WHEAT AND BARLEY TOLERANCE AND THREE COMMON GRASSY WEED SUSCEPTIBILITY TO CLODINAFOP- PROPARGYL (TOPIK)

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Abstract

A series of experiments were carried out, in wheat fields at Sids Agricultural Research Station in three successive winter seasons 2005/2006, 2006/2007 and 2007/2008, in addition to five pot experiments in Weed Research, Laboratory FCRI, ARC, Giza in 2009/2010 winter season. The objective of the this study was to determine the tolerance of wheat and barley crops and susceptibility of three winter common grassy weeds, i.e. *Avena fatua* (wild oat), *Phalaris minor* (canary grass) and *Lolium temulentum* (rye grass) to clodinafop propargyl (Topik 15% WP) at rates of 70, 140 and 210 g/fad at two times of applications, 30 and 45 days after sowing (DAS) as compared to unweeded check.

The main findings revealed that wheat was tolerant to the herbicide at the recommend rate (140 g/fad) when applied 45 DAS whereas the herbicide was very effective against canary grass and increased wheat production at Sids. On the other hand, under pot experiments, wheat was tolerant to the herbicide at the three applied rates , 70, 140 and 210 g/fad applied 30 and 45 DAS as compared with barley which was sensitive to all studied rates. Topik at 210g/fad applied 30 DAS extremely inhibited chl a, chl b and carotenoid pigments of barley plants by 56.2, 64.2 and 70.1%, respectively. Furthermore, Topik at the three rates of 30 and 45 DAS gave a 100% reduction in *A.fatua* and *P.minor*, but, at rate of 70g/fad applied at 45 DAS , a reduction of 100% in *A.fatua* was achieved. Moreover, Topik at 140 and 210g/fad at both 30 and 45 DAS gave approximately 100% reduction of *L.temulentum*. These results suggest that clodinafop-propargyl (Topik 15% WP) should be used for controlling grassy weeds effectively in wheat, but farmers should be advised to avoid using this herbicide in barley fields due to its high phytotoxicity to barley, inspite of its efficacy on controlling grassy weeds.

INTRODUCTION

Clodinafop-propargyl (2-propynyl–2 (4-5-chloro-3-fluoro-2-pyridinoloxy–propinate) is known commercially as Topik 15% WP, applied as post emergence and registered as selective herbicide in Egypt to control grassy weeds in wheat at rate of 140 g/fad 45 days after sowing. The main mode of action of the herbicide is to avoid the lipid synthesis by inhibiting acetyl Co.A. Hassanein et al (1993), Hassanein et al (2005) and Jarwar et al (2005) proved that this herbicide at 0.238 l/ha (140 g/fad) effectively controlled the three common grassy weeds canary grass, rye grass and wild oat selectively to wheat plants. Mohan et al (1988) found the response of "Era"

(tolerant) and "Coteau" susceptible hard red spring wheat (*Triticum aestivum* L.) to CGA–82725 2-propynyl ester of (2-(40 (3,5-dichloropyridnyl) oxy) phenoxy) propanic acid) was similar and the translocation increased with time regardless of cultivar. Most of the absorbed C^{14} retained in the treated leaf in both cultivars. Recently, numerous farmers inquires about the potentiality of Topik herbicide to control efficiently grassy weed communities which including the three studied weeds in wheat fields. Furthermore, the probability of using this herbicide on barley fields without crop injury is expected. Thus, this research was designated to clarify the tolerance of wheat and barley to clodinafop-propargyl and susceptibility of canary grass, rye grass and wild oat to this herbicide.

