Evaluation of Chloridazon and Desmedipham Mixture with and without Surfactant for Weed Control in Sugar Beet

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ABSTRACT

This experiment was conducted in 2002 and 2003 to evaluate the effects of chloridazon and desmedipham mixture plus a nonionic surfactant on weeds of sugar beet at Safi Abad agricultural research center of Dezful, Iran. The experimental design was a randomized complete block with 12 treatments and three replications. Treatments included postemergence application of the mixture of chloridazon + desmedipham at 3.2 + 0.78, 3.2 + 0.63, 2.4 + 0.63, 4 + 0.47 and 3.2 + 0.47 kg ai ha^{-1} and aforementioned herbicide treatments each plus a nonionic surfactant (Citowett) at 0.35% (v/v) at the 4- leaf stage of sugar beet, weed free and weedy check. In both years, application of the mixture of the chloridazon + desmedipham treatments each plus surfactant compared to the application of the same treatments without surfactant had 61 and 38% higher efficacy in reducing the total number of broadleaf weeds, respectively. Application of mixture of the chloridazon + desmedipham treatments at the abovementioned rates with and without surfactant provided 91 and 83% of sugar beet root yield, respectively. Weedy check plots had only 50% of sugar beet root yield. Application of the mixture of the chloridazon + desmedipham treatments at the abovementioned rates with and without surfactant provided 93 and 83% of pure sugar yield, respectively,

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while weedy check plots had only 52% of pure sugar yield.
Key words: Weeds, herbicides, sugar beet, yield.

چکیده
این آزمایش به منظور بررسی کارآیی اثر مویان غیریونی بر افزایش تأثیرعلفکش‌ها روی علف‌های هرز چغندرقند در سال های زراعی ۸۲-۱۳۸۱ و ۸۳ – ۱۳۸۲ به صورت طرح بلوک‌های کامل تصادفی با ۱۲ تیمار در سه تکرار، در مرکز تحقیقات کشاورزی صفی آباد دزفول، ایران اجرا شد. تیمارهای آزمایش عبارت بودند از: کاربرد مخلوط علفکش‌های کلریدازون + دس مدیفام به میزان (۳/۲+۰/۷۸) ، (۳/۲+۰/۶۳) ، (۲/۴+۰/۶۳) ، (۴+۰/۴۷) و (۳/۲+۰/۴۷) کیلوگرم مادهِ مؤثر در هکتار، تیمارهای یاد شده هر کدام به اضافه مویان غیریونی سیتوویت به میزان ۰/۳۵ درصد در مرحله چهار برگی چغندرقند و علف‌های هرز پهن برگ و شاهدهای بدون و با علف هرز. کاربرد تیمارهای کلریدازون + دس مدیفام همراه مویان در مقایسه با کلریدازون + دس مدیفام بدون مویان ، در سال های ۱۳۸۱ و ۱۳۸۲ به ترتیب ۶۱ و ۳۸ درصد کارآیی بیشتری در کاهش تعداد علف های هرز پهن برگ داشت. به طور متوسط، در مقایسه با تیمار شاهد بدون علف هرز، کاربرد تیمارهای کلریدازون + دس مدیفام با و بدون مویان به ترتیب ۹۱ و ۸۳ درصد و شاهد با علف هرز ۵۰ درصد تولید ریشه چغندرقند داشتند. کاربرد کلریدازون + دس مدیفام با مویان در مقایسه با کاربرد تیمارهای کلریدازون + دس مدیفام بدون مویان ، ۹ درصد در افزایش عملکرد ریشه چغندرقند کارآیی بیشتر داشت. به طور متوسط، در مقایسه با شاهد بدون علف‌هرز،کاربرد تیمارهای کلریدازون + دس مدیفام با و بدون مویان به ترتیب ۹۳ و ۸۳ درصد و شاهد با علف‌هرز ۵۲ درصد تولید عملکرد شکر خالص داشتند. کاربرد کلریدازون + دس مدیفام به اضافه مویان در مقایسه با کلریدازون + دس مدیفام بدون مویان ، ۱۱ درصد در افزایش عملکرد شکر خالص کارآیی بیشتر داشت.

