

## The Response of Annual Italian Ryegrass in Saudi Arabia to Some Grass Herbicides

Khalid F. Al Mutlaq<sup>1</sup> and Carol Mallry-Smith<sup>2</sup>

<sup>1</sup>Dept. of Plant Protection, College of Agriculture, King Saud University  
P. O. Box. 2460, Riyadh 11451, Kingdom of Saudi Arabia

<sup>2</sup>Dept. of Crop and Soil Sci., College of Agriculture, Oregon State University,  
Corvallis 97331, U.S.A.

**Abstract.** Greenhouse experiments were conducted to study the effect of grass herbicides on selected population of annual Italian ryegrass that survive diclofop-methyl field application in wheat fields in Saudi Arabia. Seeds were collected from Al-Kharj and Al-Qasium area. The survival population of annual Italian ryegrass to diclofop-methyl in Al-Kharj area were found sensitive to Diclofop-methyl, Poast, Axiom, and Maverick. While Al-Qasium selection exhibit resistant to double field rate of diclofop-methyl. However, Axiom and Maverick can be recommended as alternative herbicide for controlling this selection in wheat. While Poast can be used to control this population if they emerge in tolerance crops to Poast such broadleaf crops.

**Key words :** Italian Ryegrass, resistant, Saudi Arabia, Oregon diclofop-methyl.

### Introduction

Chemical control of annual Italian ryegrass in wheat field with diclofop-methyl (methyl-2-[4-(2,4-dichlorophenoxy) phenyl]pro-panoate) at Saudi Arabia has been found not to be effective as it used to be. Saudi farmers have reported the failure of diclofop-methyl to control annual Italian ryegrass. Field application of diclofop-methyl to invested wheat farms in different region of Saudi Arabia showed no reduction of the population of annual Italian ryegrass (Al Mutlaq, 2002). World wide evaluation of herbicides resistant biotype of Italian ryegrass has been reported. *Lolium temulentum*, and *L. perenne* were

confirmed resistant to diclofop in Arkansas, USA, using whole-plant assay (Kuk, *et al.*, 2000). A biotype of *Lolium rigidum* resistant to diclofop-methyl was found in a monoculture winter wheat field in Lerida (Spain) that was due to the presence of a resistant form of the ACCase I isoform (Osuna *et al.*, 2000). In central Italy, a population of *Lolium* spp. was found to resist field application of diclofop-methyl (Bravin, *et al.*, 2001). Continues use of ACCase and ALS-inhibitor herbicides in Greece cause evolution of a population of *Lolium rigidum* resistant to diclofop and chlorsulfuron (2-chloro-N-[[4-methoxy-6-methyl-1,3,5 (Kotoula *et al.*, 2000). *L. rugidium* biotype SLR31 resistant to diclofop-methyl exhibit a cross resistant to

chlorosulfuron and imazamthabenz (Christopher, *et al.*, 1991). A diclofop-methyl resistant annual Italian ryegrass may develop cross resistant to other herbicide classes. For example, *L. rigidium* population was found to be cross resistant to fluazifop-butyl, 82725, chlorsulfuron and DPX-T6376 (Heap, 1986, 1982). Also, glyphosate resistant biotype of *L. rigidium* has been reported in Australia (Pratly *et al.*, 1999 and Powles *et al.* 1988). Biotypes resistant to several weeds have been reported to be resistance to several herbicides (Al Mutlaq, 2002; LeBaron and Creessel, 1982; Osuna *et al.*, 2000; Stanger and Applby, 1989; Thai *et al.*, 1985; Todd and Stobbe, 1977). The objective of this study was to test the response of diclofop-methyl resistant population of annual Italian ryegrass collected from Saudi Arabia to some grass herbicides.

## Materials and Methods

### Herbicides treatments:

Herbicides treatments were Holeon (Diclofop-methyl, 1.2 kg ai/ha), Maverick (Sulfosulfuron; 1-(2-ethylsulfonylimidazo [1,2a] pyridine-3-ylsulfonyl)-3-(4,6-dimethoxy pyrimidin-2-yl) urea: 0.036 kg air/ha), and Axiom 0.03 kg/ha (mix of flufenacet; N-(4-fluorophenyl)-N-(1-methyl ethyl)-2-[5-(trifluoro-methyl)-1,3,4-thiazol-2-yloxy]acetamide: 54% plus metribuzin; 4-amino-6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazin-5(4H)-one: 13.6%), Poast (sethoxydim; 2[1-(ethoxyimino)butyl]-5-[2-(ethylthio) propyl]-3-hydroxy-2-cyclohexene-1-one: 0.448 kg ai/ha).