MATERIALS AND METHODS

Three field experiments were conducted at Sids Agricultural Research Station during the period from 2005 to 2008 winter seasons, to compare the efficacy of clodinafop-propargyl to hand weeding on controlling *Phalaris minor* in wheat. Additionally, a set of pot experiments were conducted during 2009/2010 winter season in the wire house of Weed Research Laboratory, FCRI, ARC, Giza, to determine the response of wild oat (*Avena fatua)*, canary grass (*Phalaris minor)* , rye grass (*Lolium temulentum)*, wheat and barley crops to clodinafop-propargyl (Topik 15% WP) treatment as follows:

I- Field experiments: Comparison Topik **"clodinafop-propargyl" to hand weeding on phalaris control in wheat:**

This study was carried out to compare between the effect of clodinafop-propargyl and hand weeding on controlling *Phalaris minor* and wheat production in fields. Three wheat field experiments were conducted at Sids Agriculture Research Station through winter seasons of 2005/2006, 2006/2007 and 2007/2008. Each experiment consisted of three treatments in four replicates using randomized complete block design as follows:

a) Topik 15% WP at 140 g/fad at 45 DAS.

b) Hand weeding twice.

C) Untreated check.

Data recorded,

1- Fresh weight of canary grass plants /m^2 one month after herbicide application.

2- Grain yield in ard/fad at harvest.

II- Pot experiments: -

A - **Wheat & barley tolerance to Topik:**

Two pot experiments were carried out to test the tolerance of wheat and barley to clodinafop-propargyl. Each experiment consisted of seven treatments in a complete randomized design with four replicates sowing was in Nov. 2009 using wheat cultivar Bani Suef 3 and barley cultivar Giza 126. Treatments were as follows :

1- Topik 15% WP at 70 g/fad 30 DAS.
2- Topik 15% WP at 140 g/fad 30 DAS.
3- Topik 15% WP at 210 g/fad 30 DAS.
4- Topik 15% WP at 70 g/fad 45 DAS.
5- Topik 15% WP at 140 g/fad 45 DAS.
6- Topik 15% WP at 210 g/fad 45 DAS.
7- Untreated check.

Data recorded at 90 DAS as follows: -

1- Wheat plant height in cm.
2- Fresh weight of wheat plant in g.
3- Barley plant height in cm.
4- Fresh weight of barley plant in g.
5- Phytotoxicity percentage of wheat and barley was visually measured two weeks after herbicide application.
6- After 15 days from spraying, 0.1 g fresh samples of leaves of each wheat and barley were taken and grounded in acetone and completed to 25 ml acetone 85% and the photosynthetic pigments (chlorophyll a, chlorophyll b and carotenoid) were colormetrically determined for wheat and barley according to Metzner et al (1965). The pigment concentrations were calculated by using the spectrophotometer at 663, 644 and 452 nm. Pigment concentrations were calculated according the following formulae:
   - Chl. a (mg/ml acetone) = (10.3 * OD 663) - (0.918* OD 644)
   - Chl. b (mg/ml acetone) = (19.7 * OD644) – (3.87 * OD 663)
   - Carotenoids (mg/ml acetone) = (4.2 * OD 452) – (0.0264 * Chl. (a) – 0.496 * Chl. (b)).

B - Weed susceptibility to Topik:

Three pot experiments were designed to study the susceptibility of the three common grassy weeds, i.e. wild oat, canary grass and rye grass to clodinafop-propargyl. One experiment for each weed, 20 weed seeds were collected from

wheat fields at Giza farm during May 2009 and sown in each pot. Treatments were the same as in part II, A.

Data recorded:

1- Survival weed plants/pot.

2- Fresh weight of weed plants/pot.

In all experiments, the pots were 30 cm diameter, filled with clay soil and the sowing date was on mid November, 2009 and harvest date was mid February, 2010.

Data of field and pot experiments were subjected to the proper statistical analysis of variance of a randomized complete block design as out lined by **Steel and Torre (1980).** Least significant difference (LSD) at 5% level of probability was used for mean comparisons.

