

(*Orobanche aegyptiaca*)
(*Lycopersicum esculentum*)



(: :)

(41%EC)

(75% WG)

Investigating broomrape (*Orobanche aegyptiaca*) populations diversity in response to herbicides and banzotiadiazol in tomato (*Lycopersicum esculentum*)

N. NEZAMABADI¹, **H. RAHIMIAN MASHHADI¹**, **E. ZAND²**, **H. M. ALIZADEH¹** and **M. R. NAGHAVI¹**

1- University of Tehran, Faculty of Agriculture, Karaj, Iran

2- Iranian Research Institute of Plant Protection, Weed Research Department, P. O. Box 1454, Tehran 19395, Iran

Abstract

Knowledge about population diversity of broomrape in response to herbicides can help to better management this parasite. This experiment was carried out in a factorial with randomized complete block design with 3 replications under natural condition. First factor was broomrape populations and second factor was included active ingredient (a.i) of glyphosate (41%EC) at 21 & 41 ml ha⁻¹ and sulfosulfuron (75% WG) at 27 & 50 g a.i ha⁻¹, and 15, 20 and 30 ppm banzotiadiazol (BTH) sprayed 30, 40 & 50 days after transplanting or DAT. Density and dry weight reduction percentages of broomrape and yield loss of tomato were estimated. In all population except Oromieh 50 g a.i ha⁻¹ sulfosulfuron was the best treatment (80% control). But only Behshahr broomrape population was completely controlled. Oromieh broomrape population was controlled 80% with 41 ml a.i ha⁻¹ glyphosate. All dosages of banzotiadiazol except 30 ppm a. i. ha⁻¹, couldn't control broomrape populations.

Key words: broomrape population, Density, dry weight of broomrape, sulfosulfuron, glyphosate.

✉ Corresponding author: nezamabadi_n@yahoo.com

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Dianat *et al.*, 2008; Luzuriaga *et al.*, 2006;)

.(Mehrafarin *et al.*, 2008

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.(Diaby and Kasler, 2003)

(*Orobanche aegyptiaca* Pers.)

Phelipanche aegyptiaca Walp

(SAR)

.(Sauerborn *et al.*, 2002)

.(Montemurro *et al.*, 2006)

Fan *et al.* (2003)

Eizenberg *et al.* (2004)

O. aegyptiaca

(*Bemisia tabaci* Gennadius)

Fusarium oxysporum f. sp. *Radicis –lycopersici*

.(Nombela *et al.* 2005)

Forozesh *et al.* (2009)

Orobanche ramosa L.

.(Gonsior *et al.*, 2004)

Sauerborn *et al.* (2002)

Kazerooni Monfared *et al.* (2012) .

Systemic Acquired Resistance (SAR)

BTH (1, 2, 3-Benzothiadiazole-7-carbothioic acid S-methyl ester,
BION® 50 WG, Syngenta)

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Table 1. Characteristics of broomrape populations collected from different locations of Iran

Num.	Population	Host	Province	Year	Latitude	Longitude
1	Arak	Potato	Markazi	2008	34 05 09.9	49 41 52.8
2	Behshahr	Tobacco	Mazandaran	2009	36 42 03.9	53 32 30.2
3	Eivanakie	Melon	Semnan	2009	35 18	52 00
4	Garmsar	Tomato	Semnan	2008	35 20 40.7	52 03 24.1
5	Hamadan	Potato	Hamadan	2008	35 13 07.3	48 41 49.0
6	Mashhad1	Tomato	Khorasan razavi	2008	36 26	59 25
7	Mashhad2	Tomato	Khorasan razavi	2008	36 17	59 36
8	Oromieh	Sunflower	Azarbayjan gharbi	2008	37 40 8.28	45 04 06.9
9	Pishva	Tomato	Tehran	2008	35 18	51 42
10	Saveh	Cantaloupe	Markazi	2008	35 1	50 21
11	Hashtgerd	Tomato	Alborz	2009	35 53	50 36
12	Varamin	Tomato	Tehran	2009	35 19 24.3	51 39 20.8

