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Management of Spreading Dogbane (*Apocynum androsaemifolium)* in Wild Blueberry Fields

Lin Wu and Nathan S. Boyd*

Spreading dogbane is a troublesome weed of wild blueberry fields. Field studies were conducted in 2008 and 2009 to evaluate efficacy of different herbicides and application techniques on spreading dogbane as well as blueberry tolerance. Results indicated that summer-broadcast nicosulfuron at 25 g ai ha^{-1} with 0.5% v/v blend of surfactant with petroleum hydrocarbons suppressed (> 60%) spreading dogbane at three of four sites. Spot sprays with dicamba at 1 kg ae ha^{-1} effectively controlled (> 80%) spreading dogbane with minimal (19 to 23%) blueberry damage at three of four sites. Glyphosate spot sprays at 5 g ae L^{-1} water provided more effective and longer control than hand pulling. Wiping with glyphosate at 154 g ae L^{-1} water or wiping triclopyr at 29 g ae L^{-1} water onto the shoots is also an effective control method for localized patches of spreading dogbane. Although low to moderate crop damage may accompany these techniques, it may still be tolerable for growers to apply these options to limit long-term yield loss caused by spreading dogbane.

Nomenclature: Dicamba; glyphosate; mesotrione; nicosulfuron; primisulfuron; spreading dogbane, *Apocynum androsaemifolium* L.; wild blueberry, *Vaccinium angustifolium* L.

Key words: Herbicide, horticulture, perennial weeds, POST herbicides, weed control.

Apocynum androsaemifolium es una maleza problemática en campos de arándano silvestre. En 2008 y 2009, se realizaron estudios de campo para evaluar la eficacia de diferentes herbicidas y técnicas de aplicación sobre *A. androsaemifolium* y la tolerancia del arándano. Los resultados indicaron que la aplicación general durante el verano de nicosulfuron a 25 g ai ha^{-1} con una mezcla de surfactante con hidrocarburos de petróleo 0.5% v/v, suprimió (>60%) *A. androsaemifolium* en tres de los cuatro sitios experimentales. Aplicaciones localizadas de glyphosate a 5 g ae L^{-1} agua brindaron un control más efectivo y duradero que la deshierba manual. La aplicación con azadón químico de glyphosate a 154 g ae L^{-1} agua o de triclopyr a 29 g ae L^{-1} agua sobre tejido aéreo fueron también métodos efectivos de control cuando *A. androsaemifolium* tuvo una distribución localizada. Aunque un daño al cultivo de bajo a moderado puede acompañar a estas técnicas de aplicación, esto puede ser tolerable para productores que apliquen estas opciones con el objetivo de limitar pérdidas en rendimiento a largo plazo causadas por *A. androsaemifolium*.

The wild blueberry is a perennial deciduous shrub native to North America (Vander Kloet 1978) growing best in wooded or open areas with well-drained acidic soils (Kinsman 1993). Commercial wild blueberry fields are not planted but are managed intensely to encourage blueberry clonal spread, usually under a 2-yr production cycle on commercial lands. Fields are pruned by burning or mowing to stimulate vegetative growth in the first year (vegetative year). Flowering, fruit development, and harvest occur in the second year (crop year) (Kennedy et al. 2010). Nova Scotia is the second largest producer of wild blueberries in Canada and the industry is a significant part of Nova Scotia's provincial heritage and natural vegetation economy (Sibley 1987). Based on the province's 2008 farm report, Nova Scotia makes up 29% of the country's total wild blueberry sales, which represent 5.6% of total provincial farm cash receipts, with 15,985 ha of blueberries (Makki 2010). In 2009, production of wild blueberries in Nova Scotia was 16,503 tons, with a farm value of Can$13 million (Anonymous 2010).

