Selectivity of herbicide oxadiazon to processing tomato and control of American black nightshade plants

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ABSTRACT

American black nightshade (*Solanum americanum*) is one of the main weeds for tomato crops. However, no herbicide approved for this crop in Brazil is effective for the control of this species and selective to tomato plants. Therefore, the objective of the present study was to evaluate the selectivity of the herbicide oxadiazon to plants of three processing tomato hybrids and the control of American black nightshade plants. Four trials were installed: one under greenhouse and three under field conditions. The greenhouse trial was conducted in a completely randomized design with four replications, using a 2x5 factorial arrangement consisting of preemergence and postemergence applications of five oxadiazon rates (75, 125, 250, 375, and 500 g ha^{-1}) to control American black nightshade plants, and two control treatments without herbicide application. The field trials were conducted in a randomized blocks design with four replications on commercial production areas in the municipality of Cristalina-GO, Brazil. The tomato hybrids tested were Acangata 9992, H-9553, and HMX 7885, one in each trial. The treatments consisted of application of five oxadiazon rates (125, 250, 375, 500, and 625 g ha^{-1}) at pre-planting of the tomato seedlings, and a control treatment without herbicide application. The application of oxadiazon in preemergence, in the greenhouse, was more efficient for controlling American black nightshade plants under greenhouse conditions than the application on plants with 2-3 leaves. However, the weed control was satisfactory (>90%) when rates up to 246 g ha^{-1} were used, in both application times. The herbicide application caused no visual injuries to tomato plants under field conditions, and had no negative effect on fruit yield. Therefore, the herbicide oxadiazon was highly selective to the three processing tomato hybrids when applied at pre-planting, using rates of up to 625 g ha^{-1}. The herbicide presented excellent control of American black nightshade plants, using rates from 125 to 371 g ha^{-1}.

Keywords: *Solanum lycopersicum*, *Solanum americanum*, chemical control, phytotoxicity.

RESUMO

Seletividade do herbicida oxadiazon para o tomate rasteiro e controle de maria-pretinha

Maria-pretinha (*Solanum americanum*) é uma das principais plantas daninhas da cultura do tomate rasteiro. Porém, não há herbicidas registrados no Brasil eficazes para o seu controle e seletivos para o tomateiro. Por isso, objetivou-se avaliar a seletividade do herbicida oxadiazon para três híbridos de tomateiro rasteiro e o controle de maria-pretinha. Quatro experimentos, um em casa de vegetação e três em campo, foram desenvolvidos. Em casa de vegetação, o delineamento experimental foi inteiramente casualizado, em esquema fatorial 2x5, com quatro repetições. O oxadiazon foi pulverizado em pré e pós-emergência das plantas de maria-pretinha, nas dosagens de 75, 125, 250, 375 e 500 g ha^{-1}, além da manutenção de duas testemunhas sem herbicida. Em campo, os três experimentos foram instalados em áreas de produção comercial, no município de Cristalina-GO, com os híbridos Acangata 9992, H-9553 e HMX 7885, um por experimento. O delineamento experimental foi de blocos ao acaso com quatro repetições e os tratamentos constituídos pela aplicação de cinco dosagens do herbicida oxadiazon (125, 250, 375, 500 e 625 g ha^{-1}) no pré-plantio das mudas e a manutenção de uma testemunha sem herbicida. Em casa de vegetação, a aplicação de oxadiazon em pré-emergência foi mais eficaz para o controle de maria-pretinha do que a aplicação em plantas com 2-3 folhas. Contudo, nas duas épocas, a partir de 246 g ha^{-1} o controle foi satisfatório, maior que 90%. Em campo, o herbicida não ocasionou injúria visual às plantas de tomateiro, com reflexo na produtividade de frutos, que não foi prejudicada. Por isso, concluiu-se que o oxadiazon foi altamente seletivo para os três híbridos de tomateiro rasteiro, quando pulverizado no pré-plantio em dosagens de até 625 g ha^{-1}, e resultou em excelente controle de maria-pretinha com dosagens de 125 a 371g ha^{-1}.

