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Fighting off the sucking pests of soybean: managing stink bugs and whiteflies

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Supplementary Table 1. Active ingredient, trade name, dose of active ingredient ha^{-1} and dose of commercial product ha^{-1} of the insecticides evaluated for the control of stink bugs and whiteflies on soybean plants under field conditions in two cropping seasons. Santa Maria, RS, Brazil.

Treatment ID	Active ingredient (trade name)		Chemical group (mode of action)		Dose a.i. ha^{-1} (c.p.)[1]	
	1st spray	2nd spray	1st spray	2nd spray	1st spray	2nd spray
1	Cyantraniliprole (10%) + bifenthrin (10%) (Benevia® + Talstar®)	Cyantraniliprole (10%) + bifenthrin (10%) (Benevia® + Talstar®)	Diamide (ryanodine receptor modulator) + pyrethroid (sodium channel modulator)	Diamide (ryanodine receptor modulator) + pyrethroid (sodium channel modulator)	50 + 50 (500 + 500)	50 + 50 (500 + 500)
2	Cyantraniliprole (10%) + bifenthrin (10%) (Benevia® + Talstar®)	Cyantraniliprole (10%) (Benevia®)	Diamide (ryanodine receptor modulator) + pyrethroid (sodium channel modulator)	Diamide (ryanodine receptor modulator)	50 + 50 (500 + 500)	50 (500)
3	Cyantraniliprole (10%) + bifenthrin (10%) (Benevia® + Talstar®)	Bifenthrin (10%) (Talstar®)	Diamide (ryanodine receptor modulator) + pyrethroid (sodium channel modulator)	Pyrethroid (sodium channel modulator)	50 + 50 (500 + 500)	50 (500)
4	Cyantraniliprole (10%) + bifenthrin (5%) + carbosulfan (15%)	Cyantraniliprole (10%) + bifenthrin (5%) + carbosulfan (15%)	Diamide (ryanodine receptor modulator) + pyrethroid (sodium channel modulator) +	Diamide (ryanodine receptor modulator) + pyrethroid (sodium channel modulator) +	50 + 30 + 90 (500 + 600)	50 + 30 + 90 (500 + 600)

	(Benevia® + Talisman®)	(Benevia® + Talisman®)	carbamate (AChE inhibitor)	carbamate (AChE inhibitor)		
5	Cyantraniliprole (10%) + bifenthrin (5%) + carbosulfan (15%) (Benevia® + Talisman®)	Cyantraniliprole (10%) (Benevia®)	Diamide (ryanodine receptor modulator) + pyrethroid (sodium channel modulator) + carbamate (AChE inhibitor)	Diamide (ryanodine receptor modulator)	50 + 30 + 90 (500 + 600)	50 (500)
6	Cyantraniliprole (10%) + bifenthrin (5%) + carbosulfan (15%) (Benevia® + Talisman®)	Bifenthrin (5%) + carbosulfan (15%) (Talisman®)	Diamide (ryanodine receptor modulator) + pyrethroid (sodium channel modulator) + carbamate (AChE inhibitor)	Pyrethroid (sodium channel modulator) + carbamate (AChE inhibitor)	50 + 30 + 90 (500 + 600)	30 + 90 (600)
7	Acetamiprid (20%) + pyriproxyfen (10%) (Privilege®)	Acetamiprid (20%) + pyriproxyfen (10%) (Privilege®)	Neonicotinoid (nAChR agonist) + pyriproxyfen (juvenile hormone mimic)	Neonicotinoid (nAChR agonist) + pyriproxyfen (juvenile hormone mimic)	20 + 40 (200)	20 + 40 (200)
8	Sulfoxaflor (10%) + lambda-cyhalothrin (15%) (Expedition®)	Sulfoxaflor (10%) + lambda-cyhalothrin (15%) (Expedition®)	Sulfoximine(nAChR agonist) + pyrethroid (sodium channel modulator)	Sulfoximine(nAChR agonist) + pyrethroid (sodium channel modulator)	30 + 45 (300)	30 + 45 (300)
9	Dinotefuran (8.4%) + lambda-cyhalothrin (4.8%) (Zeus®)	Dinotefuran (8.4%) + lambda-cyhalothrin (4.8%) (Zeus®)	Neonicotinoid (nAChR agonist) + pyrethroid (sodium channel modulator)	Neonicotinoid (nAChR agonist) + pyrethroid (sodium channel modulator)	58.8 + 33.6 (700)	58.8 + 33.6 (700)
10	Acetamiprid (25%) + bifenthrin (25%) (Sperto®)	Acetamiprid (25%) + bifenthrin (25%) (Sperto®)	Neonicotinoid (nAChR agonist) + pyrethroid (sodium channel modulator)	Neonicotinoid (nAChR agonist) + pyrethroid (sodium channel modulator)	75 + 75 (300)	75 + 75 (300)
11	Thiamethoxam (14.1%) + lambda-cyhalothrin (10.6%) (Engeo Pleno S®)	Thiamethoxam (14.1%) + lambda-cyhalothrin (10.6%) (Engeo Pleno S®)	Neonicotinoid (nAChR agonist) + pyrethroid (sodium channel modulator)	Neonicotinoid (nAChR agonist) + pyrethroid (sodium channel modulator)	35.2 + 26.5 (250)	35.2 + 26.5 (250)
12	Untreated control	—	—	—	—	—