Weed competition is one of the major factors inhibiting berry yields (Jensen 2003; Yarborough 2011). They compete with the blueberry plants for the resources necessary for adequate plant growth, serve as alternate hosts for insects and diseases, hinder harvest, and contaminate blueberry packs (Jensen and Yarborough 2004). Many problem weeds in blueberry fields are creeping perennials that spread vegetatively via underground root systems or rhizomes. Common production practices such as pruning and fertilization promote perennial weed growth and spread.

Spreading dogbane is a creeping perennial herb that spreads via seeds and underground rhizomes (Sampson et al. 1990). It is considered a weed in wild blueberry fields because of its competitive ability and rapid spread once established (Sampson et al. 1990). Spreading dogbane can substantially decrease blueberry yields and field profitability (Yarborough and Marra1997). Yarborough and Bhowmik (1989) reported spreading dogbane as one of the most frequent weeds in blueberry fields in Maine, infesting 57% of the fields surveyed. A survey of blueberry fields in Quebec reported that spreading dogbane infested 87.5% of the fields surveyed in the Saguenay–Lac-Saint-Jean region (Lapointe and Rochefort 2001). In Nova Scotia, McCully et al. (1991) reported that only 3.6% of 115 fields surveyed were infested by spreading dogbane. Recent grower reports throughout Nova Scotia suggest that spreading dogbane is becoming more common in the province.

There is no published research on spreading dogbane susceptibility to herbicides and blueberry growers across the region do not have effective management options for this

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* Graduate Student and Associate Professor, Department of Environmental Sciences, Nova Scotia Agricultural College, Truro, NS, Canada B2N 4V9. Corresponding author's E-mail: nboyd@nsac.ca

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species. However, several management studies have been conducted on the related species hemp dogbane (*Apocynum cannabinum* L.) (Glenn and Anderson 1993; Ransom and Kells 1998). This species is susceptible to POST products such as glyphosate (Curran et al. 1997; DiTommaso et al. 2009; Doll 1997; Webster and Cardina 1999), 2, 4-D plus dicamba (Orfanedes and Wax 1991; Schultz and Burnside 1979), nicosulfuron (Dobbels and Kapusta 1993; Glenn et al. 1997), and primisulfuron (Curran et al. 1997; Doll 1994).

The objectives of this study were to: (1) evaluate efficacy of summer-broadcast herbicides applied in the vegetative year, (2) evaluate efficacy of summer spot sprays applied in the vegetative year, (3) compare efficacy of hand pulling vs. spot sprays with glyphosate, and (4) compare efficacy of wiping and spot sprays with glyphosate, and wiping with triclopyr. All herbicide products were evaluated for blueberry tolerance and spreading dogbane efficacy.

Materials and Methods

Experiments were conducted in 2008 and 2009 to evaluate various herbicide options for spreading dogbane control. All experiments were conducted in the vegetative year of commercial wild blueberry fields located in Windham Hill (45°36′50″N, 63°59′45″W), Salt Springs (45°30′44″N, 63°00′40″W), Oxford (45°43′48″N, 63°52′12″W), Collingwood (45°36′36″N, 63°47′10″W), and Southampton (45°34′48″N, 64°14′24″W), Nova Scotia, as well as one site in Mt. Stewart, Prince Edward Island (46°21′56″N, 62°52′08″W), Canada.

All soils had a low pH (4.8–5.2), with 4 to 8.2% organic matter. Soil at Windham Hill and Salt Springs was a Westbrook type soil series that was well drained and composed of reddish brown sandy loam over reddish brown sandy loam to gravelly sandy loam (Webb et al. 1991). Soil at Oxford was of the Hebert type soil series, excessively drained and composed of grayish brown or brown over yellowish red sand to sandy loam (Nowland and MacDougall 1973). Soil at the Collingwood site was a stony, well drained sandy loam of the Rodney soil series (Nowland and MacDougall 1973). Soil at Southampton was of the Rodney type soil series, well drained and composed of dark brown sandy loam over yellowish red to reddish brown gravelly sandy loam to gravelly loam (Nowland and MacDougall 1973). Soil at Mt. Stewart, PEI was medium to moderately coarse textured, acid fluvial material on depressional to gently undulating relief and poorly drained (MacDougall et al. 1988).