Palavras-chave: *Solanum lycopersicum*, *Solanum americanum*, controle químico, fitointoxicação.

American black nightshade (*Solanum americanum*) is one of the main weed species for processing tomato crops (Correia, 2015). It is an annual, herbaceous, erect, glabrous, branched plant, reproduces by seeds and presents 40 to 90 cm height, but can reach more than one-meter height under favorable conditions (Kissmann & Groth, 2000; Lorenzi, 2008). Plants of this species cause several losses to tomato crops due to effects on fruit yield and quality (Hernandez *et al.*, 2007) and difficulties for mechanized harvest. The presence of American black nightshade plants in tomato crops can significantly increase the amount of green and rotten fruits, which are not accepted by processing industries and, therefore, are totally discarded (Hernandez *et al.*, 2007). Moreover, this species is a host of nematodes (Lorenzi, 2008) and bacteria (*Ralstonia solanacearum*) (Wicker *et al.*, 2009).

Although American black nightshade is a serious weed species for tomato crops, no herbicide approved for this crop is efficient in its control (Agrofit, 2020; Rodrigues & Almeida, 2018). Thus, only mechanical control through manual weeding is efficiently used, but it is economically unviable due to the labor demand and high costs. However, in some cases, tomato growers use manual weeding to complement chemical control, removing surviving American black nightshade plants.

Metribuzin is the main approved herbicide used for tomato crops, mainly for processing tomato grown for industrial processing (Correia, 2015). This herbicide controls mainly eudicotyledons, and is little efficient for controlling American black nightshade plants. Metribuzin is recommended to be applied after the transplanting of tomato seedlings, at preemergence or early postemergence of weeds, at a rate of 480 g ha^{-1} (Rodrigues & Almeida, 2018). However, in the field, the herbicide metribuzin is applied at rates from 288 to 480 g ha^{-1} before the seedling transplanting, and at rates from 192 to 384 g ha^{-1} after the seedling transplanting (Correia, 2015). This practice is used to cause a suppressive effect on American black nightshade plants, since surviving plants can hinder the mechanized harvest of fruits depending on the infestation level and weed plant sizes.

An efficient herbicide for tomato crops should control weeds and be selective to the crop, causing no fruit quality and yield losses. However, few studies on chemical control of American black nightshade plants, selective to tomato crops, are found. In addition, no herbicides are approved by the Brazilian Ministry of Agriculture, Livestock, and Supply (MAPA) for the control of American black nightshade plants in tomato crops. Therefore, studies addressing this issue are important to evaluate the potential of herbicides for later approval.

Oxadiazon is among the potential herbicides for the control of American black nightshade plants. This broad-spectrum herbicide of the oxadiazole group controls monocotyledon and eudicotyledon weeds (Rodrigues & Almeida, 2018). Its mechanism of action consists of inhibiting protoporphyrinogen oxidase (PROTOX) enzymes, which oxidate protoporphyrinogen into protoporphyrin IX, precursors of chlorophyll. The death of susceptible plants by this herbicide is fast due to the formation of reactive oxygen species (singlet) responsible for peroxidation of cell membrane lipids (Oliveira Junior, 2011).

Oxadiazon is approved by the MAPA for other vegetables, such as garlic and onion, with recommended rates from 0.75 to 1.0 kg ha^{-1} after planting and at preemergence of weeds, except for American black nightshade plants (Rodrigues & Almeida, 2018). However, this herbicide is not used for onion crops because of losses in bulb yield when using the label rates, according to vegetable growers. Losses in onion bulb yields after oxadiazon application had been found in other countries, reaching 22 to 69%, depending on the rates used (0.0375 to 3.00 kg ha^{-1}), time of application (preemergence or postemergence), and onion genotypes (Ghosheh, 2004; Qasem, 2005, 2006; Uygur *et al.*, 2010).