RESULTS AND DISCUSSION

1- Field experiments: -

- Effect of Topik at recommended rate versus hand weeding on *phalaris minor* and wheat yield

Data obtained from Table 1, revealed that Topik at 140 g/fed, applied at 45 DAS reduced the fresh weight of *Phalaris minor* plants/m^2 by 99.9 , 97.6 and 96.2% in 2005/2006, 2006/2007 and 2007/2008 winter seasons, respectively , compared to untreated as control and was comparable to results obtained by hand weeding twice which estimated by 99.1 , 96.2 and 96.4% , in the three respective seasons. On other hand, wheat productivity tended to increase significantly than unweeded check. These results were true in all seasons under both Topik or hand weeding. These results are in harmony with those of Hassanein et al (1993) and Jarwar et al (2005).

Table 1. Effect of Topik on *Phalaris minor* control and wheat productivity during 2005/2006, 2006/2007 and 2007/2008

Treatments	DAS	2005/2006			2006/2007			2007/2008		
		Phalaris		Yield ard /fad	*Phalaris*		Yield ard /fad	*Phalaris*		Yield ard /fad
		g/m^2	Control %		g/m^2	Control %		g/m^2	Control %	
Topik	45	0.5	99.9	21.6	5.25	97.6	23.0	91.0	96.2	23.8
HW	45	5.0	99.1	20.0	8.25	96.2	20.1	36.0	96.4	23.0
Untreated		554	0	13.5	215	0	12.7	2366	0	12.0
LSD 0.05		433.4		0.84	22.9		1.22	1708		2.3

II- Pot experiments

- Wheat and barely tolerance to Topik: -

Data in Table (2) show that no visible phytotoxicity on wheat plants due to Topik at the three rates in the two times of applications. There is some inhibition effect due to Topik treatments in chl. a & b and carotoniods contents especially with chl a by different rates, but with no significant difference between rate and times of application. Also, there is no significant difference on plant height or its fresh weight compared to untreated control. These results suggest that Topik is a safe and selective herbicide for controlling grassy weeds in wheat. Similar results were obtained by Mohan et al (1988). Meanwhile, Topik application at all studied rates (70, 140 and 210 g/fad) at both 30 and 45 DAS caused severe phytotoxicity and significant inhibitory effects on chl. a & b and carotonoids of barley plants. The highest phytotoxicity for chl. a & b and carotoniods appeared with 210 g/fad of Topik at 30 DAS reaching 56.2, 64.2 and 70.1 precent compared with the untreated check, respectively, and less phytotoxicity was happened at 70 g/fad when applied at the same times. These results show that the barley plant inhibitory effects increased with increasing Topik rates either at 30 or 45 DAS.

Both plant height and plant weight of barley behaved similarly with those obtained with phytotoxicity on chlorophyll pigment apparatus. Thus, Topik can't be used as a selective herbicide against grassy weeds in barley fields.

B - Grassy weed susceptibility to Topik:

Data in Table (3) and Figure (1) show that depending on no. of plants per pot and weight of *Phalaris minor* , *Lolium temulentum* and visual assessment of *Avena fatua*, the reduction percentage was amounted to 100% for *Avena fatua*, *Phalaris poradxa* and *Lolium temulentum* when Topik applied either at 30 or 45 DAS after sowing except *Phalaris paradoxa* or *Lolium temulentum* which decreased to 47 and 82.2% with Topik at 70 g/fed . This means that there is no resistance to Topik in these weed species.