All herbicides were applied with a CO_2-pressurized hand-held sprayer equipped with Teejet 8002VS nozzles (Rittenhouse, 1402 Fourth Ave., St. Catharines, ON, Canada L2R 6P9) spaced 50 cm on a 1.5-m boom for broadcast sprays and a single nozzle for spot sprays. The application rate for all herbicides was based on the herbicide labels or recommendations from herbicide manufacturers. The unit was calibrated to deliver the appropriate water volume at a pressure of 275 kPa. Different spray volumes were normally adjusted by walking speed. A "hockey-stick" applicator (Red Weeder®, Smucker Manufacturing, Inc., 22919 N Coburg Rd., Harrisburg, OR 97446) was used for wiping. The herbicide was slowly delivered to an absorbent wick to saturation. The hockey-stick applicator was operated slowly to thoroughly wet the foliage and was wiped in two directions to improve coverage and control. Unless otherwise stated, all herbicides were applied between the flower bud to early flowering growth stage of spreading dogbane while blueberries were at or near the tip dieback stage, which is the stage blueberry stems stop stem elongation after pruning.

All experiments except the spot spray treatments were arranged in a randomized complete block design with four blocks in each field and were repeated in four fields unless otherwise stated. Individual plot size was 2 m by 6 m with a 1-m-wide unsprayed strip between each plot. An untreated control was included in each experiment unless otherwise stated.

Summer Broadcast. Efficacy of five broadcast POST herbicides was evaluated on spreading dogbane at Windham Hill and Salt Springs, NS in 2008 and Oxford, NS and Mt. Stewart, PEI in 2009. Nicosulfuron (Accent® herbicide, DuPont Canada Agricultural Products, P.O. Box 2300, Streetsville, Mississauga, ON L5M 2J4) was applied at a rate of 25 g ai ha^{-1} with a water volume of 190 L ha^{-1}, with either 0.2% v/v nonionic surfactant Activate Plus (Activate Plus™, Agriliance, St. Paul, MN 55164) or 0.5% v/v crop oil surfactant Merge (Merge™, BASF Canada Inc., 345 Carlingview Drive, Toronto, ON M9W 6N9), respectively. Mesotrione (Callisto® herbicide, Syngenta Crop Protection Canada, Inc., 140 Research Lane, Research Park, Guelph, ON N1G 4Z3) at 101 g ai ha^{-1}, premix of nicosulfuron at 13 g ai ha^{-1} and rimsulfuron at 13 g ai ha^{-1} (Ultim® herbicide, DuPont Canada Agricultural Products, P.O. Box 2300, Streetsville, Mississauga, ON L5M 2J4), tank-mix mesotrione at 101 g ai ha^{-1} with nicosulfuron at 13 g ha^{-1} and rimsulfuron at 13 g ai ha^{-1} were applied in a water volume of 200 L ha^{-1}, 400 L ha^{-1}, and 400 L ha^{-1}, respectively. The nonionic surfactant Activate Plus was added to mesotrione, premix of nicosulfuron and rimsulfuron, and tank-mix mesotrione with nicosulfuron and rimsulfuron at 0.2% v/v, respectively.

Herbicides were sprayed on July 2 at Windham Hill, July 4 at Salt Springs, 2008, July 8 at Mt. Stewart, and July 9 at Oxford 2009. Average spreading dogbane heights on application dates were 47, 52, 80, and 76 cm for Windham Hill, Salt Springs, Mt. Stewart, and Oxford, respectively. Average spreading dogbane shoot density on application dates across all treatments was 2, 10, 43, and 3 m^{-2} for Windham Hill, Salt Springs, Mt. Stewart, and Oxford, respectively.