(Roundup, 41%EC)

(Apyros, 75% WG)

.(Bion, 50% WG)

(Bion, 50%WG)

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O. aegyptiaca

Archive of SID

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(Sandral *et al.*, 1997) EWRC

Super strain "B"

European Weeds Research Council rating

Minbashi *et al.* (2008)

(Batchvarova *et al.*, 1999)

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SAS

Lyra *et al.* (2004)

Lopez-Granados and Garcia-Torres (1996)

Average linkage 16 SPSS

UPGMA

Unweighted paired group method using arithmetic average

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جدول ۲- جدول تجزیه واریانس کاهش تراکم، وزن خشک و عملکرد (میانگین مربعات) جمعیت‌های گل جالیز کشور در واکنش به تیمارهای علفکش و بنزوتیادiazol نسبت به شاهد آلوده و بدون آلودگی به گل جالیز در سال ۱۳۸۹ و ۱۳۹۰

Table 2. Variance analysis of density, dry weight and yield reduction percentages (mean square) in broomrape populations response to the herbicides and banzotiazol, corresponding to the control with and without broomrape in 2010 and 2011

Source of variation	MS							
	2010				2011			
	df	Broomrape density reduction (%)	Broomrape dry matter reduction (%)	Yield reduction (%)	df	Broomrape density reduction (%)	Broomrape dry matter reduction (%)	Yield reduction (%)
Block	2	1779.5**	55.53 ^{ns}	0.13 ^{ns}	2	2.88 ^{ns}	0.30 ^{ns}	0.017 ^{ns}
Population	4	3231.08**	19.18 ^{ns}	0.11**	11	2.90 ^{ns}	3.35**	0.24**
Herbicide	12	6649.1**	459.5**	0.17**	11	345.5**	84.7**	1.19**
Population*Herbicide	44	384.8*	34.58*	0.012**	121	3.74**	0.70*	0.01*
Error	116	234.1	23.13	0.004	285	2.34	0.56	0.007
C.V. (%)		27.5	28.7	18.4		27.9	16.1	16.9

*: Significant at the 5% probability level, **: Significant at the 1% probability level, ns : Not significant
 *: معنی دار در سطح احتمال ۵ درصد، **: معنی دار در سطح احتمال ۱ درصد، ns: عدم تفاوت معنی دار



جدول ۳- مقایسه میانگین درصد کاهش تراکم و وزن خشک جمعیت های گل جالیز مختلف کشور در واکنش به تیمارهای علف کش و بنزوتیادیازول نسبت به شاهد آلوده به گل جالیز در سال ۱۳۸۹
Table 3- Means comparison of density reduction percentages in broomrape populations response to the herbicides and bantzotiazol, corresponding to the control with broomrape in 2010