### Greenhouse experiment:

Greenhouse experiments were conducted to determine the response of diclofop-methyl resistant population of annual Italian ryegrass collected from Saudi Arabia to some dim and

fop grasses herbicides inside the greenhouse of Weed research lab at Oregon state university. Corvallis, Oregon State, USA. Annual Italian ryegrass seeds were collected from local Saudi farms that have survival populations after single diclofop methyl application at field rate (1.2 kg ai/ha) in Al Qasium and Al Kharj area. Resistant seeds of annual Italian Ryegrass were obtained from Weed Research lab at Oregon state University, Corvallis, Oregon. USA. While sensitive seeds of annual Italian ryegrass were purchased from Local market in Riyadh City, Saudi Arabia. The seeds were planted in 20-cm plastic pots that was filled with mixed potting soil and then irrigated with tap water.

When weed seedlings reached 3 to 4 leaf stage, they were thinned to 4 plants per pot and sprayed with five rates that represent the double, one and half, signal, half and quarter of the recommended labeled field rate of each herbicide plus the control treatment. All herbicide treatments were applied to the weed seedling using CO<sub>2</sub> cabinet sprayer that was calibrated to deliver 200 L/ha at a pressure of 34 psi. Weed seedlings were harvested at the soil surface 28 days after herbicide treatments, dried and total shoot dry weight was recorded. The experiment was arranged as Randomize Complete Block Design with three replications. The experiment was carried out twice in the greenhouse.

Both experiments data were combined and subjected to the analysis of variance and mean separation using LSD test. All statistical analysis were carried out using SAS program (SAS 1991).

## Results and Discussion

The difference of the responses of diclofop-methyl resistant and sensitive annual Italian

**Table 1.** The responses of seedling shoot dry weight of commercial Italian ryegrass selection to herbicides treatment.

Rate	Herbicide			
	Axion	Hoelon	Poast	Maverick
Control	0.62a*	0.69a	0.68a	0.60a
0.25 X ♦	0.69a	0.49b	0.54a	0.66a
0.50X	0.62a	0.11c	0.07b	0.70a
1.00X	0.40b	0.06c	0.04b	0.62a
1.50X	0.28b	0.05c	0.06b	0.46b
2.00X	0.05c	0.05c	0.03b	0.33c
LSD	0.21	0.12	0.16	0.23

♦X denotes the label rate of each herbicide. \*Means with the letter a within column is not significant different from the control at  $p < 0.05$ .

**Table 2.** The responses of seedling shoot dry weight of Al-Kharj Italian ryegrass selection to herbicides treatment.

Rate	Herbicide			
	Axion	Hoelon	Poast	Maverick
Control	1.07a*	1.4a	1.17a	1.15a
0.25 X ♦	1.36a	1.10a	1.44a	1.36a
0.50 X	1.28a	1.11a	0.64b	1.16a
1.00	0.97b	1.12a	0.09c	0.99a
1.50 X	0.63c	1.18a	0.14c	1.03a
2.00 X	0.03d	0.91a	0.07c	0.48b
LSD	0.33	0.40	0.28	0.41

♦X denotes the label rate of each herbicide. \*Means with the letter a within column is not significant different from the control at  $p < 0.05$ .

ryegrass to Axiom (flufenacet plus metribuzin), diclofop-methyl, Poast, and Maverick are shown in tables 1,2,3, and 4. Table 1. shows that Diclofop biotype highly affected by diclofop-methyl at all doses. The shoot dry weight significantly reduced by the lower rate of Diclofop-methyl. However the response to other herbicides was vary. The shoot dry weight of sensitive biotype was started to response to the half-dose of Poast, single rate of Axiom and one and half dose of Maverick. Most interesting result in Table 1. is that sensitive biotype had similar response to half and higher doses of Diclofop-methyl and Poast. These observation confirm that the target site of the Diclofop-methyl and Poast in the sensitive biotype is very sensitive to the half dose of

these herbicides which caused complete death of plant. Other observation is the shoot dry weight of the sensitive biotype reduced as Axiom and Maverick doses increased. This may be due to the fact that the target site of these herbicides in the sensitive biotype is less sensitive compared to that of Diclofop-methyl and Poast and its sensitivity to Axiom and Maverick was dose dependent.