واژه های کلیدی: علف‌های هرز، علف‌کش‌ها، چغندر قند، گیاه زراعی

INTRODUCTION

Sugar beet (*Beta vulgaris* L.) growing area is nearly 7 M ha in the world (Draycott, 2006). In Iran, its area under cultivation is 152875 ha with an average yield of 32 t ha^{-1} and in Khuzestan province it is planted on 2438 ha with an average yield of 54 t ha^{-1} (Anonymous, 2005). Weeds can compete with sugar beet for light, nutrients, water and space, and reduce sugar beet root yield by 33-100% (Haji

Allahverdipoor, 1973; Ghanbari Birgani *et al*., 1997 and 1998). Annually, one third of sugar beet production cost is allocated to weed control practices (Hatzios & Penner, 1985 and Hejazi, 2000).

Postemergence weed control is affected by environmental factors and additives (Hartzler & Foy, 1983; Hatzios & Penner, 1985). Adjuvants often increase herbicide efficacy by improving retention and absorbtion on the leaf (Hatzios & Penner, 1985). Urea ammonium nitrate and crop oil concentrates (COC) are used for enhancing herbicide efficacy (Wicks *et al*., 1994). Addition of a nonionic surfactant to the herbicides such as sulfonylurea herbicides often increases their efficacy (Beyer *et al*., 1988). Addition of an adjuvant to the herbicide solution increases postemergence herbicide efficacy (Buhler & Burnside 1984; Harrison *et al*., 1986; Wixon & Shaw, 1991; Haet *et al*., 1992; Harker, 1992) and improves weed control.

Result of an experiment which was conducted in Canada in 1991 and 1993 showed that mixture of crop oil concentrate with ammonium sulfate was the only adjuvant that overcame the antagonistic effect of sodium bicarbonate of ground waters over clethodim and effectively controlled barley (McHullan, 1994). Application of ammonium sulfate and ammonium nitrate completely overcame the antagonistic effect of sodium bicarbonate on sethoxydim and a part of antagonism was caused by sodium salt of bentazon (Nalewaja *et al*., 1989). Application of ammonium sulfate completely overcame the antagonistic effect of bentazon on absorption of sethoxydim (Wanamarta *et al*., 1993) and also increased the phytotoxicity of sethoxydim on wild oat (Nalewaja *et al*., 1994).

In Iran, pre-plant and pre-emergence application of chloridazon at 3.2 to 4 and metamitron at 2.8 to 3.1 kg ai ha^{-1}, preplant application of cycloate at 2.9 to 3.6 kg ai ha^{-1}, post-emergence split application of ethofumesate + phenmedipham + desmedipham mixture at 0.36 + 0.36 kg ai ha^{-1} or 0.72 kg ai ha^{-1} are recommended for broadleaf weed control in sugar beet (Ghanbari Birgani *et al*., 1997 and 1998). Application of Citowett at 0.25 L ha^{-1} in combination with herbicides is also recommended in Iran (Nouroozian, 1999).

In USA, application of EPTC at 2 to 3 kg ai ha^{-1}, cycloate at 3 to 4 kg ai ha^{-1} and chloridazon at 3.2 to 3.7 kg ai ha^{-1} (Wanamarta *et al.*, 1993), and using adjuvants (McWhorter, 1982) are recommended for weed control in sugar beet.

Objective of this experiment was to evaluate the efficacy of the surfactants (Citowett) in combination with chloridazon + desmedipham for weed control in sugar beet.

MATERIALS AND METHODS

This experiment was conducted in 2002 and 2003 at two sites at the Safi Abad Agricultural Research Center of Dezful, Iran. The experimental design was a randomized complete block with 12 treatments and three replications. Treatments included post-emergence application of the mixtures of chloridazon (Pyramin WP, 800 g ai kg $^{-1}$, BASF) + desmedipham (Betanal AM EC , 157 g ai L^{-1}, Shring) at 3.2 + 0.78, 3.2 + 0.63, 2.4 + 0.63, 4 + 0.47 and 3.2 + 0.47 kg ai ha^{-1} and aforementioned herbicide treatments each plus Citowett nonionic surfactant [(Alkylarylpolyglycol ether), (Citowett L, 100%, BASF)] at 0.35% (v/v) in the 4-leaf stage of sugar beet, weed free, and weedy checks. Seedbed preparation operations consisted of moldboard plowing, double disking and application of N at 74 kg ha^{-1}, P_2O_5 at 46 kg ha^{-1} and K_2O at 150 kg ha^{-1} according to soil test recommendations. Soil textures and characteristics of the experimental sites were different in 2002 and 2003 and are listed in table 1.

