Short Communication

Evaluation of Post-emergence Herbicides in Sugar Beet

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ABSTRACT

The efficacy of Iran produced chloridazon 50% SC (CSC) was compared with its original formulation, 80% WP (CWP), the formulation which has been registered to use in sugar beet fields in Iran. The present study was conducted in three different provinces of Iran, including Tehran, Khorasan and Khuzestan during 2001. The treatments consisted of the application of CWP at 3.2 and 4 kg ai ha^{-1} , CSC at 2.5 and 3 kg ai ha^{-1} , tank mixed application of CWP or CSC at above mentioned rates with desmedipham (DMP) at 0.8 kg ai ha^{-1}, phenmedipham 6% + desmedipham 6% + ethofumisate6% (PDE) at 0.7 kg ai ha^{-1}. All herbicides were applied as post-emergence when sugar beet was at 4-leaf stage. Weedy and weed free checks were also included. In Tehran experiment, application of CWP at 3.2kg ai ha^{-1} plus DMP or PDE resulted in the best control of *Amaranthus retroflexus*. In Khorasan , CSC,CWP and CSC + DMP controlled this weed better than other treatments. In the recent experiment, CSC and CWP, alone or mixed with DMP, controlled *A. albus* significantly. The effect of CSC at 2.5kg ai ha^{-1}+ DMP, CWP at 4 kg ai ha^{-1}+ DMP, and PDE at 0.7 kg ai ha^{-1} on *Chenopodium album* was better

than that of other treatments. The treatments had no significant effect on *Malva sylvestris*, compared with weedy check. The best control of *Carthamus oxyacantha* and *Fumaria officinalis* was achieved by application of CWP at 3.2 kg ai ha^{-1}, and CSC at 3 kg ai ha^{-1}+ DES. *Beta maritima* was more efficiently controlled using CSC at 3 kg ai $ha^{-1}$and CSC at 3 kg ai ha^{-1}+ DES. The results indicated that for the control of broad leaf weeds in sugar beet fields, the new formulation of chloridazon, (SC), was similar to the original formulation (WP).

Key words: Sugar beet, chloridazon, Weed, *Amaranthus retroflexus*, *Chenopodium album*, *Malva sylvestris*, *Carthamus oxyacantha*, *Fumaria officinalis*.

چکیده

کارایی کلریدازون (اس سی ۵۰٪) ، با فرمولاسیون پودروتابل ۸۰ ٪ آن که در حال حاضر در مزارع چغندر قند ایران به ثبت رسیده و استفاده می‌گردد، مقایسه شد. این بررسی در سال ۱۳۸۰ در تهران، خراسان، و خوزستان صورت گرفت. تیمارهای آزمایش شامل کاربرد کلریدازون اس سی (CSC) با میزان ۲/۵و۳ کیلو گرم، کلریدازون پودروتابل (CWP) به میزان ۳/۲ و ۴ کیلو گرم، تیمارهای فوق باضافه ۰/۸ کیلو گرم دس مدیفام (DEP)، آمیخته فن‌مدیفام ۶٪+ دس مدیفام ۶٪+ اتوفومیست ۶٪ (PDE) به میزان ۰/۷ کیلوگرم همگی بر مبنای ماده موثردر هکتار و همچنین وجین دستی و شاهد بدون کنترل علف هرز بودند. علفکش‌ها در مرحله ۴ برگی چغندرقند مصادف با رویش لولیه علف‌های‌هرز مصرف شدند. مطلوب ترین تیمارهای برای کنترل تاج خروس در تهران عبارت بودند از آمیخته CWP +DEP و PDE. هر دو دز مصرف شده CSC و CWP به تنهایی و CSC + DEP ، تاج خروس وحشی را در خراسان بهتر از تیمارهای دیگر کنترل نمودند. کنترل تاج خروس سفید توسط دزهای بالای CSC و CWP به تنهایی و یا به همراه DEP مطلوب تر از سایر تیمارها بود. بهترین کنترل سلمک در تیمارهایDEP + CSC، CWP +DEP و PDE نمایان بود. پنیرک توسط کلیه علفکش‌ها، در قیاس با شاهد بخوبی کنترل گردید. بهترین کنترل گلرنگ وحشی در تیمارهای CSC به تنهایی و یا دزهای ۲/۵و۳ کیلوگرم آن به همراه CWP، DEP بدست آمد. شاه تره نیز با تیمارهای CSC، هر دو دز CSC و CWP به همراه DEP بهتر از سایر تیمارها کنترل گردید. تیمارهای مطلوب برای کنترل

چغندر وحشی عبارت بودند از دزهای بالای CSC ، CWP ، و CSC + DEP. نتایج کلی آزمایش نشـان داد که کارایی هر دو فرمولاسیون آزمایش شده کلریدازون مشابه یکدیگر است.

کلمات کلیدی: چغندر قند، کلریدازون، تاج خروس، سلمک، پنیرک، گلرنگ، وحشی، چغندر وحشی، شاه تره.