Summer Spot Spray. Herbicide efficacy was evaluated on spreading dogbane at Windham Hill and Collingwood, NS in 2008 and Southampton, NS and Mt. Stewart, PEI in 2009. The experimental design was a completely randomized design with seven replications at each site. Forty-nine individual spreading dogbane ramets were randomly selected and flagged in each field. Treatment 1 was aminopyralid (Milestone ® herbicide, DowAgroSciences LLC, 9330 Zionsville Road, Indianapolis, IN 46268) at 120 g ae ha^{-1} in 200 L ha^{-1} water. Treatment 2 was premix diflufenzopyr with dicamba (Overdrive ® herbicide, BASF Canada Inc., 345 Carlingview

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Drive, Toronto, ON M9W 6N9) at 24 and 152 g ae ha^{-1}, respectively, in 200 L ha^{-1} water. Treatment 3 was premix pyrasulfotole with bromoxynil (Infinity ® herbicide, Bayer Crop Science, Inc., Suite 200, 160 Quarry Park Blvd. S.E. Calgary, AB, Canada T2C 3G3) at 31 and 174 g ai ha^{-1}, respectively, in 100 L ha^{-1} water. Treatment 4 was glyphosate (Roundup WeatherMAX® herbicide, Monsanto Company, 800 North Lindbergh Boulevard, St. Louis, MO 63167) at 5 g ae L^{-1} water. Treatment 5 was dicamba (Banvel® herbicide, BASF Canada Inc., 345 Carlingview Drive, Toronto, ON M9W 6N9) at 1 kg ae ha^{-1} in 550 L ha^{-1} water. Treatment 6 was tank-mix dicamba with 2,4-D LV ester (Salvo ® herbicide, United Agri Products Canada Inc., 789 Donnybrook Drive, Dorchester, ON N0L 1G5) at 1.1 and 3.8 kg ae ha^{-1}, respectively, in 550 L ha^{-1} water. Treatment 7 was premix primisulfuron with dicamba (Summit ® herbicide, Syngenta Crop Protection Canada, Inc., 140 Research Lane, Research Park, Guelph, Ontario, N1G 4Z3) at 26 and 140 g ae ha^{-1}, respectively, in 200 L ha^{-1} water. Nonionic surfactant (NIS) was added to treatments 1, 2, and 7, at 0.2% v/v. Herbicides were sprayed between the flower bud formation and early flowering stage until the dogbane foliage was thoroughly wet. All herbicides were applied overtop blueberry plants. Herbicides were applied July 2 and 4 at Windham Hill and Collingwood, respectively, in 2008 and July 8 and 9 at Mt. Stewart, PEI and Southampton, NS in 2009. Average spreading dogbane heights on application dates were 47, 49, 79, and 33 cm for Windham Hill, Collingwood, Mt. Stewart, and Southampton, respectively.

Summer Spot Spray vs. Hand Pulling. An experiment comparing spot spraying with glyphosate vs. hand pulling occurred in Salt Springs, NS in 2008 and was repeated in Southampton, NS and Mt. Stewart, PEI in 2009. Glyphosate was applied at 5 g L^{-1} water to thoroughly wet the foliage of all dogbane plants in the plot. For hand pulling, all spreading dogbane plants were grabbed close to the ground and pulled out. Both treatments were done between the flower bud formation stage and early flowering stage on July 3, 2008 in Salt Springs, and July 9 in Southampton and July 8 in Mt. Stewart in 2009. Average spreading dogbane heights on application dates were 51, 32, and 79 cm for Salt Springs, Southampton, and Mt. Stewart, respectively. Average spreading dogbane density on application dates across all treatments was 6, 7, and 35 m^{-2} for Salt Springs, Southampton, and Mt. Stewart, respectively. No nontreated plots were set up for this experiment.