Due to its broad-spectrum control, the herbicide oxadiazon applied at preemergence of weeds and before the tomato planting can be efficient in controlling American black nightshade plants, and selective to the crop. Thus, the objective of the present study was to evaluate the selectivity of the herbicide oxadiazon to plants of three hybrids of processing tomato and the control of American black nightshade plants.

MATERIAL AND METHODS

The study consisted of one greenhouse trial and three field trials. The greenhouse trial was conducted from November 14, 2016 to January 24, 2017 at the Experimental Field Sector of the Embrapa Hortaliças, Brasília-DF, Brazil (15°56'02"S, 48°08'16"W, 993 m altitude).

A completely randomized experimental design with four replications was used, in a 2x5 factorial arrangement. Five rates (75, 125, 250, 375 and 500 g ha^{-1}) of the herbicide oxadiazon were applied at preemergence and postemergence of American black nightshade plants, and two control treatments without herbicide application (one for the preemergence and other for the postemergence applications) to determine control level in each treatment. Tomato plants were not evaluated. The commercial product used in the field and greenhouse experiments was Ronstar 250 BR.

The experimental units consisted of plastic pots with 3.0 dm^3 of soil. The soil was mixed with sand and a plant compost at a proportion of 3:1:1 (v:v:v), respectively, and fertilized with 100 mg kg^{-1} N, 200 mg kg^{-1} P, and 150 mg kg^{-1} of K. Approximately 0.3 g of American black nightshade seeds were distributed homogeneously on the soil surface in the pots and incorporated up to 2 cm depth, on November 14, 2016. The plants were thinned at 30 days after sowing, maintaining four plants per pot, for the treatments of postemergence herbicide application.

Each pot was placed on a wider plastic container with no holes to maintain the soil water regime by capillarity, with no irrigation or wetting of the soil surface in the pots. The soil moisture was evaluated daily, and the water was replenished when necessary.

The herbicide was applied on November 14, 2016 (preemergence), and December 10, 2016 (postemergence) when the plants had 2 to 3 leaves, between 10:20 and 10:45 h. A CO_2-pressurized backpack sprayer was used, equipped with a bar with two flat jet nozzles (TTI 110015; Teejet®, Wheaton, USA) spaced 0.5 m apart, with a constant pressure of 275 kPa cm^{-2} and a solution flow of 200 L ha^{-1}. The herbicide rates were applied under the following conditions: 22.8 to 26.2°C air temperature; 25.5 to 29.5°C soil temperature; 70 to 78% relative air humidity; 80 to 100% cloudiness; no wind and on wet soil.

Visual evaluations were carried out at 15 and 40 days after the preemergence or postemergence herbicide applications to determine the control of American black nightshade plants, using a scale of grades (0 to 100%), in which zero

represents the absence of visual injuries and 100 represents the death of the plant (SBCPD, 1995). The whole green aerial part of the plants was collected at 40 days after application (DAA) of herbicide to determine the shoot dry matter. The samples were dried in a forced air circulation oven at 50°C until constant weight. Obtained data were transformed to percentages of decrease in shoot dry matter relative to the respective control treatment with no herbicide application, in each application time.

The data were subjected to analysis of variance by the F test and, when significant ($p < 0.01$ or $p < 0.05$), the application times were compared by the F test and the herbicide rates were compared by polynomial fit of data. The control treatments without herbicide application were not included in the statistical analysis, since the control levels were attributed considering the development of plants, and the shoot dry matter data were transformed into percentages of decrease relative to the shoot dry matter of plants in the control treatments. The analyses were carried out using the Sisvar program (Ferreira, 2011).

Three field experiments were conducted from April 14, 2018 to October 18, 2018 in commercial processing tomato production areas in the municipality of Cristalina-GO, Brazil, irrigated by central pivot. The geographical coordinates, altitude of the locations, transplanting time, planting spacings, plant populations, and hybrids of tomato used in each experiment are presented in Table 1.