Monogerm sugar beet cv. 'Rasool' was drill planted on Oct.7th and Oct.16th, in 2002 and 2003, respectively. Individual plot consisted of four rows of sugar beet spaced 61 cm apart and 5 m long. Herbicides were applied with a backpack sprayer equipped with 11004 flat fan nozzles calibrated to deliver a spray volume of 400 L ha^{-1} at 245 kPa. Herbicide treatments were applied on Oct.28th, 2002 and Nov.9th, 2003, respectively. Deltametryn (Decis EC, 25 g ai L^{-1}, Bayer) was applied at 0.037 kg ai ha^{-1} on the experimental areas on Oct. 26th, 2002 and Nov. 13th, 2003 to control cutworm (*Agrotis segetum* Schiff) and armyworm (*Spodoptera exigua* Hb.) at the 4- leaf stage of sugar beet.

Table 1. Soil characteristics at the experimental sites in 2002 and 2003.

Soil characteristics	2002	2003
Texture	Silty clay loam	Silty loam
Clay	36%	24%
Silt	46%	52%
Sand	18%	24%
pH	7.1	7
Organic matter	1.08%	1.73%
EC	2.8 (ds m^{-1})	2.3 (ds m^{-1})

Sugar beet plants were thinned at 20 cm spacing on Nov. 6th, 2002 and Nov. 9th, 2003, respectively, and N was applied as side dress at 74 kg ha^{-1}. Phytotoxicity percentages of herbicides were recorded weekly until four weeks after herbicide applications according to the EWRC scales (data not shown). Broadleaved weed species were counted in a randomly placed one m^2 quadrate from the center of each plot at 4 weeks after application of herbicide treatments in each year. At the tillering stage of grass weeds, haloxyfop-ethoxy-ethyl (gallant, EC, 12.5 g ai L^{-1}, Dow) was applied on the experimental area at 0.25 kg ai ha^{-1} to control grass weeds. On Feb.19th, 2003 and Mar.4th, 2004, broadleaved weeds were clipped off the soil surface from the 1m^2 area of the center of each plot and their fresh and dry weights were determined. Sugar beet roots were harvested from 4.8 m^2 area from the two center rows of each plot, counted and weighed on June 9th, 2003 and 2004, respectively. Technical qualities of sugar beet root samples were determined using standard methods in sugar beet seed institute. For homogeneity of variances, weeds and sugar beet root yield data were transformed using Log (x + 10) transformation prior to the analysis of variance. Treatment means were separated using Duncan's multiple range test at 0.05 level of significance.

RESULTS AND DISCUSSION

Crop Injury

No sugar beet injury was observed by application of chloridazon + desmedipham, but application of chloridazon + desmedipham + surfactant caused little crop injury (data not shown). Sugar beet leaves were wrinkled and crinckled but rercovered after two weeks.

Weed Density

Effect of year by herbicide treatment on weed density was significant. Therefore, mean weed density in 2002 and 2003 are presented separately in table 2.

In 2002. Dominant weed species of the sugar beet experimental field were common mallow (*Malva sylvestris* L.), cleome (*Cleome viscosa* L.), malta jute (*Corchorus olitorius* L.), common purselane (*Portulaca oleracea* L.) and ground cherry (*Physalis* sp.).

In 2003. Eight weed species were present in sugar beet experimental field of which common mallow was the dominant weed species. Other weed species included amee (*Ammi majus* L.), pimpernel (*Anagallis arvensis* L.), wild beet (*Beta maritima* L.), bindweed (*Convolvulus arvensis* L.), purple nutsedge (*Cyperus rotundus* L.), wireweed (*Polygonum aviculare* L.) and wild mustard (*Sinapis arvensis* L.).

Common Mallow

Common mallow is the predominant weed species in sugar beet fields of Khuzestan province. In 2002, compared to the weedy check, adding surfactant to the chloridazon + desmedipham mixture increased common mallow control at herbicide rates (kg ai ha^{-1}) of 3.2 + 0.78 from 82 to 86%, of 3.2 + 0.63 from 61 to 88%, of 2.4 + 0.63 from 71 to 88%, of 4 + 0.47 from 65 to 92% and of 3.2 + 0.47 from 73 to 92%. (Table 2). Plots treated with chloridazon + desmedipham at 4 + 0.47 kg ai ha^{-1} plus surfactant with 4 plants m^{-2} had the lowest common mallow density (Table 2). Addition of surfactant increased the efficacy of chloridazon + desmedipham treatments in controlling common mallow by 62%.

