EVALUATION OF EFFICACY AND EFFECT OF APPLICATION TIMING OF A NEW HERBICIDE, A.I. PROPOXY-CARBAZONE + IODOSULFURON + MEFENPYR ON *TRITICUM DURUM*

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SUMMARY

A study was performed from February to May 2010 by Bioagritest according to EPPO guidelines and Principles of Good Experimental Practice (GEP), in the land of Altamura (BA), in the core of Murgia, Apulia Region (Italy). The purpose of the study was to evaluate the efficacy and effect of two different application times of the herbicide SIT90 (propoxycarbazone + iodosulfuron + mefenpyr) on *Triticum durum* for weeds' control.
Sit90 was applied alone or in combination with the herbicide Dicuran (a.i. chlortolorun) in early post-emergence, and in late post emergence once more alone or in combination with the adjuvant Biopower or with the commercial formulate Atlantis WG (mesosulfuron+ iodosulfuron+ mefenpyr) + Biopower. *T. durum* cultivar was "Iride".
The study has given sufficient results on the use of SIT90, in the conditions foreseen by the protocol and in consideration of the present weeds, which represented the species mostly diffused in the Murgia, mainly *Avena ludoviciana* and *Papaver rhoaes*. Treatments with the SIT90 alone (even in combination with Chortoluron), applied in early or in late post-emergence, were very ineffective on grass weeds and dicotyledonous, highlighting the importance of the adjuvant Biopower to enhance the expression of the herbicide. In fact, the presence of the adjuvant allowed the expression of a clear and good overall herbicide activity of SIT90 for the control of *P. rhoaes* and other dicotyledonous, but also a discrete activity against grasses. More reliable was the treatment with SIT90 mixed with Atlantis, against the entire community of grass weeds and on *F. officinalis*. The performance of all the treatments was insufficient on *P. rhoaes*, because of the clear resistance shown by the weed.

Key words: Propoxycarbazone-sodium, iodosulfuron-methyl-sodium, Mefenpyr-diethyl, Herbicide, *Triticum durum*, weeds.

INTRODUCTION

Triticum durum is a typical crop of the Murgia in the Bari Province, Apulia region (Italy). The predominant weeds essentially present in this area are *Avena ludoviciana* and *Papaver rhoeas* that, in recent years, have developed phenomena of resistance against the most common herbicides used, above all sulfonylureas (Délye *et al.*, 2011; Kaloumenos *et al.*, 2011; Moss, 2004).
The purpose of the study was to evaluate the efficacy of a new herbicide, coded SIT90, and the effect of two different application times on *Triticum durum* for weeds control. Sit90 is a mixture of three active substances: Propoxycarbazone-sodium 168 g/Kg, iodosulfuron-methyl-sodium 10 g/Kg and Mefenpyr-diethyl 80 g/Kg. Propoxycarbazone-sodium belongs to

the HRAC group B, WSSA Group 2, chemical group of sulfonylaminocarbonyl-triazolinone, and is a selective early spring and fall herbicide for post-emergence grass control in cereals. It acts as an Acetolactate synthase (ALS) inhibitor. Iodosulfuron-methyl-sodium also belongs to the same HRAC group B, WSSA Group 2 and is an acetolactate synthase (ALS) inhibitor, but belongs to the chemical group of sulfonylurea and is selective to cereals. Finally, Mefenpyr-diethyl is a herbicide safener that acts enhancing tolerance to herbicides in cereals (including wheat) by elevating the expression of xenobiotic detoxifying enzymes, such as glutathione transferases (GSTs).