A randomized block experimental design with four replications was used in each experiment. The treatments consisted of application of five rates of the herbicide oxadiazon (125, 250, 375, 500, and 625 g ha^{-1}) at pre-planting of tomato, and a control treatment with no herbicide application, with manual weeding during the whole period of the experiment.

The processing tomato seedlings used were from a commercial nursery. Seedlings were transplanted mechanically, using a transplanter F-MAX (Ferrari, Italy), in conventional tillage system with specific planting spacings and plant populations for each tomato hybrid and experimental area. Soil fertilization consisted of KCl applications at pre-planting, N-P-K formulations at planting, and N topdressing applications: 200 kg ha^{-1} of KCl, 2,000 kg ha^{-1} of 08-24-12 and 66 kg ha^{-1} of N for the first experiment; 300 kg ha^{-1} of KCl, 1,600 kg ha^{-1} of 04-30-10 and 112.5 kg ha^{-1} of N for the second experiment; and 350 kg ha^{-1} of KCl, 1,500 kg ha^{-1} of 04-30-10 and 135 kg ha^{-1} of N for the third experiment.

Each plot measured 2.0 m (first experiment) or 1.8 m (second and third experiments) × 4.0 m, with an evaluation area of 4.2 m^2 (1.4 m × 3.0 m). An area of 0.45 m^2 (0.45 m × 1.0 m) within the evaluation area of each plot was sown with 0.4 g of American black nightshade seeds, which were broadcasted on the soil surface and then covered with approximately 1 cm of soil, one day before the herbicide application to evaluate the control of this species by the oxadiazon rates used. The remaining 3.75 m^2 of the evaluation area of each plot was used for the evaluation of tomato plants. The sowing of weeds in the field was needed to assure the occurrence of weeds at an adequate density and uniform to the plots for a more efficient comparison between treatments.

The oxadiazon rates were applied at the pre-planting of tomato seedlings, using a CO_2-pressurized backpack sprayer equipped with a bar with four flat jet nozzles (TTI 110015; Teejet®, Wheaton, USA) spaced 0.5 m apart, with a constant pressure of 275 kPa cm^{-2} and a solution flow of 150 L ha^{-1}. The intervals between applications and transplanting were 1, 3, and 4 days, respectively for the third, second, and first experiments. The date, hour, air and soil temperatures, relative air humidity, wind speed, and cloudiness at the time of herbicide applications in each experiment are shown in Table 2. The soils of the three areas were wetted to 5 cm depth.

All plots were maintained without weeds until the tomato harvest, with manual removal of the American black nightshade plants that survived chemical control, and manual removal of all

Table 1. Farm name, geographical coordinates, and altitude of the experiment areas, transplanting dates, spacings, plant populations, and hybrids of tomato of each field experiment. Cristalina, Embrapa, 2018.

Characteristics	Experiment 1	Experiment 2	Experiment 3
Farm	Poções - Agriter	Village	Village
Latitude	S 16º26'08.3"	S 16º24'41.7"	S 16º25'49"
Longitude	W 47º37'27.3"	W 47º33'21.3"	W 47º35'29"
Altitude	917	833	935
Transplanting date	04/18/2018	05/07/2018	06/06/2018
Spacing (m)[1]	1.3 x 0.7 x 0.3[1]	1.1 x 0.7 x 0.33	1.1 x 0.7 x 0.33
Population (plants ha^{-1})	33,333	33,670	33,670
Hybrid	Acangata 9992	H-9553	HMX 7885
Harvest date	09/04/2018	09/12/2018	10/18/2018

[1]Spacing between double rows × between rows within the double rows × between plants.

Table 2. Date, hour, air and soil temperatures, relative air humidity (AH), wind speed (WS), and cloudiness (CL) at the time of application of the herbicide oxadiazon in the three experiments. Cristalina, Embrapa, 2018.