Summer Spot Spray vs. Wiping. An experiment comparing spot spraying vs. wiping occurred in Southampton, NS and Mt. Stewart, PEI in 2009. The treatments were: (1) wiping with glyphosate at 154 g L^{-1} water, (2) wiping with triclopyr (Garlon® herbicide, Dow AgroSciences LLC, 9330 Zionsville Rd., Indianapolis, IN 46268) at 29 g L^{-1} water; (3) spot spray with glyphosate at 5 g L^{-1} water, and (4) a nontreated control. All treatments were applied between the flower bud formation and early flowering stage at July 9 and July 8 in Southampton and Mt. Stewart, respectively. Average spreading dogbane heights on application dates were 32 and 79 cm for Southampton and Mt. Stewart, respectively. Average spreading dogbane density on application dates across all treatments was 6 and 33 m^{-2} for Southampton and Mt. Stewart, respectively.

Data Collection. The total number of spreading dogbane ramets was counted in each plot in all experiments at the day herbicides were sprayed and at the final damage rating (last week of August). The difference between counts was used to estimate percent aboveground control.

Herbicide damage was evaluated in most experiments 14, 21, 35, and 56 d after treatment (DAT) using a 0 to 100 scale where 0 was no visible injury and 100 was complete death. Both blueberry and spreading dogbane were rated.

Ten spreading dogbane shoots were harvested from each plot in the summer broadcast experiment at all four sites at the last week of August. Shoots were collected at 50-cm intervals along a diagonal transect. Samples were dried at 60 C for 48 h and then weighed. Blueberry floral buds provide an estimate of yield potential and were counted on 15 stems located every 40 cm along a diagonal transect in early September of the vegetative year. Floral buds were not counted at Oxford in 2009 because of low blueberry percent cover.

Statistical Analysis. Blueberry injury and weed damage ratings were analyzed using the PROC MIXED procedure with repeated measures in the SAS (SAS software, Version 9.1, 2002–2003, SAS Institute Inc., Cary, NC) system for Windows (SAS Institute. 1999). Percent control of spreading dogbane, spreading dogbane shoot biomass, and blueberry floral bud numbers were also statistically analyzed using the PROC MIXED procedure in SAS. All sites were analyzed separately unless otherwise stated. Differing transformations (square root, log) were used when needed to normalize the data. Nontransformed data are presented with statistical interpretation based on transformed data. Mean separation for treatment differences was performed using LSD. Unless otherwise stated, significance values were set at $P < 0.05$.

Results and Discussion

Summer Broadcast. Sites were analyzed separately because the effect of site was significant in the model ($P < 0.0001$) and there were known differences between sites in soil type, management, environment, and dogbane population density. Schultz and Burnside (1980) also found that herbicide efficacy on hemp dogbane was not consistent between sites because of different edaphic, climatic, and biotic factors.

Treatment efficacy varied within Salt Springs and Mt. Stewart ($P < 0.0001$). Nicosulfuron plus a crop oil surfactant, tank mix of nicosulfuron/rimsulfuron with mesotrione, and nicosulfuron plus rimsulfuron controlled spreading dogbane (> 83%) at two of four sites. Nicosulfuron with a NIS and mesotrione suppressed spreading dogbane (> 60%) at Windham Hill and Mt. Stewart. The tank mix of nicosulfuron/rimsulfuron plus mesotrione, and the premix of nicosulfuron and rimsulfuron did not provide additional control when compared with nicosulfuron alone except at the Salt Springs site. These results suggest that control was mainly provided by the nicosulfuron component. None of the

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Table 1. Summer-broadcast herbicide efficacy on spreading dogbane and wild blueberry at Windham Hill and Salt Springs, NS in 2008 and Oxford, NS and Mt. Stewart, PEI in 2009.