In Table 2. the response of Al-Kharj selection, which was suspect to be resistant to diclofop-methyl depend on the herbicides and the dose. The result shows that the shoot dry weight of this biotype had low response to Axiom because it was affected only by the one and half dose. Moreover Maverick showed effect on the shoot dry weight of Al-Kharj

**Table 3.** The responses of seedling shoot dry weight of Al-Qasium Italian ryegrass selection to herbicides treatment.

Rate	Herbicide			
	Axion	Hoelon	Poast	Maverick
Control	0.62a*	0.69a	0.68a	0.60a
0.25 X ♦	0.69a	0.49b	0.54a	0.66a
0.50X	0.62a	0.11c	0.07b	0.70a
1.00X	0.40b	0.06c	0.04b	0.62a
1.50X	0.28b	0.05c	0.06b	0.46b
2.00X	0.05c	0.05c	0.03b	0.33c
LSD	0.21	0.12	0.16	0.23

♦ X denotes the label rate of each herbicide. \*Means with the letter a within column is not significant different from the control at  $p < 0.05$ .

**Table 4.** The responses of seedling shoot dry weight of Oregon Italian ryegrass selection to herbicides treatment.

Rate	Herbicide			
	Axion	Hoelon	Poast	Maverick
Control	1.19a*	1.19a	1.03a	1.22a
0.25 X ♦	1.41a	1.36a	1.05a	1.17a
0.50X	1.04a	1.06a	0.66b	1.15a
1.00X	0.95b	1.30a	0.23c	0.92b
1.50X	0.50c	1.44a	0.18c	0.82c
2.00X	0.19c	0.45a	0.06c	0.67c
LSD	0.38	0.26	0.38	0.41

♦ X denotes the label rate of each herbicide. \*Means with the letter a within column is not significant different from the control at  $p < 0.05$ .

selection at the recommended rate and higher. However the Poast was highly effective in reducing shoot dry weight compared to other herbicides. Shoot dry weight of Al-Kharj selection showed significant reduction in shoot dry weight when it was treated by quarter rate and higher of Poast where all rates showed similar effect that is a complete death of the treated plants. Al-Kharj selection did not exhibit any resistant to diclofop-methyl except to quarter rate. The similarity of the general pattern of the commercial sensitive biotype and Al-Kharj selection biotype to the herbicides treatment specially to diclofop-methyl indicates that Al-Kharj selection exhibit no resistance to Diclofop-methyl as expected. Or at least it has a hetrogenetic of resistant and sensitive trait to

Diclofop-methyl in the field.

Table 3. shows that Al-Qasium selection of annual Italian ryegrass exhibited resistant to diclofop-methyl. Shoot dry weight of Al-Qasium selection did not reduce by all treated rates of diclofop-methyl. Similar response of Al-Qasium selection to Maverick was observed except in the double recommended dose. This biotype resistance was not observed with Axiom and Poast. The shoot dry weight of Al-Qasim selection started to be reduced by half rate of Poast and the recommended rate of Axiom. More than 90% reduction in shoot dry weight was observed with the recommended rate dose of Poast.

Table 4. showed that Oregon selection exhibit resistant to diclofop-methyl and

responded to herbicides similarly as Al-Qasim selection. Little different on the response of shoot dry weight of Oregon selection that was more sensitive to Mavreick and it reduced by the recommended rate compared to Al-Qasim selection that was reduced only by the double rate of the same herbicide.

This study conclude that field survival population of annual Italian ryegrass to diclofop-methyl in Al-Kharj area my due to unknown factor other than herbicides resistant. These observation encourage for more research for this selection. While Al-Qasium selection exhibit diclofop-methyl resistant. Axiom can be recommended as alternative herbicide for controlling this selection in wheat or other serial field, while Poast can be used to control this population if they exhibit in crop tolerant to Poast such as broadleaf crops.