Experiment	Date	Hour	Temperature (ºC)		AH (%)	WS (km h^{-1})	CL (%)
			Air	Soil			
First	04/14	15:45-16:10	26.9-26.0	26.5-25.5	63	2.3-4.8	90-85
Second	05/04	11:05-11:30	25.1-26.1	24.5	75-69	5.0-5.7	10
Third	05/15	10:00-10:30	23.4-23.6	22.5-21.5	66	4.6-8.7	0

weeds in the treatment without herbicide application. However, the plants from American black nightshade seeds sown in the sample area were maintained in the plots until 45 days DAA.

The experiments were irrigated weekly using a central pivot system, with 35 mm of water, based on the irrigation practiced in the whole commercial area. The irrigation was suspended at approximately 30 days before the harvest of tomato fruits. The plant protection management consisted of weekly applications of insecticides (spinetoram or thiamethoxam plus lambda-cyhalothrin) and fungicides (tebuconazole, azoxystrobin, or cyproconazole) at the recommended rates by the manufacturers, based on the management practiced in the whole commercial area.

Tomato plant injury was evaluated visually at 30 and 45 DAA, using a scale of grades (0 to 100), in which zero represents the absence of visual damages and 100 represents the death of the plant (SBCPD, 1995). The control of American black nightshade plants was also evaluated at 30 and 45 DAA, attributing grades of 0% to 100%.

The tomato plant stand was evaluated by counting the plants in the evaluation area of the plots at the time of harvest, at 139, 128, and 134 days after transplanting of the seedlings, respectively, for the first, second, and third experiments. The fruits of seven plants in the two central rows within the evaluation area (3.75 m^2) without American black nightshade plants were collected and separated into commercial and non-commercial fruits. Commercial fruits were those without pest attack (moth and borer) or diseases, cracks, green or black parts, and mold, and with diameter higher than 15 mm, according to the tomato industry criterion. These data showed the quantity and production of commercial fruits per plant (kg per plant) and per area (units or t ha^{-1}), and fruit weight of commercial fruits (g).

The data obtained in each experiment were subjected to analysis of variance by the F test and, when significant (p<0.01 or p<0.05), the results found for the oxadiazon rates were compared by polynomial fit of the data. The treatment with no herbicide application (control) was not included in the analysis because the control grades were defined as a function of the development of American black nightshade plants of this treatment. The analyses were carried out using the Sisvar program (Ferreira, 2011).

RESULTS AND DISCUSSION

The greenhouse experiment showed significant effects of application times and oxadiazon rates on weed control percentages at 15 and 40 days after application (DAA) and on shoot dry matter. However, the interaction between application time and herbicide rate was not significant for none of the evaluated characteristics, indicating that the factors affected the variables independently (Table 3).

A higher control percentage of American black nightshade at 15 DAA was found for the oxadiazon application in postemergence. However, at 40 DAA, the herbicide applied in preemergence showed greater efficiency, with decreases in shoot dry matter of almost 95%. These results showed that applications of oxadiazon at pre-planting of the crop for controlling American black nightshade plants at early developmental stages (with 2 to 3 leaves) are efficient; the herbicide controlled emerged plants and maintained the control for up to 40 days after application due to its residual effect in the soil. The oxadiazon rates from 246 g ha^{-1} controlled more than 90% of the American black nightshade plants, with polynomial fit of control percentage and shoot dry matter data (Figure 1).

A high viability of using oxadiazon to control American black nightshade plants was also found in the field experiments. The effects of the herbicide rates were different in both evaluation times (30 and 45 DAA) only in the first experiment (hybrid of tomato Acangata 9992), with polynomial fit of data and grades higher than 90% for rates from 347 g ha^{-1} at 30 DAA, and from 371 g ha^{-1} at 45 DAA (Figure 2). The experiments with the hybrids of tomato H-9553 and HMX 7885 showed no differences regarding the effects of the herbicide rates, presenting means of 95.6% and 100% weed control, respectively.