In 2003, compared to the weedy check, adding surfactant to the chloridazon + desmedipham mixture increased common mallow control at herbicide rates (kg ai ha^{-1}) of 3.2 + 0.78 from 75 to 67%, of 3.2 + 0.63 from 45 to 57%, of 2.4 + 0.63 from 23 to 45%, of 4 + 0.47 from 45 to 90% and of 3.2 + 0.47 from 45 to 67%. (Table 2). Plots treated with chloridazon + desmedipham at 4 + 0.47 kg ai ha^{-1} plus surfactant with 0.7 plants m^{-2} had the lowest common mallow density (Table 2). Addition of surfactant increased the efficacy of chloridazon + desmedipham treatments in controlling common mallow by 43% which shows the importance of adding a surfactant (Table 2).

Other Broadleaf Weeds

In 2002, compared to the weedy check, other broadleaf weeds such as *Cleome viscosa* L., *Corchorus olitorius*, *Portulaca oleracea*, and *Physalis* sp. were controlled effectively by all herbicide treatments up to 100, 100, 88 and 100% respectively (data not shown). In 2003, **c**ompared to the weedy check, application of all chloridazon + desmedipham treatments controlled other broadleaf weeds by 100% (data not shown).

Total Weed Density

In 2002, compared to the weedy check, adding surfactant to the chloridazon + desmedipham mixture increased total weed control at herbicide rates (kg ai ha^{-1}) of 3.2 + 0.78 from 94 to 95%, of 3.2 + 0.63 from 86 to 95%, of 2.4 + 0.63 from 90 to 95%, of 4 + 0.47 from 89 to 97% and of 3.2 + 0.47 from 90 to 97% (Table 2).

Plots treated with chloridazon + desmedipham at 4 + 0.47 and 3.2 + 0.47 kg ai ha^{-1} plus surfactant each with 5 plants m^{-2} had the lowest total weed density (Table 2). Addition of surfactant increased the efficacy of chloridazon + desmedipham treatments in controlling total weeds by 61% which shows the importance of adding a surfactant.

In 2003, **c**ompared to the weedy check, adding surfactant to the chloridazon + desmedipham mixture increased total weed control at herbicide rates (kg ai ha^{-1}) of

3.2 + 0.63 from 88 to 92%, of 2.4 + 0.63 from 85 to 88%, of 4 + 0.47 from 88 to 97% and of 3.2 + 0.47 from 88 to 92% (Table 2).

Plots treated with chloridazon + desmedipham at 4 + 0.47 kg ai ha^{-1} plus surfactant with 0.7 plants m^{-2} had the lowest total weed density (Table 2). Addition of surfactant increased the efficacy of herbicide treatments in controlling total weeds by 43% which shows the importance of adding a surfactant to the herbicide solution.

Assessments of field trials which were conducted in 1989 with sugar beet grown at 2 sites in the UK, revealed that the additions of 1.0 and 1.0 to 2.0 L ha^{-1} paraffinic oil to the Metamitron + phenmedipham mixture applied to sugar beet at the expanded cotyledon to first true leaf stage at 875 + 194 g ai ha^{-1}, either alone or with an additional 34 g phenmedipham. had the lowest weed densities (Buckley, 1991).

Similar results have been obtained in UK in field trials conducted during 1990 – 1993. The effects of applying spray additives with half the recommended rate of phenmedipham (200 g ai ha^{-1}) and with phenmedipham + metamitron (97 + 438 g ai ha^{-1}), compared with applying the full recommended rates of these herbicides without additives, were evaluated for weed control in sugar beet. The additives tested included a mineral oil, a vegetable oil, tallow amines, a silicone additive and a novel additive. Compared with the untreated control treatment, all herbicide treatments reduced the total number of weeds per m^2 (May, 1993).

In ten field trials conducted in UK during 1989 – 1993, the effects of applying low – dose multiple herbicide mixtures (including phenmedipham, metamitron, ethofumesate, chloridazon and lenacil) were evaluated. Herbicide mixtures containing phenmedipham at 114 g plus 3 – 4 other herbicides resulted in good weed control, reducing the number of weeds per m^2 from untreated control values of 38.9 plants to 2.7 – 3.4 plants. However, these mixtures reduced sugar beet vigour. Mixtures of phenmedipham at 86 g, ethofumesate at 100 g and metamitron at 350 g, lenacil at 200 g or chloridazon at 325 g resulted in good weed control and crop safety (May & Cleal, 1993) which confirms the results of our experiments.