Note. [1]a.i. = active ingredient (g hectare^{-1}). c.p. = commercial product (mL hectare^{-1}).

Supplementary Table 2. Mean number (M) of living adults and nymphs per soybean trifoliate and control efficacy (CE%) of whitefly adults and nymphs in response to the insecticide treatments sprayed on soybean plants, under field conditions, in the second summer cropping season (2020/21). The active ingredients used in each treatment are presented in Supplementary Table 1. Santa Maria, RS, Brazil

Treat-ment	0 DA1S[1]	3 DA1S		5 DA1S		7 DA1S		10 DA1S		14 DA1S		3 DA2S		7 DA2S		10 DA2S		14 DA2S		Mean
	M[2]	M	CE%	M	CE%	M	CE%	M	CE%	M	CE%	M	CE%	M	CE%	M	CE%	M	CE%	CE%
										Adults										
1	5.0 a	2.2 b	84.3	2.1 de	80.9	2.7 b	85.6	1.3 bcd	89.4	3.1 b	85.2	0.8 bc	87.6	0.4 c	93.7	0.5 b	94.2	0.4 b	97.6	88.7 ab
2	6.1 a	2.4 b	83.2	2.4 cde	78.2	1.9 b	90.1	1.2 cd	90.2	2.1 b	89.8	1.5 bc	76.0	0.5 c	91.3	0.8 b	90.2	0.5 b	96.9	87.3 ab
3	4.1 a	3.1 b	78.0	4.2 bc	62.7	2.5 b	86.7	1.9 bcd	84.5	2.5 b	87.8	1.1 bc	82.2	0.9 bc	85.0	0.5 b	94.2	0.9 b	94.4	84.0 ab
4	3.1 a	3.3 b	76.6	4.0 bcd	64.4	2.4 b	87.5	3.2 bcd	73.6	3.2 b	84.2	1.1 bc	83.7	1.0 bc	84.2	1.3 b	84.5	1.6 b	90.6	81.0 bc
5	3.2 a	4.0 b	72.0	4.4 b	60.9	2.2 b	88.2	4.0 bc	67.5	4.6 b	77.6	2.2 b	65.9	2.1 b	66.9	1.1 b	87.9	1.2 b	93.0	75.5 c
6	2.7 a	3.2 b	77.6	3.4 bcde	69.3	2.5 b	86.7	2.2 bcd	82.1	2.9 b	85.6	1.0 bc	84.5	0.7 c	89.0	0.5 b	93.7	1.1 b	93.5	84.7 ab
7	2.6 a	3.2 b	77.6	2.4 cde	78.2	2.0 b	89.6	0.6 d	95.1	1.7 b	91.5	1.1 bc	83.7	0.5 c	92.1	0.9 b	89.7	0.8 b	95.2	88.1 ab
8	3.9 a	2.4 b	83.2	3.0 bcde	73.3	1.5 b	91.9	1.8 bcd	85.0	2.8 b	86.1	0.7 bc	89.1	0.5 c	91.3	0.7 b	91.4	1.0 b	94.2	87.3 ab
9	4.0 a	2.6 b	81.5	3.5 bcde	68.4	2.4 b	87.5	5.5 b	54.9	3.9 b	81.0	1.1 bc	82.9	0.5 c	91.3	0.8 b	90.8	1.2 b	92.7	81.2 bc