Despite the sowing was carried out with the same amount of American black nightshade seeds in the three field experiments, the number of emerged plants in the plots of the control treatment in the first experiment was higher (35.6
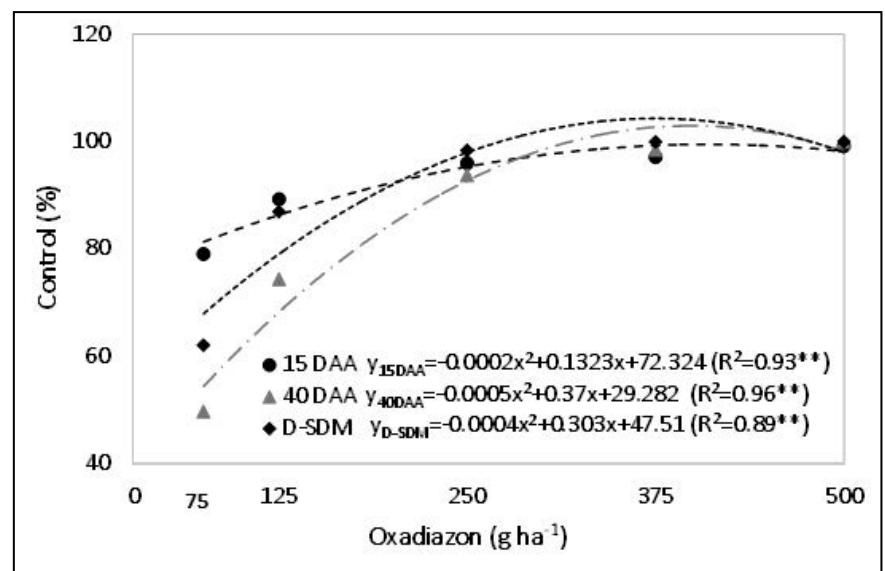

Figure 1. Control (%) of American black nightshade plants at 15 and 40 days after herbicide application (DAA) and decrease in percentage of shoot dry matter (D-SDM) at 40 DAA relative to controls without herbicide application, as a function of application of the herbicide oxadiazon at the rates of 75, 125, 250, 375, and 500 g ha^{-1}, under greenhouse conditions. Brasília, Embrapa, 2018.

plants m^{-2}) than those in the second and third experiments, which were 20 and 25 plants m^{-2}, respectively. This difference can be explained by thermal variations in the experiment implementation times, which affected seed germination and, consequently, the emergence of plants. American black nightshade seeds require environments with variation in temperature, and present higher germination potential under a thermal regime of 20/30°C (16:00h/8:00h) (Leal *et al.*, 1993). The higher density of American black nightshade plants in the first area probably contributed to the need for a higher herbicide rate for the weed control, when compared to the other areas.

The oxadiazon bioavailability in the soil can also affect the weed control efficiency. The soil type and organic matter contents affect the herbicide bioavailability in the soil solution. The herbicide in the soil can be absorbed by plants, lost by leaching and volatilization, or degraded. The incorporation of organic matter to the soil may affect the oxadiazon mobility in the soil profile, although the herbicide remains concentrated in the first 10 cm of soil, regardless the incorporation of organic matter (Mendes *et al.*, 2016). The soil of the three experimental areas evaluated in the present study presented clayey texture, with organic matter contents of 33 g kg^{-1} (first experiment), 35 g kg^{-1} (second experiment), and 34 g kg^{-1} (third experiment). Thus, no expressive differences between soils explains the lower control of American

Table 3. Results of the F test of the analysis of variance for control of American black nightshade plants at 15 and 40 days after application (DAA) of the herbicide oxadiazon at different rates (75, 125, 250, 375, and g ha^{-1}) and times (preemergence and postemergence), and shoot dry matter of plants at 40 DAA, in greenhouse conditions. Brasília, Embrapa, 2018.