Dry Weight of Weeds

Effect of herbicide treatments on dry weight of weeds was significant. Compared to the weedy check, adding surfactant to the chloridazon + desmedipham mixture reduced dry weight of weeds at herbicide rates (kg ai ha^{-1}) of 3.2 + 0.78 from 56 to 66%, of 3.2 + 0.63 from 60 to 83%, of 2.4 + 0.63 from 61 to 68%, of 4 + 0.47 from 52 to 70% and of 3.2 + 0.47 from 61 to 72%.(Table 2). Plots treated with chloridazon + desmedipham at 3.2 + 0.63 kg ai ha^{-1} plus surfactant with 98 g m^{-2} had the lowest weed dry weight (Table 2). Addition of surfactant increased the efficacy of chloridazon + desmedipham treatments in decreasing weeds dry weight by 32% which shows the importance of adding a surfactant to the herbicide solution (Table 2).

Sugar Beet Yield and Quantity

Effect of herbicide treatments on sugar beet root yield, gross sugar yield, and white sugar yield was significant but on other components of sugar beet root yield were not significant.

Root Yield

Compared to sugar beet root yield in 2002 (43.9 t ha^{-1}), and due to the 80% reduction in mean weed density in 2003, sugar beet root yield (78.5 t ha^{-1}) had a yield increase by 79% (Table 2). Compared to the weedy check, adding surfactant to the chloridazon + desmedipham mixture increased sugar beet root yield at herbicide rates (kg ai ha^{-1}) of 3.2 + 0.78 from 66 to 75%, of 3.2 + 0.63 from 55 to 88%, of 4 + 0.47 from 55 to 94% and of 3.2 + 0.47 from 63 to 77%. (Table 3). Addition of surfactant increased the efficacy of chloridazon + desmedipham treatments by 9% in increasing sugar beet root yield which indicates the importance of adding a surfactant for increasing total weed control. Plots treated with chloridazon + desmedipham at 4 + 0.47 kg ai ha^{-1} plus surfactant and weed free check with 70 and 71 t ha^{-1}, respectively, and weedy check with 36 t ha^{-1} had the highest and lowest level of sugar beet root yield (Table 3). Compared to the weed free check, adding surfactant to the chloridazon + desmedipham mixture increased sugar beet root yield at herbicide rates (kg ai ha^{-1}) of 3.2 + 0.78 from 84 to 88%, of 3.2 + 0.63 from 78 to 95%, of 4 + 0.47 from 78 to 98% and of 3.2 + 0.47 from 82 to 89%. (Table 3).

In an experiment which was carried out in Poland during 1992 to 1997, mixture of(chloridazon + phenmedipham + desmedipham) at 0.8 – 1.2 kg ai ha^{-1} with a surfactant at 0.5 l ha^{-1} was used for control of weeds in sugar beet. Results of the experiment indicated that application of this mixture decreased total weed density by 87 – 100% and increased sugar beet root yield by 28% (Paradowski, 1998), which is in agreement with the results of present study.

Weeds with total dry weight of 564 g m^{-1} decreased sugar beet root yield by 49% (Tables 2 and 3). Regression of dry weight of weeds against sugar beet root yield showed a linear relationship as fallow:

$$Y = \surd 5327.6-7.086 \times (r^2 = 0.90)$$

where Y, is the sugar beet root yield and x, is the dry weight of weeds. Results of another experiment which was conducted during the same years at a different site at the Safi Abad Agricultural Research Center of Dezful indicated each 100 g m^{-2} increase in dry weight of weeds caused 5 t ha^{-1} sugar beet root yield reduction, which confirm the results of present study.(Ghanbari Birgani *et al.*, 2006).

Sugar Yield

Addition of surfactant which increased the weed control efficacy of chloridazon + desmedipham treatments also caused sugar yield increase of 12%, which indicates the importance of adding a surfactant to the herbicide solution (Table 3).

Weed free and weedy checks with 11.287 and 5.877 t ha^{-1}, respectively, had the highest and lowest level of sugar yield (Table 3). Weeds with total dry weight of 564 g m^{-1} decreased sugar yield by 48% (Tables 2 and 3).

White Sugar Yield

Addition of surfactant which increased the weed control efficacy of chloridazon + desmedipham treatments also caused white sugar yield increase by 12%, which indicates the importance of adding a surfactant to the herbicide solution (Table 3).