MATERIALS AND METHODS

The new herbicide SIT90 was applied in early post-emergence, on 25th February 2010 (wheat was sown at the end of November), alone (0.250 and 0.333 Kg/ha) or (0.250 Kg/ha) in combination with the herbicide Dicuran 700 g/L (a.i. chlortolorun 59.10%, a selective herbicide for weed control in wheat and other winter cereals, to be used in pre-emergence or early post-emergence) 3.2 L/ha. The wheat BBCH growth stage at this time of application (timing A) was 15-22 (h: 15-17 cm, beginning of tillering). In late post-emergence, on 25th March, it was applied again alone (0.250 and 0.333 Kg/ha) or (0.333 Kg/ha) in combination with the adjuvant Biopower (27% w/w sodium laureth sulphate, adjuvant of Atlantis, it works by increasing the wettability of the herbicide and its absorption by the weeds) 1L/ha, or (0.150 Kg/ha) in combination with the adjuvant Biopower plus the commercial standard Atlantis WG 0.250 Kg/ha (selective herbicide, member of the sulfonylurea group of herbicides HRAC group B, acetolactate synthase (ALS) inhibitor). The wheat BBCH growth stage at this time of application (timing B) was 31-31 (h: 25-28 cm, first node at least 1 cm above tillering node). All treatments were compared with an untreated control and with the commercial standard Atlantis WG 0,500 kg/ha (plus Biopower 1L/ha) (table 1). *T. durum* cultivar was "Iride".
Experimental design consisted in randomized complete blocks, 4 replicates, the system cultivation was at rows, each plot was 10 m^2. Cultural conditions were uniform for all plots and conform to local agricultural practices, the soil type was sand clay. Predominant weeds were, among monocots, *Avena ludoviciana*, *Alopecurus myosuroides* and, toward the end of cycle, a mixed infestation of *Phalaris brachistachis* and *P. paradoxa*. Among dicots, *Papaver rhoeas* and *Fumaria officinalis*. BBCH grow stages for these weeds were registered at both application times and are reported in table 2. Meteorological conditions were monitored during the realization of the experiment and they were normal for the period.
Three assessments were performed starting from 21 days after the application time B, exactly on 22nd April, 3rd and 18th May 2010. They consisted in the evaluation of control activity (expressed as %) on every single weed checked, using a scale where 0% = same weed infestation as untreated plots and 100% = total weed control. Also, possible phytotoxic effects on *T. durum, identifiable in necrosis, chlorosis and burns were evaluated*, using a 0-100 scale where 0 = no damage and 100 = death of the plant.

Table 1. Description of treatments (trt).

Trt.	Active ingredient	Commercial name	*Content a.i.*	Formulation	Dose	Timing
1	--	--	--	--	--	
2	[propoxycarbazone + iodosulfuron + mefenpyr]	SIT90	[168 g/Kg + 10 g/Kg + 80 g/Kg]	WG	0.250 Kg/ha	A
3	[propoxycarbazone + iodosulfuron + mefenpyr]	SIT90	[168 g/Kg + 10 g/Kg + 80 g/Kg]	WG	0.333 Kg/ha	A
4	[propoxycarbazone + iodosulfuron + mefenpyr] + chlortolorun	SIT90 + DICURAN	[168 g/Kg + 10 g/Kg + 80 g/Kg] + 500 g/L	WG SC	0.250 Kg/ha 3.2 L/ha	A
5	[propoxycarbazone + iodosulfuron + mefenpyr]	SIT90	[168 g/Kg + 10 g/Kg + 80 g/Kg]	WG	0.250 Kg/ha	B
6	[propoxycarbazone + iodosulfuron + mefenpyr]	SIT90	[168 g/Kg + 10 g/Kg + 80 g/Kg]	WG	0.333 Kg/ha	B
7	[propoxycarbazone + iodosulfuron + mefenpyr]+ Biopower*	SIT90 + BIOPOWER	[168 g/Kg + 10 g/Kg + 80 g/Kg]	WG SC	0.333 Kg/ha 1 L/ha	B
8	[propoxycarbazone + iodosulfuron + mefenpyr] + [mesosulfuron + iodosulfuron + mefenpyr]+ Biopower*	SIT90 + ATLANTIS WG- BIOPOWER	[168 g/Kg + 10 g/Kg + 80 g/Kg]+ 30 g/Kg + 6 g/Kg + 90 g/Kg	WG WG SC	0.150 Kg/ha 0.250 Kg/ha 1 L/ha	B
9	[mesosulfuron + iodosulfuron + mefenpyr] + Biopower*	ATLANTIS WG + BIOPOWER	30 g/Kg + 6 g/Kg + 90 g/Kg	WG SC	0.500 Kg/ha 1 L/ha	B

*6.7% w/w 3,6-dioxaeicosylsulphate sodium salt and 20.2% w/w 3,6-dioxaoctadecylsulphate sodium salt.

Table 2. BBCH growing stages of wheat and weeds at application timing A and B. h: height; d: diameter.