Treatment	Broomrape population															
	Eivanakie				Garmsar				Pishva				Varamin			
	Broomrape density reduction (%)	Broomrape dry matter reduction (%)	Broomrape density reduction (%)	Broomrape dry matter reduction (%)	Broomrape density reduction (%)	Broomrape dry matter reduction (%)	Broomrape density reduction (%)	Broomrape dry matter reduction (%)	Broomrape density reduction (%)	Broomrape dry matter reduction (%)	Broomrape density reduction (%)	Broomrape dry matter reduction (%)	Broomrape density reduction (%)	Broomrape dry matter reduction (%)		
21 ml glyphosate	57.5 b	39.8 bc	82.8 a	64.6 ab	32.8 bc	50.9 cd	24.2 de	39.0 de	85.0 a	77.6 a	83.5 ab	79.4 a	81.5 ab	82.1 a	79.4 a	79.4 a
41 ml glyphosate	85.0 a	77.6 a	79.4 ab	83.5 ab	79.4 a	81.5 ab	82.1 a	79.4 a	85.0 a	77.6 a	83.5 ab	79.4 a	81.5 ab	82.1 a	79.4 a	79.4 a
26.6 g sulfosulfuron	87.5 a	84.8 a	66.3 ab	76.4 ab	67.2 a	65.6 bc	58.0 b	57.7 a-c	95.8 a	91.2 a	96.8 a	87.7 a	91.5 a	86.9 a	88.3 a	88.3 a
50g sulfosulfuron	95.8 a	91.2 a	95.2 a	96.8 a	87.7 a	91.5 a	86.9 a	88.3 a	16.2 c	24.1 c	21.9 c	12.2 c	33.1 e	5.6 fg	19.8 e	19.8 e
15 ppm BTH	16.2 c	24.1 c	38.1 cd	21.9 c	12.2 c	33.1 e	5.6 fg	19.8 e	74.2 ab	63.7 ab	48.7 bc	35.6 bc	42.2 de	16.1 de	31.5 c-e	31.5 c-e
20 ppm BTH	74.2 ab	63.7 ab	41.6 cd	48.7 bc	35.6 bc	42.2 de	16.1 de	31.5 c-e	74.2 ab	70.4 ab	40.0 bc	36.7 bc	56.2 cd	42.0 c	42.8 b-d	42.8 b-d
30 ppm BTH	74.2 ab	70.4 ab	47.3 bc	40.0 bc	36.7 bc	56.2 cd	42.0 c	42.8 b-d	12.5 c	19.0 c	25.1 c	32.8 bc	39.6 de	0.0 g	36.4 b-e	36.4 b-e
15 ppm spray BTH	12.5 c	19.0 c	30.9 d	25.1 c	32.8 bc	39.6 de	0.0 g	36.4 b-e	82.5 a	67.6 ab	46.4 bc	37.2 bc	33.2 e	29.2 d	51.8 a-d	51.8 a-d
20 ppm spray BTH	82.5 a	67.6 ab	43.5 cd	46.4 bc	37.2 bc	33.2 e	29.2 d	51.8 a-d	89.2 a	85.0 a	79.3 ab	58.6 ab	43.7 de	66.27 b	65.0 ab	65.0 ab
30 ppm spray BTH	89.2 a	85.0 a	84.1 a	79.3 ab	58.6 ab	43.7 de	66.27 b	65.0 ab								

*حروف مشابه بعد از اعداد در هر ستون نمایانگر عدم اختلاف معنی دار بین آنها در سطح ۵ درصد است (آزمون چند دامنه‌ای دانکن).

#Numbers followed by similar letters in each column are not significantly different at the 5% level according to Duncan's Multiple Range Test.

BTH= bantzotiazol, spray BTH= bantzotiazol (BTH) sprayed 30, 40 & 50 Days after transplanting.

All dosages of herbicides and bantzotiazol were based on active ingredient in hectare (a. i. ha⁻¹) and sprayed 30, 40 & 50 Days after tomato transplanting.

Table 4. Means comparison of tomato yield loss percentages in response to the broomrape populations, herbicides and banzotiadiazol, corresponding to the control without broomrape in 2010

Treatment	Broomrape population			
	Eivanakie	Garmsar	Pishva	Varamin
21 ml glyphosate	15.7 ab	15.6 cd	16.9 bc	11.8 ef
41 ml glyphosate	5.7 cd	7.6 e	2.7 e	11.1 ef
26.6 g sulfosulfuron	9.1 cd	29.4 ab	9.8 cd	14.2 de
50g sulfosulfuron	4.2 d	3.7 f	0.0 f	7.8 f
15 ppm BTH	24.6 a	30.2 ab	23.6 a	30.1 a
20 ppm BTH	22.2 a	29.7 ab	14.2 bc	26.1 ab
30 ppm BTH	21.4 a	21.8 bc	10.4 cd	21.1 bc
15 ppm spray BTH	24.2 a	32.1 a	19.2 ab	22.6 b
20 ppm spray BTH	10.8 bc	31.1 ab	8.2 cd	17.1 cd
30 ppm spray BTH	8.3 cd	9.4 de	6.3 d	10.9 ef

*Numbers followed by similar letters in each column are not significantly different at the 5% level according to Duncan's Multiple Range Test.