INTRODUCTION

Sugar beet is grown on about 192 thousand ha in Iran with an annual production rate of 6 million metric tons, more than two thirds of which is in six provinces of Khorasan, Fars, W. Azarbaijan, Esfahan, Kermanshah, and Hamedan (Anonymous, 2003). Sugar beet has slow growth rate in early season, which makes it vulnerable to weeds (Norris, 1996), thus the sugar beet yield reduction is estimated to be about 33-100% (Ghanbari Birgani *et al*., 1998 & 2000). Norris (1996) has stated that no control of weeds in sugar beet could result in a yield reduction of more than 90%. Redroot pigweed at a density of 3 plants per meter row can cause 44% sugar beet yield loss (Dexter, 1996).

Chloridazon, a photosynthetic electron transport inhibitor, and a selective systemic herbicide, rapidly absorbed by the roots with translocation acropetally to all parts of sensitive plants (Tomlin, 2004). The herbicide has been registered in Iran since 1968 under two formulations of 80% WP and 65% DF (Nowroozian,1999)of which the WP formulation is widely applied in sugar beet fields of Iran. This herbicide has a worldwide popularity as a sugar beet herbicide (Shaufele & Winner, 1986; Ceglarek & Plaza, 1994; Rola 1994;Bee *et al.* 1995; May, 1997; Anonymous, 1998; Meister, 2000; Proctor, 1993;).

The objective of this research was evaluating the efficacy of new formulation of chloridazon 50% SC with its WP formulation and current herbicides used in sugar beet fields in Iran. The efficacy of herbicides was evaluated based on their potential in the control of broadleaf weeds and selectivity with sugar beet.

MATERIALS AND METHODS

The experiments were carried out in Tehran and Khorasan (temprate climate) and Khuzestan (warm climate) in 2001. The experimental design was randomized complete block with four replications. Four broadleaf herbicides (see Table 1) were compared with weed-free control, and weedy control. The sugar beet sowing date was May in Tehran and Khorasan and November in Khuzestan.

Grass weeds were controlled in all plots at the 3-6 leaf stage with haloxyfop ethoxy ethyl 12.5% EC at 0.25 kg ha^{-1}. Other herbicide treatments were applied at the 4-leaf stage of sugar beet. A knapsack sprayer with a flat nozzle was used for all treatments with 300 L of water ha^{-1}. Plots size was 7×2 m and consisted of four rows spaced 50 cm apart. Irrigation was set up such that out-going water from one plot would not enter any other one. The dominant weeds of the experiment were counted in a 1×1 m^2 fixed quadrates placed in the center rows of each plot one month after treatment.

Data were analyzed using SAS software, and mean comparison performed using Duncan's Multiple Range Test. The data from each location were analyzed separately due to the different environments and weed species present.

RESULTS AND DISCUSSIONS

No visual damage was observed on sugar beet as a result of herbicide applications. Dominant weeds grown at each location are presented in Table 1. Results show that weed flora in Khuzestan was completely different from the other two locations.

In Tehran, the highest control of *Amaranthus retroflexus* was achieved by application of CWP at 3.2 kg ha^{-1}+ DEP, and PDE (Table 1). Herbicide application caused significant differences for number of weeds. Totally, PDE and CWP+ DEP were the most efficient treatments which caused satisfactory control of *A. retroflexus* in this location. Consequently, the highest sugar beet yield was obtained under application of PDE, so that no significant difference was observed with weed free check.

In Khorasan (Table 2) application of CSC at 2.5 kg ha^{-1}+ DEP, and CWP at 4 kg ha^{-1} resulted in the best control of *Amaranthus* spp. In the case of *Chenopodium album*, the best control was achieved using CWP at 4 kg ha^{-1}+ DEP, CSC at 2.5 kg ha^{-1}+ DEP, and PDE. As for yield, no significant difference was observed among herbicide treatments.

In Khuzestan, application of CWP at 4 kg ha^{-1}+ DEP resulted in the best control of *Malva sylvestris*. *Carthamus oxycantha* was best controlled by CWP 3.2 kg + DEP and CSC 3 kg ha^{-1}+ DEP. *Fumaria officinalis* was controlled more efficiently by application of CSC 3 kg ha^{-1}+ DEP., CWP 3.2 kg ha^{-1}+ DEP, CSC 3 kg ha^{-1}, CSC 2.5 kg ha^{-1}+ DEP and CWP 4 kg ha^{-1}+ DEP. *Beta maritima* was best controlled by application of CSC 3 kg ha^{-1}, CSC 3 kg ha^{-1}+DEP, CWP 4 kg ha^{-1} and CSC 2.5 kg ha^{-1} + DEP. No control of *B. maritima* was achieved, using PDE. Yield in all herbicide treatments was at least 50% below that of weed free check.

By reviewing above results, it can be concluded that both the WP and SC formulations of chloridazon have performed almost equally. Due to the fact that the SC formulation is more advanced, locally produced, and that a lower dosage is used, it can be economically beneficial to the country.