Weed free and weedy checks with 9.818 and 5.163 t ha^{-1}, respectively, had the highest and lowest level of white sugar yield (Table 3). Weeds with total dry weight of 564 g m^{-1} decreased net sugar yield by 48% (Tables 2 and 3).

Table 2. Effect of herbicide treatments on density of common mallow and total weeds in 2002 and 2003 and dry weight of weeds.

Herbicide treatments	Rate (kg ai ha^{-1})	Density * (plant m^{-2})				Dry weight of weeds (g m^{-2})
		2002		2003		
		Common mallow	Total weed	Common mallow	Total weed	
Chloridazon+ desmedipham	3.2+ 0.78	9 ^{bcd}	11 ^{bcd}	2.7 ^{bcd}	2.7 ^{b}	247 ^{abc}
Chloridazon+ desmedipham	3.2+0.63	20 ^{b}	22 ^{b}	3.3 ^{c}	3.3 ^{b}	225 ^{abc}
Chloridazon+ desmedipham	2.4+0.63	15 ^{bc}	16 ^{bc}	4.7 ^{abc}	4.7 ^{b}	218 ^{abc}
Chloridazon+ desmedipham	4+0.47	18 ^{bc}	18 ^{bc}	3.3 ^{bc}	3.3 ^{b}	271 ^{ab}
Chloridazon+ desmedipham	3.2+0.47	14 ^{bc}	17 ^{bc}	3.3 ^{bc}	3.3 ^{b}	218 ^{abc}
Chloridazon+ desmedipham + Surfactant	3.2+ 0.78 + 1.4	7 ^{bcd}	7 ^{bcd}	2 ^{abc}	2 ^{b}	190 ^{bc}
Chloridazon+ desmedipham + Surfactant	3.2+0.63 + 1.4	6 ^{cd}	7 ^{bcd}	2.6 ^{abc}	2.6 ^{b}	98 ^{c}
Chloridazon+ desmedipham + Surfactant	2.4+0.63 + 1.4	7 ^{bcd}	9 ^{bcd}	3.3 ^{abc}	3.3 ^{b}	179 ^{bc}
Chloridazon+ desmedipham + Surfactant	4+0.47 + 1.4	4 ^{cd}	5 ^{cd}	0.7 ^{ab}	0.7 ^{b}	170 ^{bc}
Chloridazon+ desmedipham + Surfactant	3.2+0.47 + 1.4	5 ^{cd}	5 ^{cd}	2 ^{abc}	2 ^{b}	161 ^{bc}
Weed free check	-	0 ^{d}	0 ^{d}	0 ^{a}	0 ^{b}	0 ^{d}
Weedy check	-	52 ^{a}	163 ^{a}	6 ^{d}	27.3 ^{a}	564 ^{a}

Means within each column followed by the same letters are not significantly different according to Duncan's multiple range test at the 0.05 probability level.

Table 3. Effect of herbicide treatments on sugar beet root yield, gross and net sugar yield in 2002 and 2003.

Herbicide treatments	Rate (kg ai ha^{-1})	Root yield (t ha-1)	Gross sugar yield (t ha-1)	Net sugar yield (t ha-1)
Chloridazon + desmedipham	3.2+ 0.78	60.089 ab	9.482 ab	8.206 abc
Chloridazon + desmedipham	3.2+0.63	56.352 b	8.864 b	7.675 c
Chloridazon + desmedipham	2.4+0.63	65.103 ab	10.336 ab	8.959 abc
Chloridazon + desmedipham	4+0.47	56.594 b	9.125 b	7.980 bc
Chloridazon + desmedipham	3.2+0.47	59.095 ab	9.153 b	7.930 bc
Chloridazon + desmedipham +surfactant	3.2+ 0.78 + 1.4	63.61 ab	9.965 ab	8.611 abc
Chloridazon + desmedipham +surfactant	3.2+0.63 + 1.4	68.781 ab	10.962 ab	9.544 abc
Chloridazon + desmedipham +surfactant	2.4+0.63+ 1.4	62.982 ab	10.206 ab	8.968 abc
Chloridazon + desmedipham +surfactant	4+0.47+ 1.4	70.206 ab	11.123 a	9.676 ab
Chloridazon + desmedipham +surfactant	3.2+0.47+ 1.4	64.442 ab	10.100 ab	8.780 abc
Weed free check	_	71.074 a	11.287 a	9.818 a
Weedy check	_	36.491 c	5.877 c	5.163 d

Means within each column followed by the same letters are not significantly different according to Duncan's multiple range tests at the 0.05 probability level.

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