BTH= banzotiadiazol, spray BTH= banzotiadiazol (BTH) sprayed 30, 40 & 50 Days after transplanting.

All dosages of herbicides and banzotiadiazol were based on active ingredient in hectare (a. i. ha⁻¹) and sprayed 30, 40 & 50 Days after tomato transplanting.

Orouji *et al.* (2012)

جدول ۵- مقایسه میانگین درصد کاهش تراکم جمعیت های گل جالیز مختلف کشور در واکنش به تیمارهای علف کش و بنزیوتیادیازول نسبت به شاهد آلوده به گل جالیز در سال ۱۳۹۰

Table 5. Means comparison of density reduction percentages in broomrape populations response to the herbicides and bantzotiadiazol, corresponding to the control with broomrape in 2011

Treatment	Broomrape population											
	Arak	Behshahr	Eivankie	Garnsar	Hamadan	Mashhad 1	Mashhad 2	Oromieh	Pishva	Saveh	Hashitgerd	Varamin
21 ml glyphosate	33.3 cd	61.1 ab	12.3 d-f	36.1 ab	33.3 bc	36.7 b	21.7 b-d	0.0 d	15.0 cd	23.3 cd	33.3 bc	41.6 b-d
41 ml glyphosate	83.3 ab	91.7 a	71.1 ab	61.1 ab	75.0 b	78.3 a	73.9 a	91.7 a	65.2 a	76.7 a	83.3 a	82.2 a
26.6 g sulfosulfuron	41.6 c	33.3 b-d	42.2 a-c	30.5 b	41.7 b	50.0 ab	47.8 ab	44.4 b	41.1 a-c	38.3 bc	50.0 ab	47.8 ab
50g sulfosulfuron	91.7 a	100.0 a	77.8 a	69.4 a	83.3 a	80.0 a	77.8 a	47.4 b	67.2 a	78.3 a	94.6 a	88.8 a
15 ppm BTH	0.0 e	11.1 d	0.0 f	0.0 c	0.0 c	0.0 d	0.0 e	0.0 d	0.0 d	0.0 f	0.0 e	0.0 d
20 ppm BTH	16.6 d	0.0 d	22.4 e-e	11.1 c	33.3 b	6.7 c	0.0 e	8.2 cd	26.1 bc	6.7 ef	0.0 e	11.1 cd
30 ppm BTH	41.7 c	16.7 cd	28.9 b-d	30.5 b	25.0 b	13.3 c	17.8 cd	36.1 b	34.4 bc	15.0 ef	8.3 de	26.1 bc
15 ppm spray BTH	16.7 d	0.0 d	6.7 ef	8.3 c	16.7 c	13.3 c	15.0 cd	16.7 c	15.0 cd	38.3 bc	16.7 c-e	15.0 b-d
20 ppm spray BTH	33.3 cd	16.7 cd	35.6 a-c	30.8 b	16.7 c	43.3 ab	41.1 a-c	0.0 d	24.4 bc	38.4 bc	33.3 bc	30.0 bc
30 ppm spray BTH	50.0 bc	52.8 bc	42.2 a-c	50.0 ab	41.7 b	48.3 ab	67.2 a	55.6 ab	47.8 ab	61.7 ab	50.0 ab	47.8 d

*حروف مشابه بعد از اعداد در هر ستون نمایانگر عدم اختلاف معنی دار بین آنها در سطح ۵ درصد است (آزمون چند دامنه ای دانکن).

*Numbers followed by similar letters in each column are not significantly different at the 5% level according to Duncan's Multiple Range Test.

BTH= bantzotiadiazol; spray BTH= bantzotiadiazol (BTH) sprayed 30, 40 & 50 Days after transplanting.

All dosages of herbicides and bantzotiadiazol were based on active ingredient in hectare (a. i. ha⁻¹) and sprayed 30, 40 & 50 Days after tomato transplanting.