Source of variation	Control (DAA)		Shoot dry matter[1]
	15	40	
Time	6.03*	5.35*	7.98**
Rate	32.49**	24.84**	15.45**
Time × rate	0.22	2.26	3.14
CV (%)	4.40	14.57	13.07
Time	Mean (%)		
Preemergence	90.52 b[2]	87.70 a	94.69 a
Postemergence	93.68 a	78.82 b	84.25 b

**, * Significant at 1% and 5% probability levels, respectively, by the F test. [1]The data were transformed into decreases in percentage of dry weight relative to the respective controls without herbicide. [2]Means followed by the same letter in the columns are not significantly different by the F test.

Table 4. Results of the F test of the analysis of variance for control of American black nightshade plants at 30 and 45 days after application (DAA) of the herbicide oxadiazon, tomato plant population per hectare (TPP), production of commercial fruits per plant (PCF), fresh mass per fruit (FM), number of commercial fruits per hectare (NCF), and commercial fruit yield (CFY), as a function of the treatments[1], for each field experiment. Cristalina, Embrapa, 2018.

Source of variation	Control - DAA (%)		TPP (n × 10³)	PCF (kg)	FM (g)	NCF (n x 10⁶)	CFY (t ha⁻¹)
	30	45					
Experiment 1 (hybrid Acangata 9992)							
Treatments	8.66**	9.36**	1.10	1.28	0.08	1.11	1.76
Block	0.85	2.44	5.16**	3.15*	0.23	2.95	3.41*
CV (%)	22.61	12.93	4.61	11.87	5.84	12.46	12.44
Means	81.45	83.00	35.62	3.08	54.97	2.00	109.84
Experiment 2 (hybrid H-9553)							
Treatments	1.36	1.33	0.67	2.59	0.04	1.73	1.48
Block	2.56	2.59	1.49	7.18*	0.89	2.86	6.06*
CV (%)	5.71	6.24	6.25	10.78	8.87	12.60	12.52
Means	95.62	96.34	33.73	3.80	52.20	2.47	128.27
Experiment 3 (hybrid HMX 7885)							
Treatments	0.00	0.00	0.79	0.62	0.84	1.73	0.48
Block	0.00	0.00	5.41**	1.09	0.25	2.57	0.09
CV (%)	0.00	0.00	5.96	17.84	20.51	12.75	15.32
Means	100.00	100.00	41.63	4.21	58.79	3.02	174.75