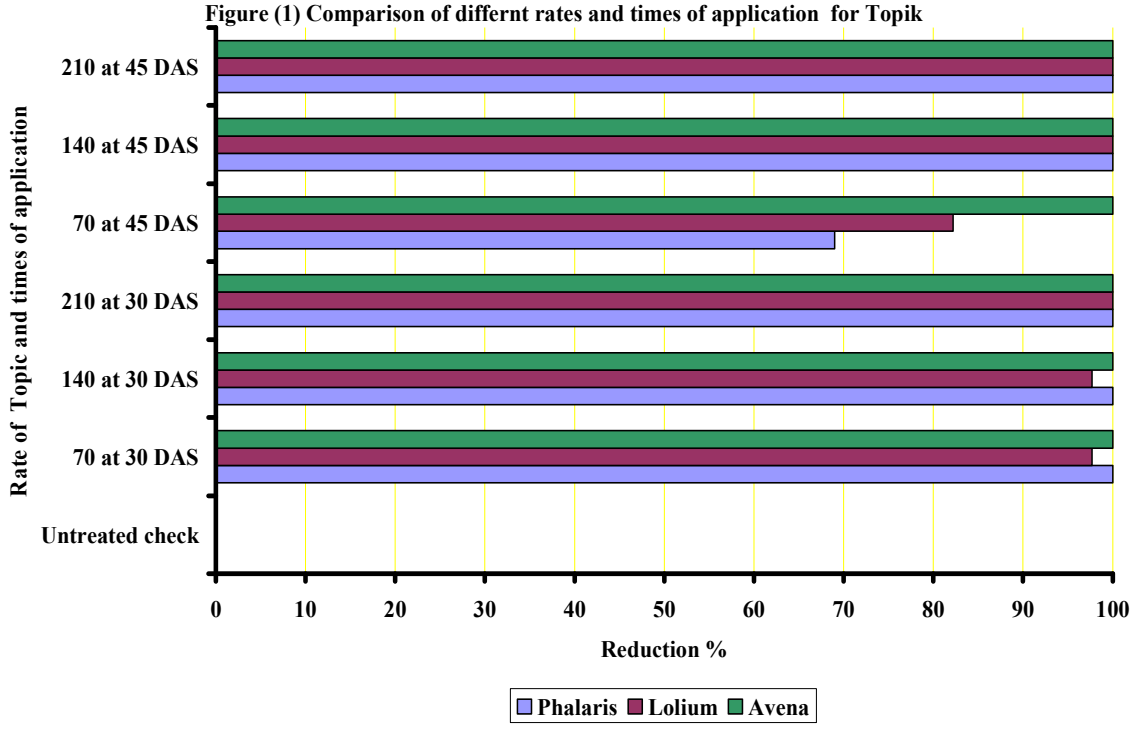
Symptoms of Topik phytotoxicity first appearing arrested plant growth follow by selectivity discolouration of foliage of susceptible weeds then begin to desiccate and die. These results suggest that wheat can tolerate the use of Topik for controlling grassy weeds i.e. *Phalaris minor*, *Lolium temulentum* and *Avena fatua* than barley and both *phalaris* or *Lolium* could be less affected by the half dose at later time of application (45 DAS) than earlier time (30 DAS). Farmers should be advised to use Topik according to the rate at the suitable time of application for wheat only due to its high selectivity to the herbicide. Similar results were obtained by Hassanein et al. (1993).

Table 2. Effect of Topik rate and time of application on phytotoxity %, plant height (cm), shoot fresh weight (g/plant) and photosynthetic pigments of wheat and barley; pot experiments 2010 season.

Topik g/fed rate	DAS	Wheat						Barley					
		Phytotoxicity %	Plant height (cm)	Fresh Shoot weight g/plant	Photosynthetic pigments			Phytotoxicity %	Plant height (cm)	Fresh Shoot weight g/plant ^{2}	Photosynthetic pigments		
					Chl. a	Chl. b	Carotinoids				Chl. a	Chl. b	Carotinoids
70	30	0	41	1.5	3.56	2.37	3.32	10	45	2.8	1.62	1.02	1.30
140	30	0	34	1.2	3.2	3.15	3.52	10	41	2.6	1.84	0.84	1.21
210	30	0	34	1.1	3.62	3.84	3.66	60	35	2.6	1.34	0.76	0.83
70	45	0	38	1.6	2.44	2.27	2.66	15	38	1.7	1.77	1.12	1.27
140	45	0	41	1.4	3.38	3.15	3.13	20	31	3.5	1.37	0.97	1.22
210	45	0	42	1.3	3.0	2.31	2.98	30	32	3.6	1.87	1.33	1.8
Untreated check		0	34	1.1	4.5	2.46	3.55	0	50	4.1	3.06	2.16	2.79
L.S.D 0.05			NS	NS	1.33	1.38	1.08		5.2	1.23	1.35	0.86	0.81

Table 3. Control of grassy weed species by Topik (pot experiment).

