub> : 0,7237			
Leaf diameter: P <sub>herbicide</sub> : 0,0001*, P <sub>season</sub> : 0,3257, P <sub>herbicide*season</sub> : 0,0162			
Leaf length: P <sub>herbicide</sub> : 0,0001*, P <sub>season</sub> : 0,0001, P <sub>herbicide*season</sub> : 0,0001			

Development of the upper soil parts of *A. aestivus* has been reduced significantly by the application of different herbicides. Herbicides primarily reduce the biological activity of plant structure, and then weaken its metabolism. Thereafter, many metabolic reactions such as oxidation, reduction, hydrolysis and conjugations occur in plant structure (Hatzios and Penner, 1982). Oxidation, reduction and hydrolysis come in first among these reactions that usually the stage in which the destructive processes take place. The next stage is the conjugation, where there new molecules are synthesized. Metabolites produced in the last stage of conjugation, which is formed from enzymatic and/or non-enzymatic reactions, are separated in the plant cells and then transported to different points (Shimabukuro et al., 1981; Hatzios and Penner, 1982). Herbicides are more soluble in water as they metabolize in the first two stages, but they lose their solubility in the last stage. Phytotoxicity of herbicides is reduced depending on each stage, and the phytotoxicity is disappeared in the last stage since they are metabolized (Ashton and Crafts, 1981; Hatzios and Penner, 1982; Corbett et al., 1984). Chlorosulfuron, triasulfuron, metsulfuron, lodosulfuron, thifensulfuron and tribenuron herbicides, used in this research, are also included in the general herbicide group of sulfonylureas. Herbicides, belonging to this group, inhibit the amino acid synthesis, photosynthesis, respiration and protein synthesis in plant. The growth of plant stops and the plant dies slowly because these herbicides slow down cell division while glyphosate inhibits EPSP (5-enolpyruvylshikimate 3-phosphate synthase) enzymes, disrupts aromatic amino acid synthesis (Jaworski, 1972; Hollander and Amrhein, 1980), inhibits protein synthesis (Cole et al., 1980), blocks photosynthetic carbon mechanics (Servaites et al., 1987), and prevents respiration of plant. These physiological effects of herbicides caused a significant decrease in plant growth. As a matter of fact, in another study carried out in the same region, the effects of herbicides and their application doses on the number of plants, plant height, leaf number, leaf diameter and leaf length were examined. As a result of this, a decrease with the ratio of 6,4–111,5% in vegetative growth of weed plant has been determined because of herbicides application (Alatürk et al., 2017).

The applied herbicides on summer asphodel became more effective in spring. The effects of herbicides are closely related to environmental conditions. The most important factor is the temperature among all of these. Herbicidal activity has also increased in spring, because, it is warmer than that of the fall. Because herbicides are more effective in the majority of plants at the temperature of 21–30°C (Altın et al., 2005). In addition, cool climatic plants enter into the growth process in spring with the effect of environmental factors. In this period when the physiological activities are increased in the plants, herbicides are increasingly taken into the body, then transported and used in physiological developments of plant. Consequently, it increases the effectiveness of herbicides.

## **CONCLUSION**

Summer asphodel spreads very quickly because it grows vegetatively and generatively, and also poisonous. In this case, the use of rangelands and the quality of hay are reduced. Therefore, in this study, it is aimed to control this plant. For this, the plant growth has been examined depending on five herbicides and their application in spring and fall. As a result of this research, all applied herbicides reduced the vegetative growth of the plant by 30–350% when compared with control. In addition, significant differences have been observed between the seasons in which the herbicides were applied, and the application of different herbicides also limited plant growth by 20–180% in spring as compared to fall season. According to overall result of this study, it has been noted that all herbicides used in the control of summer asphodel were effective, but the most effective herbicides were found as tribenuron methyl+thifensulfuron methyl and chlorosulfuron. It has been concluded that the application of herbicides in spring would have better results in the control of this weed plant.

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