Herbicide	Rate	Dogbane damage[a] WH[b]	SS	OD	MS	Dogbane biomass WH	SS	OD	MS	Blueberry damage WH	SS	OD	MS	Blueberry floral buds WH	SS	OD	MS
	g ai ha^{-1}	%				g plant^{-1}				%				No. stem^{-1}			
Nontreated	-	0	0	0	0	1.6 a	2.6 b	4.4 a	8.1 a	0	0	0	0	7 a	4 a	-[c]	1 a
Nicosulfuron[d]	25	73 a[i]	18 b	53 a	60 b	1.4 a	2.4 b	3.4 a	5.9 c	15 b	13 a	15 a	18 a	6 a	4 a	-	0 a
Nicosulfuron[e]	25	85 a	58 a	60 a	85 a	1.7 a	4.6 ab	3.5 a	6.2 bc	10 b	13 a	15 a	18 a	5 a	3 ab	-	0 a
Mesotrione[f]	101	78 a	20 b	53 a	63 b	1.9 a	8.5 a	3.7 a	7.5 ab	10 b	8 a	13 a	15 a	7 a	2 b	-	0 a
Nico/rim + Mes[g]	26 + 101	83 a	20 b	63 a	93 a	1.5 a	4.9 ab	3.4 a	5.2 c	28 a	10 a	13 a	20 a	5 a	3 ab	-	1 a
Nico/rim[h]	13/13	95 a	13 b	55 a	85 a	1.9 a	2.5 b	4.1 a	5.2 c	10 b	13 a	15 a	20 a	5 a	3 ab	-	1 a

[a] Dogbane damage and blueberry damage ratings were done on a 0–100 scale. Ratings taken 56 d after treatment are reported.

[b] Abbreviation: WH, Windham Hill; SS, Salt Springs; OD, Oxford; MS, Mt. Stewart.

[c] loral bud counts were not available at Oxford in 2009.

[d] Nicosulfuron was applied with 0.2% v/v nonionic surfactant.

[e] Nicosulfuron was applied with 0.5% v/v surfactant blend with petroleum hydrocarbons solvent.

[f] Mesotrione was applied with 0.2% v/v nonionic surfactant.

[g] Nicosulfuron/rimsulfuron plus mesotrione was applied with 0.2% v/v nonionic surfactant.

[h] Nicosulfuron/rimsulfuron was applied with 0.2% v/v nonionic surfactant.

[i] Means within columns followed by the same letter are not significantly different at $P < 0.05$.

products was effective at Salt Springs, NS (Table 1). Antagonism between mesotrione and nicosulfuron/rimsulfuron as reported by Schuster et al. (2007) was not observed at any of the sites. In some cases, significantly higher control levels were obtained with the tank mix of mesotrione with nicosulfuron/rimsulfuron compared with an application of nicosulfuron/rimsulfuron alone. None of the broadcast products consistently provided adequate control levels, but nicosulfuron plus crop oil surfactant suppressed spreading dogbane (> 60%) at three of four sites. Preliminary results suggest that broadcast applications of dicamba and dicamba plus nicosulfuron in the fall after harvest but before mowing controlled 90% of the dogbane (data not shown). However, severe crop damage can occur if the both herbicides are applied directly on actively growing blueberry plants.

Nicosulfuron, a sulfonylurea herbicide, can be mixed with oil emulsifier mixtures (OEM) or NIS (Williams and Harvey 1996). Nicosulfuron with OEM (surfactant blend with petroleum hydrocarbons solvent) tended to provide higher dogbane injury than nicosulfuron with the NIS (Table 1). In Salt Springs and Mt. Stewart, the addition of an OEM provided 25 to 40% higher dogbane injuries than the addition of a NIS to nicosulfuron. A similar trend was observed at Windham Hill and Oxford, though differences were not significant. Our results support the findings of Nalewaja et al. (1991), who also found greater nicosulfuron efficacy when mixed with an OEM vs. a NIS.