## References

- Al Mutlaq, K.F. 2002. Diclofop-methyl resistance in Italian ryegrass in Saudi Arabia. *Alminia J. Agric. Sci.* V. 22: 1.
- Bravin F., G. Zanin, and C. Preston. 2001. Diclofop-methyl resistance in population of *Lolium* spp. from central Italy. *Weed Research-Oxford*. 1001. 41: 49-58.
- Christopher J.T., S.B. Powles, D.R. Liljegren, and M. A.J. Hotlum. 1991. *Plant. Physiol.* 95: 1036-1043.
- Heap I. and R. Knight. 1986. The occurrence of herbicide cross-resistance in a population of annual ryegrass, *Lolium rigidum*, resistant to diclofop-methyl. *Australian Journal of Agricultural Research*, 37: 149-156.
- Heap, J. and R. Knight, 1982. A population of ryegrass tolerant to the herbicide diclofop-methyl. *J. Aust. Inst. Agric. Sci.* 48: 156-157.
- Katoula Syka E, Tal Avi, and Rubin Baruch, 2000. Diclofop-resistant *Lolium rigidum* from northern Greece with cross-resistance to ACCase inhibitors and multiple resistance to chlorsulfuron. *Pest-Management-Science*. 56: 1054-1058.
- Kuk YongIn, N.R. Burgos, R.E. Talbert, and Y.I. Kuk. 2000. Cross-and multiple resistance of diclofop-resistant *Lolium* spp. *Weed-Science*. 48: 412-419.
- LeBaron, H.M and J. Gressel, 1982. Herbicide resistant in plants. Jhon Wiley and Sons, New York, 401 pp.
- Osuna, M.D., A. Diaz, J.L. Prado, and R. Prado. 2000. Partial purification of accase in *Lolium rigidum* resistant to diclofop-methyl. *Proceedings, 52nd International Symposium on Crop Protection, Gent, Belgium*. 65: 37-42.
- Powles, S.B., D.F. Lorraine\_colwill, J.J. Dellow and C. Preston. 1998. Evolved resistance to glyphosate in rigid reygrass (*Lolium rigidum*) in Australia. *Weed Sci.* 46: 604-607.
- Pratley, J., N. Urwin, R. Stanton, P. Baines, J. Broster, K. Cullis, D. Schafer, J. Bohn and R. Krueger. 1999. Resistance to glyphosate in *Lolium rigidum*. I. Bioevaluation. *Weed Sci.* 47: 405-411.
- SAS Institute. 1991. SAS/STAT User's Guide release 6.03. SAS Institute. Inc. Cary. NC.
- Stanger, C.I. and A.P. Appleby, 1989. Italian ryegrass *Lolium multiflurom* accessions tolerant to Diclofop. *Weed Sci.* 37: 350-352.
- Thai, K.M., S. Jana and J.M. Naylor, 1985. Variability for response to herbicides in wild oat (*Avena fatua*) population. *Weed Sci.* 33: 829-835.
- Todd, B.G. and E.H. Stobbe, 1977. Selectivity of diclofop-methyl among wheat, barley, wild oat (*Avena fatua*) and greenfoxtail (*Setaria viridis*). *Weed. Sci.* 25: 382-385.

## استجابة حشائش الهيبان في المملكة العربية السعودية لبعض مبيدات الحشائش النجيلية

خالد فرج آل مطلق<sup>1</sup> و كيرول ملاري سميت<sup>2</sup>

<sup>1</sup> قسم وقاية النبات - كلية الزراعة و الأغذية - جامعة الملك سعود

ص.ب. ٢٤٦٠ الرياض ١١٤٥١ المملكة العربية السعودية

<sup>2</sup> قسم المحاصيل والتربة - كلية الزراعة - جامعة ولايةأورجون الحكومية كورفالس

**ملخص:** أجريت تجارب في البيت المحمي لدراسة تأثير مبيدات الحشائش النجيلية علي حشيشة الهيبان المجمعة من حقول القمح في المملكة العربية السعودية والمقاومة للتطبيق الحقلية لمبيد الدايكوفوب-ميثايل . البذور جمعت من منطقة الخرج و القصيم. الهيبان المجموع من الخرج وجد أنه حساس لمبيد دايكوفوب - ميثايل - بوست - اكسيم و مافريك بينما الهيبان المجموع من القصيم وجد أنه مقاوم لضعف المعدل الحقلية لمبيد دايكوفوب - ميثايل كما يمكن التوصية باستخدام مبيد اكسيم ومافريك كبديل لمكافحة هذا النوع في حقول القمح بينما يمكن استخدام مبيد بوست لمكافحة هذا الهيبان في المحاصيل المقاومة له كمحاصيل عريضة الأوراق.