Rate of Topik g/fed	DAS	*Phalaris poradoxa*				*Lolium temulentum*				*Avena fatua*
		No. of survival plants pot	Control %	Wt. g/pot	Control %	No. of survival plants pot	Control %	Wt. g/pot	Control %	Control %
70	30	0	100	0	100	2	95.9	1.7	97.7	100
140	30	0	100	0	100	0	100	1.7	97.7	100
210	30	0	100	0	100	0	100	0	100	100
70	45	12.7	47	8	69	8	83.7	13.0	82.2	100
140	45	0	100	0	100	0	100	0	100	100
210	45	0	100	0	100	0	100	0	100	100
Untreated check		26.3	0	26.3	0	49.0	0	73.2	0	0
L.S.D 0.05		4.5	---	13.4				48.5		



The difference in susceptibility between wheat and barley or weed species to clodinafop propargyl may be depend on deposition of spray solution where the leaves of barley may be wider and can retain and eventually absorb clodinafop propargyl greater than wheat. On other hand, spray solution was retained for example diclofop

by green foxtail leaves than wheat, wild oat, or barley according to Todd and Stobbe (1977).

In summary, wheat is tolerant to all used rates of clodinafop propargyl at all times of application meanwhile, the herbicide has high activity towards the three grassy weeds.

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دراسة تحمل نباتات القمح والشعير وحساسية ثلاث أنواع من الحشائش النجيلية لمبيد كلودينافوب بروبارجيل

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تم إقامة سلسلة من التجارب في حقول القمح بمحطة بحوث سدس خلال ثلاث مواسم شتوية متعاقبة هي 2005/ 2006، 2007/2006، 2008/2007 بالإضافة إلى خمس تجارب أصص أجريت بالصوبة السلكية بمعمل بحوث الحشائش بالجيزة في الموسم الشتوي 2010/2009.

استهدفت الدراسة تقدير مدى تحمل محصولي القمح والشعير وحساسية ثلاث أنواع من الحشائش هي الزمير والفلارس والصامة لمبيد كلودينافوب بروبارجيل (توبيك 15% WP) بثلاث معدلات هي 70، 140، 210 جم مادة تجارية للفدان مع ميعادي إضافة هما 30 أو 45 يوما من الزراعة مقارنة بمعاملة المقارنة (بدون معاملة). أوضحت النتائج أن القمح يتحمل مبيد التوبيك تماما عند إضافته بالمعدل الموصى به 140 جم للفدان ويمنع منافسة الفلارس ويزيد من انتاجية القمح حتى المعدل الأعلي وهو 210 جم للفدان عند إضافته بعد 30 أو 45 يوما من الزراعة مقارنة بنبات الشعير الذي كان حساسا لجميع المعدلات المستخدمة ويثبط كلورفيلي أ، ب والكاروتينات بنسبة 56.2 و 64.2 و 70.1% للمعدلات الثلاثة المستخدمة علي التوالي.

كما أن إستخدام التوبيك بالمعدلات الثلاثه والميعادين المستخدم فيهما أعطى نسب إبادة وصلت إلي 100% لحشيشة الفلارس ما عدا معدل 70 جم/فدان بعد 45 يوم من الزراعة و 100% للزمير وأن معدلي 140 & 210 جم/فدان أعطت 100% إبادة لحشيشة الصامة . و تبين هذه النتائج أن مبيد كلودينافوب بروبارجيل (توبيك) يجب أن يقتصر إستخدامه على مكافحة الحشائش النجيلية في القمح ولا ينصح نهائيا بأستخدامه لمكافحة الحشائش النجيلية المنتشرة بحقول الشعير بالرغم من كفاءته في مكافحة الحشائش النجيلية نظرا لحساسية الشعير الشديدة لهذا المبيد مما يلقي بعض الضوء على طبيعة الإختيارية في هذه الأنواع النباتية لمبيد التوبيك.