BBCH timing	*Triticum durum*	*Avena ludoviciana*	*Alopecurus myosuroides*	*Phalaris spp.*	*Fumaria officinalis*	*Papaver rhoeas*
A	15-22 (h: 15-17 cm)	13-22 (h: 8-13 cm)	13-14 (h: 8-13 cm)	12-13 (h: 4-5 cm)	14-15 (h: 5-6 cm)	12-14 (d: 1-3 cm)
B	31-31 (h: 25-28 cm)	25-30 (h: 20-26 cm)	15-21 (h: 20-26 cm)	15-21 (h: 8-10 cm)	23-55 (h: 8-10 cm)	15-16 (d: 3-8 cm)

Table 3. Determination of efficacy expressed as % of weed control (% of control on the single weed). XLSTAT – Non-parametric test, Comparison between k samples (Kruskal-Wallis, Friedman, ...). Hypothesized difference (D): 0 - Significance level (%): 5. Pairwise comparisons using Dunn's multiple comparison procedure.

		Treatment								
Species	Date of assessment	1 – Untreated control	2 - SIT90 0.25Kg/ha, A	3 - SIT90 0.333Kg/ha, A	4 - SIT90 0.25Kg/ha + DICURAN 3.2 L/ha, A	5 - SIT90 0.25 Kg/ha, B	6 - SIT90 0.333 Kg/ha, B	7 - SIT90 0.333 Kg/ha + BIOPOWER 1L/ha, B	8 - SIT90 0.150 Kg/ha + ATLANTIS 0.250 Kg/ha + BIOPOWER 1L/ha, B	9 - ATLANTIS 0.5Kg/ha + BIOPOWER 1L/ha, B
Avena ludovici-	22.04.10	0 a	26.25 ab	33.75 abc	47.5 abc	35 bcd	47.5 bcd	61.25 cd	72.5 d	71.25 d
ana	03.05.10	0 a	5 a	16.25 a	20 ab	23.75 ab	32.5 ab	85 bc	92 bc	98.75 c
	18.05.10	0 a	12.5 ab	12.5 ab	20 abc	22.5 abc	32.5 bcd	82.5 cd	93.75 d	98.75 d
Alopecurus	22.04.10	0 a	36.25 ab	42.5 ab	57.5 abc	50 abcd	47.5 bcde	68.75 cde	77.5 de	80 e
myosuroides	03.05.10	0 a	22.5 ab	31.25 ab	48.75 abc	37.5 abc	43.75 bcd	94.5 cd	93.75 cd	99.5 d
	18.05.10	0 a	21.25 ab	27.5 ab	46.25 abc	35 abcd	43.75 bcde	95.25 cde	96.25 de	99.5 e
Papaver	22.04.10	0 a	15 ab	18.75 abc	25 abcd	28.75 abcd	28.75 bcd	48.75 cde	67.5 de	63.75 e
rhoaes	03.05.10	0 a	5 ab	7.5 ab	17.5 abc	17.5 abc	27.5 abcd	33.75 bcd	50 cd	70 d
	18.05.10	0 a	5 a	0 ab	12.5 ab	12.5 ab	25 abcd	32.5 bc	48.75 c	57.5 c
Fumaria	22.04.10	0 a	0 a	10 a	12.5 ab	13.75 ab	17.5 abcd	70 bcd	86.25 cd	80 d
officinalis	03.05.10	0 a	0 a	0 a	25 ab	45 abc	37.5 abcd	67.5 bc	90 c	95 c
	18.05.10	0 a	0 a	0 a	18.75 ab	45 abc	35 abcd	60 bc	94.5 c	95 c
Phalaris spp.	18.05.10	0 a	0 a	0 a	0 a	0 a	27.5 ab	82.5 b	80 b	90 b

RESULTS AND DISCUSSION

The study has given sufficient results on the use of SIT90, in the conditions of use foreseen by the protocol and in consideration of the weeds identified, which represented the most species present in the Murgia (table 3 and Figure 1).

Data collected in the third assessment are those that have given us more information about the efficacy of treatments, because at that time (last decade of May) all weeds, including *Phalaris* spp., were germinated. When sit90 was applied in early post emergence, no dose effect was observed in the control of all the weeds species (trts. 2 and 3), and its application in combination with Dicuran (trt. 4) has not resulted in a statistically significant difference compared to the product applied alone. Moreover, treatments 2, 3 and 4 did not differ significantly from the untreated control.