10	6.2 a	1.8 b	87.1	2.7 bcde	76.0	1.2 b	93.5	2.1 bcd	83.3	2.7 b	86.9	0.3 c	94.6	0.4 c	92.9	0.6 b	93.1	1.9 b	88.6	88.4 ab
11	5.8 a	2.1 b	85.0	1.8 e	84.0	1.2 b	93.5	0.9 cd	92.7	1.2 b	93.9	0.9 bc	85.3	0.6 c	89.8	0.8 b	90.8	0.5 b	96.8	90.2 a
12	5.9 a	14.3 a	—	11.2 a	—	19.1 a	—	12.3 a	—	20.5 a	—	6.4 a	—	6.3 a	—	8.7 a	—	16.5 a	—	—
CV(%)[3]	15.6	26.7	—	10.1	—	13.8	—	24.5	—	27.6	—	17.7	—	16.6	—	13.2	—	25.5	—	6.0
								Nymphs												
1	6.1 a	5.2 a	42.6	1.7 b	80.2	0.5 c	86.2	4.1 c	68.7	1.3 b	81.8	1.2 b	92.9	3.4 b	71.1	1.4 b	97.2	2.1 b	92.9	79.3 a
2	6.8 a	5.6 a	38.8	3.5 ab	60.4	1.0 bc	75.0	4.1 c	68.0	1.3 b	81.8	1.6 b	90.9	3.7 b	68.5	0.6 b	98.8	1.1 b	96.2	75.4 a
3	6.9 a	6.8 a	25.14	3.7 ab	57.6	0.8 bc	78.7	5.5 abc	57.1	2.5 b	64.3	1.6 b	90.6	3.1 b	73.6	1.9 b	96.1	1.4 b	95.4	71.0 ab
4	6.5 a	6.9 a	24.1	2.9 b	66.7	1.7 abc	56.2	5.7 abc	56.0	2.6 b	63.6	1.8 b	89.5	1.9 b	83.4	3.0 b	93.9	2.3 b	92.5	69.5 ab
5	5.7 a	7.1 a	22.9	3.2 ab	63.3	1.7 abc	57.5	6.3 abc	51.0	3.6 ab	48.9	1.5 b	91.5	4.3 b	63.4	1.4 b	97.2	3.9 b	87.2	64.7 ab
6	6.9 a	5.2 a	43.2	3.2 ab	63.3	3.1 ab	21.2	6.2 abc	52.1	2.9 ab	58.7	2.7 b	84.4	1.5 b	87.2	2.3 b	95.3	1.8 b	94.1	66.6 ab
7	5.7 a	6.6 a	27.9	2.1 b	75.7	0.8 c	80.0	5.3 bc	59.1	3.4 ab	51.7	1.6 b	90.6	1.8 b	84.	1.1 b	97.9	1.1 b	96.6	73.7 ab
8	6.8 a	7.7 a	15.3	1.4 b	84.2	0.4 c	90.0	3.3 c	74.5	2.2 b	69.2	1.9 b	89.2	4.3 b	63.0	0.9 b	98.1	1.7 b	94.4	75.3 a
9	5.2 a	9.5 a	0.0	4.1 ab	53.1	1.3 abc	66.2	6.5 abc	49.8	4.1 ab	43.4	1.9 b	89.2	2.5 b	78.7	1.8 b	96.3	2.4 b	92.1	63.2 ab
10	6.6 a	9.3 a	0.0	6.2 ab	29.9	2.1 abc	47.5	11.8 ab	8.8	2.1 b	71.3	3.4 b	80.7	2.2 b	80.8	2.4 b	95.0	3.7 b	87.9	55.8 b
11	6.4 a	8.4 a	8.2	2.2 b	75.1	1.6 abc	58.7	4.4 c	66.0	1.1 b	84.6	2.1 b	87.8	2.0 b	83.0	1.5 b	97.0	4.8 b	84.3	71.6 ab
12	6.9 a	9.1 a	—	8.8 a	—	4.0 a	—	12.9 a	—	7.1 a	—	17.6 a	—	11.7 a	—	49.3 a	—	30.5 a	—	—
CV(%)	14.1	14.7	—	26.1	—	23.8	—	19.9	—	22.9	—	34.9	—	25.5	—	25.2	—	40.5	—	16.6

Note. [1]DAS = Days after first (1) and second (2) spray.[2]Means followed by the same letter in the column do not differ among themselves by the Tukey test (P≤0.05). [3]CV (%) = Coefficient of variation.

Supplementary Table 3. Average means of control efficacy (CE%) of stink bug and whitefly adults and nymphs in response to the first (1st) and second (2nd) insecticide sprays on soybean plants, under field conditions, in two summer cropping seasons (2019/20 and 2020/21). Same active ingredients in the two sprays are indicated by: (2x). Statistics for stink bug control not showed due to low infestation in the second cropping season. Cyantra. (cyantraniliprole), bifent. (bifenthrin) and carbos. (carbosulfan). Santa Maria, RS, Brazil.