Nicosulfuron plus a crop oil surfactant, the premix nicosulfuront/rimsulfuron, and the tank mix of nicosulfuront/rimsulfuron with mesotrione significantly reduced dogbane biomass more than all other treatments at Mt. Stewart (Table 1). High levels of dogbane damage but no reduction in dogbane biomass was found at Windham Hill. The lack of difference in the dogbane biomass compared with the dogbane damage ratings may be contributed to damage to the leaves of the mature plants but not the stems and branches, which constitute the majority of the weight.

Table 2. Efficacy of herbicide spot sprays on spreading dogbane and blueberry damage at Farmington and Collingwood, NS in 2008 and South Hampton, NS and Mt. Stewart PEI in 2009.

Herbicide	Rate	Dogbane damage[a] FN[b]	CD	SN	MS	Blueberry injury FN	CD	SN	MS
	g ai or ae ha^{-1}	%				%			
Aminopyralid	120	100 a[d]	100 a	99 a	100 a	51 bc	67 b	87 a	41 bc
Diflufenzopyr/dicamba	24 + 152	100 a	100 a	100 a	100 a	37 d	50 cd	45 cd	27 cd
Pyrasulfotole/bromoxynil	31 + 174	90 a	76 b	100 a	87 b	61 b	59 bc	46 cd	23 d
Glyphosate	5[c]	96 a	100 a	100 a	100 a	81 a	100 a	100 a	93 a
Dicamba	1,000	57 b	100 a	80 b	99 ab	20 e	53 bc	23 e	19 d
Dicamba + 2,4-D LV ester	1,100 + 3,800	100 a	100 a	89 ab	100 a	50 c	65 b	73 b	49 b
Primisulfuron/dicamba	26 + 140	94 a	100 a	87 ab	90 ab	31 d	39 d	31 de	24 d

[a] Dogbane damage and blueberry injury ratings were done on a 0–100 scale. Ratings taken 56 d after spraying are reported.

[b] Abbreviations: FN, Farmington; CD, Collingwood; SN, Southampton; MS, Mt. Stewart.

[c] Glyphosate was applied at 5 g ae L^{-1} water.

[d] Means within columns followed by the same letter are not significantly different at $P < 0.05$.

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Table 3. Effect of spot sprays and hand pulling on spreading dogbane across three sites.

Treatment	Dogbane density	Dogbane control		
		60 DAT[a]	361 DAT[c]	Biomass
	No. plot^{-1}	——%——		g plant^{-1}
Spot spray	177	92a[b]	85 a	1.6 a
Hand pulling	207	78 b	35 b	4.9 b

[a] Spreading dogbane control at 60 and 361 d after treatment (DAT).

[b] Means within columns followed by the same letter are not significantly different (LSD P < 0.05).

[c] Only one site's data available.

Blueberry damage ratings rarely differed between treatments and ranged from 8 to 20% at 56 DAT with the exception of the tank mix of nicosulfuron/rimsulfuron with mesotrione at Windham Hill (28%). The number of blueberry floral buds, a measure of yield potential, did not differ between treatments (Table 1). Acceptable levels of blueberry injury vary between growers. For some, 15 to 20% blueberry damage may seem high but blueberry plants typically recover from low to moderate levels of herbicide damage by the following year and growers in the region are willing to accept this level of damage where severe weed problems occur, given that few floral buds form beneath a dense, mature dogbane canopy.

Summer Spot Spray. There was a significant site impact on spreading dogbane damage ratings (P < 0.0001). All herbicides spot sprayed injured spreading dogbane severely (80 to 100%) except pyrasulfotole plus bromoxynil at Collingwood and dicamba at Farmington (Table 2). All products also damaged blueberries that occurred around the dogbane plants but dicamba caused the least blueberry damage at three of four sites where damage ranged between 19 and 23% (Table 2). Primisulfuron plus dicamba caused the second lowest level of damage to blueberry plants at 24 to 39%. Crop injury was limited to plants beneath the dogbane if care was taken to limit overspray. On the basis of control and crop damage ratings in the year of application, spot sprays of dicamba or primisulfuron plus dicamba may be an option for spreading dogbane control if crop injury can be tolerated.