[1]Rates of oxadiazon plus a control without herbicide application for the evaluation of tomato plants; and rates of oxadiazon for the control of American black nightshade. **, * Significant at 1% and 5% probability levels, respectively, by the F test.
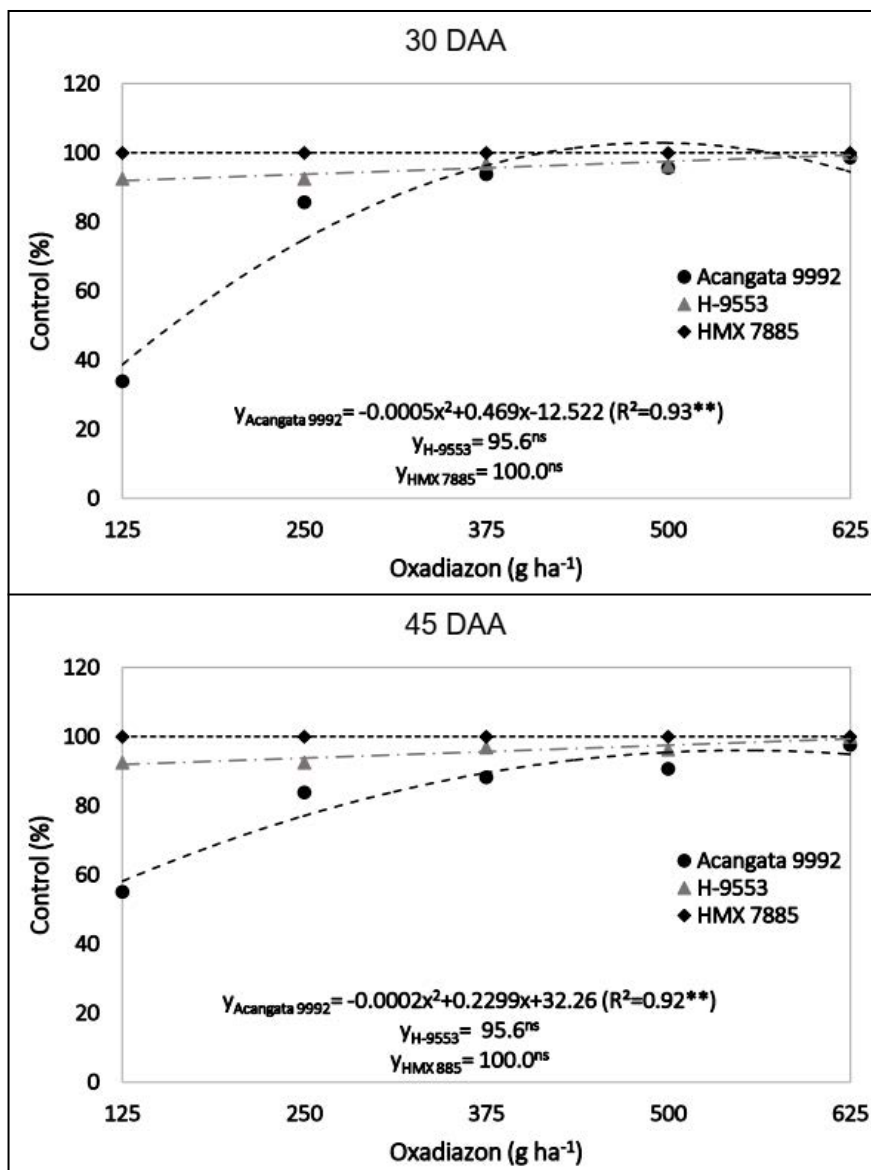
Figure 2. Control (%) of American black nightshade plants at 30 and 45 days after preemergence application (DAA) of the herbicide oxadiazon at the rates of 125, 250, 375, 500 and 625 g ha⁻¹, in three areas grown with the hybrids of tomato Acangata 9992, H-9553, and HMX 7885, under field conditions. Cristalina, Embrapa, 2018.

black nightshade plants in the first area, indicating that the infestation potential due to the weed density in each experiment may have affected the weed control.

The oxadiazon rates had no significant effect on the evaluated variables of tomato plants in any of the three field experiments (Table 4). These results showed a high selectivity of oxadiazon to the tomato hybrids Acangata 9992, H-9553, and HMX 7885, when applied at pre-planting using rates of up to 625 g ha⁻¹. In addition, the herbicide caused no visual injury to plants.

A high selectivity of oxadiazon was also found for cowpea, when applied in preemergence at the rate of 1.0 kg ha⁻¹, with no grain yield losses or phytotoxicity to the crop (Cruz *et al.*, 2018). The selectivity of oxadiazon may be explained by the plant's capacity to metabolize the herbicide, which inactivates or transforms the herbicide into non-toxic molecules (Birchfield & Casida, 1997). Mechanisms of detoxification of free radicals produced by the action of herbicides, such as increase of

production of antioxidant enzymes, specially superoxide dismutase, can also be related to the herbicide selectivity (Langaro *et al.*, 2017).

The hypothesis that preemergence application of the herbicide oxadiazon at rates of up to 625 g ha⁻¹ is selective to processing tomato crops and controls efficiently American black nightshade plants was confirmed. Thus, further studies should be carried out to extend the use of this herbicide in tomato crops.

Based on the results found, the herbicide oxadiazon is highly selective to the processing tomato hybrids Acangata 9992, H-9553, and HMX 7885 when applied at rates of up to 625 g ha⁻¹ at the pre-planting of seedlings. Moreover, the herbicide results in higher control levels of American black nightshade plants when applied at the estimated rate of 371 g ha⁻¹, for tomato crops using the hybrid Acangata 9992; and at the estimated rate of 125 g ha⁻¹, for tomato crops using the hybrids H-9553 and HMX 7885.

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