جدول ۶- مقایسه میانگین درصد کاهش وزن خشک جمعیت های مختلف گل جالیز در واکنش به تیمارهای علف کش و بنزوتیادیازول، نسبت به شاهد آلوده به گل جالیز در سال ۱۳۹۰
 Table 6. Means comparison of broomrape populations in response to the herbicides and bantzotiadiazol, corresponding to the control with broomrape in 2011

Treatment	Broomrape population											
	Arak	Behshahr	Eivanakie	Garmsar	Hamadan	Mashhad 1	Mashhad 2	Oromieh	Pishva	Saveh	Hashigerd	Varamin
21 ml glyphosate	16.8 cd	62.7 ab	15.3 cd	31.4 bc	22.9 bc	30.7 b	19.5 c	0.0 f	7.5 e	9.9 e	22.6 cd	15.5 cd
41 ml glyphosate	74.0 a	85.2 a	35.7 b	44.7 b	44.1 b	47.5 b	46.3 b	94.6 a	65.2 b	64.2 b	47.3 b	70.7 b
26.6 g sulfosulfuron	34.8 b	35.7 bc	27.2 bc	39.1 b	32.5 bc	39.5 b	43.7 b	44.9 bc	41.1 cd	38.3 c	39.7 b	44.2 c
50g sulfosulfuron	89.7 a	100.0 a	75.8 a	62.0 a	80.9 a	75.5 a	81.7 a	72.7 b	67.2 b	76.0 a	92.5 a	90.1 a
15 ppm BTH	3.6 f	5.9 e	0.0 e	14.5 d	17.1 d	3.3 d	3.2 e	1.8 d	0.0 f	3.7 e	2.3 h	2.3 h
20 ppm BTH	4.8 ef	3.9 de	6.2 de	17.1 d	27.8 bc	4.4 d	8.9 d	8.3 d	26.1 de	5.1 e	5.3 e	12.6 g
30 ppm BTH	25.2 b-d	11.3 de	33.6 b	33.6 bc	26.7 c	17.1 c	21.3 c	28.9 c	34.4 c-e	25.6 de	9.2 e	22.4 ef
15 ppm spray BTH	13.7 d	1.0 e	0.3 e	22.4 cd	9.5 cd	18.2 c	23.1 c	10.8 d	15.0 ef	28.8 c	18.8 d	12.4 g
20 ppm spray BTH	29.1 bc	19.8 c-e	23.2 bc	33.8 bc	10.7 de	36.2 b	38.6 b	28.6 c	24.4 de	37.4 c	27.5 cd	27.2 de
30 ppm spray BTH	40.1 b	27.0 c	36.1 b	45.1 b	46.3 b	44.5 b	50.1 b	50.6 bc	47.8 bc	49.3 b	45.6 bc	38.8 cd

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 BTH= bantzotiadiazol; spray BTH= bantzotiadiazol (BTH) sprayed 30, 40 & 50 Days after transplanting

All dosages of herbicides and bantzotiadiazol were based on active ingredient in hectare (a. i. ha⁻¹) and sprayed 30, 40 & 50 Days after tomato transplanting

جدول ۷- مقایسه میانگین درصد افت عملکرد گوجه فرنگی در واکنش به جمعیت های گل جالیز و تیمارهای علف کش و بنزوتیادیازول نسبت به شاهد بدون گل جالیز در سال ۱۳۹۰

Table 7. Means comparison of tomato yield loss percentages in response to broomrape populations, herbicides and bantzotiadiazol, corresponding to the control without broomrape in 2011