Table 1- Mean number of weeds, percent control and sugar beet yield in Tehran*

Treatment	**Application rate (kg ai ha^{-1})**	***Amaranthus retroflexus***		**Yield Kg ha^{-1}**
		No. of Plants m^{-2}	**% control**	
Chloridazon (80%WP)	3.2	32.5 abc	10 b	27930 de
Chloridazon (80% WP)	4	33.5 ab	8 ab	30850 cde
Chloridazon (50% SC)	2.5	26.5 e	27 d	26050 e
Chloridazon (50% SC)	3	28 cde	13 c	28750 de
Chloridazon (80%WP) + desmedipham	3.2+0.8	18 f	50 e	30850 cde
Chloridazon 80%WP + desmedipham	4+0.8	31.5 bcd	13 c	32900 bcd
Chloridazon 50% SC +desmedipham	2.5+0.8	27.5 de	24 d	34580 bc
Chloridazon 50% SC + desmedipham	3+0.8	31 bcde	14 c	31680 cd
Betanal progress AM (18%EC)**	0.7	16.5 f	54 e	37930 ab
Weed free check	-	0 g	100 f	40000 a
Weedy check	-	36.25 a	0 a	19200 f

*In the same column, values followed by the same letter are not significantly differentaccording to Duncan's Multiple Range Test at 0.01 probability**.**

****(phenmedipham 6% + desmedipham 6% + ethofumisate6%)

Table 2- Mean number of weeds, percent control and sugar beet yield in Khorasan*

Treatment	Application rate (kg ai ha^{-1})	*Amaranthus* sp.		*C. album*		Yield kg ha^{-1}
		Plants m^{-2}	% control	Plants m^{-2}	% control	
Chloridazon (80%WP)	3.2	6 b *	61 bc	3.75 ab	21 b	30720 ab
Chloridazon (80% WP)	4	5.25 b	66 c	3.25 ab	32 bc	33060 abc
Chloridazon (50% SC)	2.5	6 b	61 bc	4.5 a	5 a	35440 ab
Chloridazon (50% SC)	3	7 b	54 b	3.25 ab	32 bc	34930 ab
Chloridazon (80%WP) + desmedipham	3.2+0.8	5.25 b	61 bc	3.75 ab	21 b	26300 bc
Chloridazon 80%WP + desmedipham	4+0.8	4.75 bc	54 b	1.25 bc	74 d	30050 bc
Chloridazon 50% SC +desmedipham	2.5+0.8	7 b	69 c	2 abc	58 c	30120 bc
Chloridazon 50% SC + desmedipham	3+0.8	5.75 b	54 b	3.75 ab	21 b	31050 bc
Betanal progress AM ** (18%EC)	0.7	4 bc	59 b	2 abc	58 c	32870 abc
Weed free check	-	0 c	100 d	0 c	100 e	42600 a
Weedy check	-	15.25 a	0 a	4.75 a	0 a	21700 c

*In each column, means followed by the same letter are not significantly different at 0.01% probability.

**(phenmedipham 6% + desmedipham 6% + ethofumisate6%).

Table 3- Mean number of weeds, percent control and sugar beet yield in Khuzestan.

Treatment	Applic. rate (kg ha^{-1})	*Malva sylvestris*		*Carthamus oxycantha*		*Fumaria officinalis*		*Beta maritima*		Yield Kg ha^{-1}
		Plants m^{-2}	% control	Plants m^{-2}	% control	Plants m^{-2}	% control	Plants m^{-2}	% control	
Chloridazon (80%WP)	3.2	18.5 b	44 b	5 abc	54 d	14 ab	48 b	4 abc	50 c	14300 de
Chloridazon (80% WP)	4	13 bc	61 c	11 ab	8 b	7.5 bcd	72 c	3 bcd	62 d	18750 cde
Chloridazon (50% SC)	2.5	8.5 bc	74 cd	7.5 abc	37 c	14 bc	48 b	4 abc	50 c	1993 0 cde
Chloridazon (50% SC)	3	9 bc	73 cd	2 abcd	87 f	2 de	93 de	1 cd	87e	25690 bcd
Chloridazon (80%WP) + desmedipham	3.2+0.8	9.5 bc	71 cd	0.5 d	96 gh	0 e	100 e	4 abc	50 c	35900 b
Chloridazon 80%WP + desmedipham	4+0.8	5.5 c	83 d	2 bcd	83 ef	2 de	93 d	6 abc	25 b	30200 bc
Chloridazon 50% SC +desmedipham	2.5+0.8	9 bc	73 cd	5 abcd	87 f	2 de	93 de	3 bcd	62 d	21320 de
Chloridazon 50% SC + desmedipham	3+0.8	8.5 bc	74 cd	1 cd	92 fg	0 e	100 e	1 cd	87 e	27290 bcd
Betanal progress AM ** (18%EC)	0.7	12.5 bc	62 c	3 abcd	75 e	6 bcde	78 c	9 a	0 a	19170 cde
Weed free check	-	0d	100 e	0 d	100 h	0 e	100 e	0 d	100 f	72640 a
Weedy check	-	33a	0 a	12 a	0 a	27 a	0 a	8 ab	0 a	9600 e

*In the same column, values followed by the same letter are not significantly differen according to Duncan's Multiple Range Test at 0.01% probability.

**(phenmedipham 6% + desmedipham 6% + ethofumisate 6%).

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