Treatments	Stinkbugs (CE%)[1]	Whitefly adults (CE%)[2]	Whitefly nymphs (CE%)	Whitefly adults + nymphs (CE%)[3]	Stinkbugs + whiteflies (CE%)[4]
Cyantraniliprole + bifenthrin (2x)	92.8	89.8 a	67.8 a	78.8 a	83.5 a
Cyantra. + bifent. (1st) cyantra. (2nd)	88.5	85.8 a	59.5 a	72.7 ab	77.9 a
Cyantra. + bifent. (1st) bifent. (2nd)	95.4	80.0 a	50.9 a	65.4 ab	75.4 a
Cyantraniliprole + bifenthrin + carbosulfan (2x)	95.7	84.7 a	67.6 a	76.1 ab	82.7 a
Cyantra. + bifent. + carbos. (1st) cyantra. (2nd)	89.2	81.4 a	61.8 a	71.6 ab	77.4 a
Cyantra. + bifent. + carbos. (1st) bifent. + carbos. (2nd)	96.7	84.9 a	63.6 a	74.2 ab	81.7 a
Acetamiprid + pyriproxyfen (2x)	66.0	86.9 a	59.8 a	73.4 ab	70.9 a
Sulfoxaflor + lambda-cyhalothrin (2x)	83.1	79.8 a	48.3 a	64.1 b	70.4 a
Dinotefuran + lambda-cyhalothrin (2x)	94.0	81.4 a	51.3 a	66.4 ab	75.6 a
Acetamiprid + bifenthrin (2x)	97.8	87.8 a	58.9 a	73.3 ab	81.5 a
Thiamethoxam + lambda-cyhalothrin (2x)	86.5	82.9 a	63.3 a	73.1 ab	77.6 a
Untreated control	—	—	—	—	—
CV(%)[5]	—	6.9	21.1	4.9	8.1

Note. [1]Stink bugs not quantified in Experiment II (2020/21 cropping season) due to low infestation in the experimental plots. [2]Means followed by the same letter in the column do not differ among themselves by the Tukey test (P≤0.05).[3]Average between the third and fourth columns. [4]Average between the second, third and fourth columns. [5]CV (%) = Coefficient of variation.

Supplementary Table 4. Soybean yield (kg hectare^{-1}) in response to the first (1st) and second (2nd) insecticide sprays to control stink bugs and whiteflies on soybeans in two summer cropping seasons (2019/20 and 2029/21). Same active ingredients in the two sprays are indicated by: (2x). Santa Maria, RS, Brazil.

Treatments	First cropping season (2019/20)[1]	Second cropping season (2020/21)	Average between seasons
Cyantraniliprole + bifenthrin (2x)	3562.0 abcd	3925.4 ab	3743.7 a
Cyantraniliprole + bifenthrin (1st) cyantraniliprole (2nd)	3516.5 abcd	4082.9 ab	3799.7 a
Cyantraniliprole + bifenthrin (1st) bifenthrin (2nd)	3290.8 d	4261.7 ab	3776.3 a
Cyantraniliprole + bifenthrin + carbosulfan (2x)	3791.7 a	4208.3 ab	4000.0 a
Cyantraniliprole + bifenthrin + carbosulfan (1st) cyantraniliprole (2nd)	3698.3 ab	3738.3 ab	3718.3 a
Cyantraniliprole + bifenthrin + carbosulfan (1st) bifenthrin + carbosulfan (2nd)	3763.3 a	3888.3 ab	3825.8 a
Acetamiprid + pyriproxyfen (2x)	3380.8 cd	3820.0 ab	3600.4 a
Sulfoxaflor + lambda-cyhalothrin (2x)	3583.3 abcd	4147.5 ab	3865.4 a
Dinotefuran + lambda-cyhalothrin (2x)	3513.7 abcd	3826.7 ab	3670.2 a
Acetamiprid + bifenthrin (2x)	3561.7 abcd	3622.5 bc	3592.1 a
Thiamethoxam + lambda-cyhalothrin (2x)	3667.5 abc	3605.8 bc	3636.7 a
Untreated control	3465.0 def	2980.0 c	3222.5 a
CV(%)[2]	3.3	7.7	7.1

Note. [1]Means followed by the same letter in the column do not differ among themselves by the Tukey test (P≤0.05). [2] CV (%) = Coefficient of variation.