Treatment	Broomrape population											
	Arak	Behshahr	Eivanakie	Garmsar	Hamadan	Mashhad 1	Mashhad 2	Oromieh	Pishva	Saveh	Hashigerd	Varamin
21 cc glyphosate	33.3 cd	12.3 b	37.4 a-c	30.7 de	31.2 bc	31.6 ab	24.7 bc	17.9 a-c	25.8 bc	28.2 bc	34.2 a	39.2 a
41 cc glyphosate	24.2 e	6.5 c	32.2 c	30.2 de	22.5 de	22.3 b	12.8 d	6.2 d	22.6 c	21.3 d	23.5 cd	24.5 bc
26.6 g sulfosulfuron	28.3 de	23.9 a	34.6 bc	32.5 de	28.8 cd	26.7 ab	8.4 ef	10.0 b-d	22.2 c	26.3 c	28.8 bc	26.2 bc
50g sulfosulfuron	23.5 e	0.02 d	24.1 d	27.4 e	20.8 e	19.2 b	4.8 g	7.4 d	16.8 d	12.8 e	18.8 d	22.6 c
15 ppm BTH	44.9 a	24.2 a	41.9 ab	45.2 a	40.2 a	35.9 a	30.9 a	23.3 a	33.9 a	41.8 a	36.4 ab	41.1 a
20 ppm BTH	39.7 ab	23.8 a	43.2 ab	41.9 ab	32.3 bc	37.9 a	29.1 ab	23.1 a	28.1 a-c	39.4 a	44.1 a	39.6 a
30 ppm BTH	31.4 d	23.8 a	37.6 a-c	34.3 cd	32.2 bc	34.8 a	21.9 c	16.6 a-c	25.9 bc	25.6 a	42.5 a	37.8 a
15 ppm spray BTH	37.9 bc	26.1 a	43.9 a	38.9 bc	36.9 ab	36.7 a	20.6 a	21.9 a	32.0 a	32.7 b	38.6 ab	37.5 a
20 ppm spray BTH	31.8 d	25.1 a	36.3 a-c	34.8 cd	29.9 c	27.4 ab	10.6 de	24.3 a	29.9 ab	32.7 b	36.2 ab	30.5 b
30 ppm spray BTH	25.9 e	19.45 a	29.0 ab	29.8 de	28.7 cd	28.4 ab	5.6 fg	7.9 cd	23.3 c	24.3 cd	29.2 bc	29.7 b

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Dianat *et al.* (2008)

(*Phragmites australis* Cav. Trin. Ex steud.)

Orouji *et al.* (2012) . ()

.(Alijani, 2008)

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Archive of SID

Dianat *et al.* (2008)

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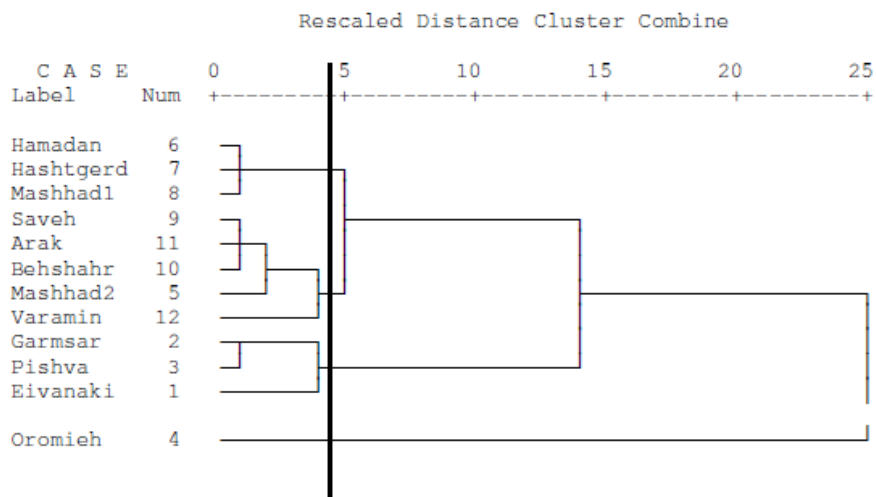
Forozesh *et al.* (2009)

Hadizadeh (2012)

(Lashgari *et al.*, 2010; Forozesh *et al.*, 2009)

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UPGMA

Fig. 1. Cluster analysis of different broomrape populations for all values, Using UPGMA method

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