The application of the herbicide alone in late post emergence has given the same results in terms of efficacy in weeds control (substantially no statistically significant difference) if compared with its application in early post emergence (trts. 5 and 6). Also in this case no dose effect was observed. At the dose of 0.333 Kg/ha SIT90 - applied in late post emergence, trt. 6 - has exerted a significant activity of control only against *Avena ludoviciana* and *Alopecuros myosuroides*, and no control of the dicots taken in consideration.

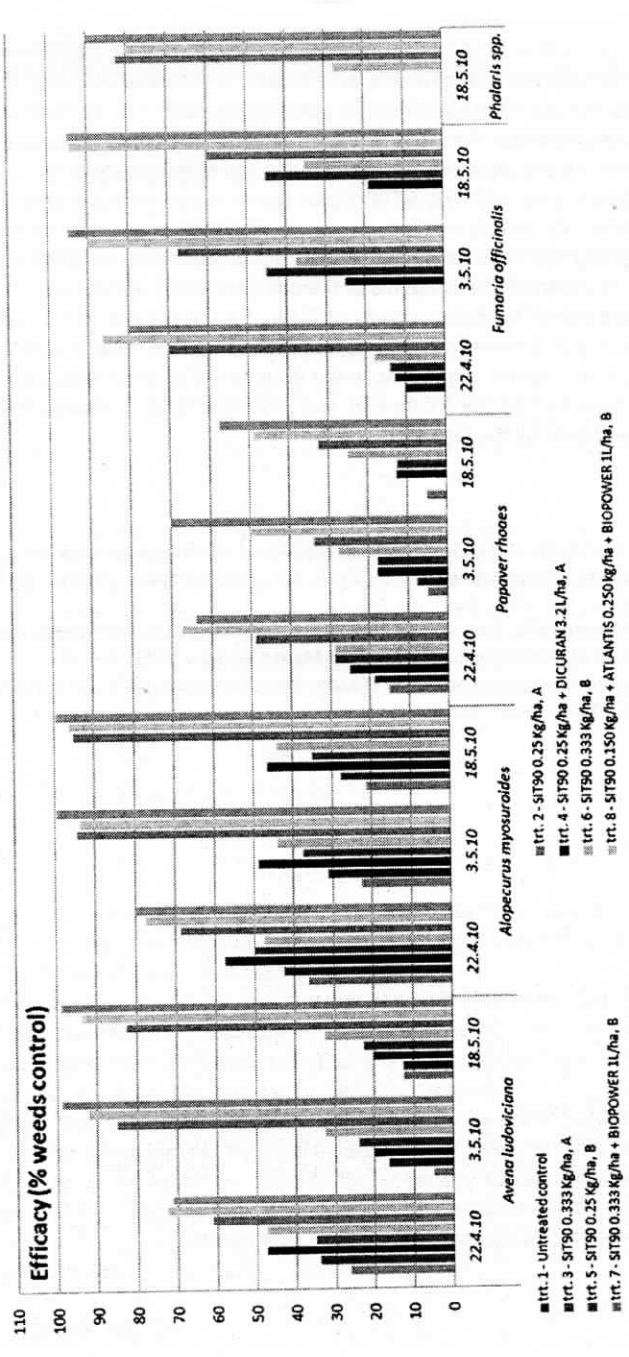

Figure 1. Determination of efficacy of SIT90 expressed as % of weeds control

The combination of SIT90 with the adjuvant Biopower (trt. 7) or with the commercial standard Atlantis (+ Biopower) (trt. 8) gave the best results in terms of efficacy, comparable to those obtained by the use of the commercial standard alone (in trt. 9), both as regards the control of monocotyledonous than that of dicots. None of the treatments was able to control 100% *P. rhoeas*. No phytotoxicity was observed in any of the treatments.

In conclusions, treatments with the SIT90 alone (even in combination with Chortoluron), applied in early or in late post-emergence, were very ineffective on grass weeds and dicotyledonous, highlighting the importance of the adjuvant Biopower to enhance the expression of the herbicide. By contrast, the presence of the adjuvant Biopower allowed the expression of a clear and good overall herbicide activity of SIT90, for the control of *P. rhoaes* and other dicotyledonous, but also a discrete activity against grasses. More reliable was the treatment with SIT90 mixed with Atlantis, against the entire community of grass weeds and on *F. officinalis*. The performance of all the treatments was insufficient on *P. rhoaes*, because of the evident resistance shown by the weed.

LITERATURE

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