Summer Spot Spray vs. Hand Pulling. Spot sprays and hand pulling were compared at three sites in 2008 and 2009. The impact of site and year was not significant and data were pooled from all three sites. Significantly greater control was achieved with spot sprays (92%) vs. hand pulling (78%) at 60 DAT. Results also showed that spot sprays provided a greater reduction in biomass than hand pulling. Significantly greater levels of control were still observed 1 yr later with spot sprays (85%) vs. hand pulling (35%) (Table 3).

Summer Spot Spray vs. Wiping. Efficacy of summer spot spray and wiping varied with site (P = 0.00013). Spot sprays with glyphosate and wiping with glyphosate or triclopyr provided good spreading dogbane control (> 89%) (Table 4). Damage levels observed in the control plots were due to late summer senescence. Despite this level of damage, the remaining treatments provided significantly higher levels of damage when compared with the untreated control. Dogbane biomass data showed that these three treatments significantly reduced dogbane's weight compared with the dogbane plants in the untreated plot, and no significant differences were found among these three treatments at any site (Table 4). Severe blueberry injury (63 to 78%) was observed at Mt. Stewart, PEI. Unusually high spreading dogbane densities (43 plants m^{-2}) and growth (plants were approximately twice as high as at the other site) at Mt. Stewart likely partially explains the higher blueberry injury at this site due to the number of plants that needed to be treated. Dense dogbane population required extensive wiping and spraying to cover shoot material at this site and increased the probability of herbicides contacting blueberry plants.

Our results indicate that summer-broadcast nicosulfuron at 25 g ha^{-1} with a water volume of 190 L ha^{-1} plus 0.5% v/v crop oil surfactant suppressed spreading dogbane. Entire plants may not be killed by this application, but removal of most shoots (60 to 80%) over time would be enough to weaken the root system and thus spreading dogbane competition. Spot sprays are recommended for treating areas with small infestation of spreading dogbane and are more effective than hand pulling. However, severe crop injury can occur when treating areas with high dogbane density. Spot sprays of dicamba at 1 kg ha^{-1} in 550 L ha^{-1} water or premix primisulfuron with dicamba at 26 and 140 g ha^{-1}, respectively, in 200 L ha^{-1} water with 0.2% v/v NIS were effective and caused less blueberry injury. Wiping with glyphosate at 154 g L^{-1} water or wiping triclopyr at 29 g L^{-1} water can also be used as an alternate method to control small populations of spreading dogbane with less impact on the blueberry shoots. Although the crop damage may still be

Table 4. Effect of wiping and spot sprays on spreading dogbane and blueberry at Southampton, NS and Mt. Stewart, PEI in 2009.

Treatment	Rate	Dogbane damage		Dogbane biomass		Blueberry injury[a]		Blueberry floral buds	
		SN[b]	MT	SN	MT	SN	MT	SN	MT
	g ae L^{-1} water	—— % ——		—— g plant^{-1} ——		—— % ——		—— No. stem^{-1} ——	
Nontreated	-	36 a[c]	40 a	5.8 a	12.6 a	0 a	0 a	2 a	0
Wiping glyphosate	154	89 b	97 b	1.7 b	3.1 b	28 b	63 b	2 a	0
Wiping triclopyr	29	98 b	100 b	1.2 b	4.0 b	38 b	70 b	1 a	0
Spot-spray glyphosate	5	93 b	96 b	1.7 b	3.2 b	20 b	78 b	3 a	0

[a] Dogbane damage and blueberry injury ratings were done on a 0–100 scale. Ratings taken 56 d after treatment are reported.

[b] Abbreviations: SN, Southampton; MS, Mt. Stewart.

[c] Means followed by the same letter within columns are not significantly different at P < 0.05.

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considered high, it may be tolerable for growers to apply these options to control the spreading dogbane before they spread out in the field and cause more yield loss.

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