

Herbicide Tolerance in Diploid 1EBN and 2EBN Potato Species

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Premise: Wild potato species are a rich source of disease resistance and other traits for the improvement of cultivated potato. Research geared towards identifying and characterizing agriculturally useful genes often requires field-based evaluation of wild germplasm. But little is known about appropriate field conditions for wild potato species. Weed control, in particular, is a challenge since herbicides may damage some wild potato species. In this two year study, we explored tolerance of 10 1EBN and 2EBN species in superseries *Stellata* to commonly used herbicides. Our results may assist researchers in establishing wild potato field plots.

Project Goal: Identification of strategies and conditions for chemical weed control for field establishment of wild potato species

Table 1—1EBN and 2EBN potato species of superseries *Stellata*^a

Series ^b	Species	EBN ^c	PI	
I. <i>Mevilliformis</i>	<i>S. elaeagn</i>	NA		
	<i>S. meviliforme</i>	NA		
II. <i>Bulboscutum</i>	<i>S. bulboscutum</i>	1	275200 588279 604051 604064	
	<i>S. cardiophyllum</i>	1	283063 342332 342335 347769	
	III. <i>Pinnatisecta</i>	<i>S. brachistotrichum</i>	1	
		<i>S. jamesii</i>	1	458423 620876 620877 623232
	IV. <i>Polyadenia</i>	<i>S. pinnatisectum</i>	1	252124 275200 275232 347766
<i>S. elongophyllidum</i>		1		
<i>S. taruii</i>		1	498043 498048 545808 570642	
<i>S. trifidum</i>		1	255541 281104 498053 558478	
<i>S. polyadenium</i>		1	347768 347769 347770 558445	
V. <i>Commerstoniana</i>	<i>S. commerstonii</i>	1	472818 474113 558048 558050	
VI. <i>Circosifolia</i>	<i>S. capricornutum</i>	1		
	<i>S. circosifolium</i>	1		
VII. <i>Lepicostella</i>	<i>S. ligusticum</i>	1		
VIII. <i>Olivianum</i>	<i>S. olivianum</i>	NA		
	<i>S. arvense</i>	2		
IX. <i>Yunguesana</i>	<i>S. chacoense</i>	2	137720 137723 175401 175419	
	<i>S. haematantherae</i>	2	549221 549223 549254 558130	
	<i>S. tarjense</i>	2		
	<i>S. yunguesana</i>	2		
	<i>S. yunguesana</i>	2		

^aClassification scheme for superseries *Stellata* of Hawkes (The Potato: Evolution, Biodiversity and Genetic Resources; Smithsonian Press, 1990) with modifications by Rodriguez and Spooner (Systematic Botany 22:31), Lara-Cabrera and Spooner (Plant Systematics and Evolution 248:129), and Spooner et al. (Systematic Botany 26:743)
^bSeries and Species names in bold faced font are examined in the current study; see associated PI entries.
^cEBN data from USDA Potato Genebank, Center for Genetic Resources (Wageningen, The Netherlands), and Jackson and Hamman (Euphytica 109:51); NA: no data on EBN available.

Table 2—ANOVA: the effect of herbicide treatment and potato species on biomass accumulation

Source	Df ^a	MS ^b
Model	63	34934.01 **
Year	1	3764.65 ns
Species	9	32281.87 **
Treatment	4	248061.54 **
Year X Species	9	18453.86 ns
Year X Treatment	4	7292.37 ns
Species X Treatment	36	19973.36 *
Error	336	13236.12

^aDegrees of freedom.
^bMean Square. ns — not significant at $\alpha=0.05$;
* — significant at $\alpha=0.05$; ** — significant at $\alpha=0.01$

Our Approach: Four seedlings of each of four populations (USDA PIs) from each of 10 wild 1EBN and 2EBN potato species (Table 1) were hand planted in treatment plots. Treatments included: (Trt 1) no broadleaf herbicide; (Trt 2) linuron (Lorox) at half the recommended rate; (Trt 3) linuron (Lorox) at the recommended rate; (Trt 4) metribuzin (Sencor) at half the recommended rate; or (Trt 5) metribuzin (Sencor) at the recommended rate. All plots were treated with a grass control herbicide (Stalwart) and received hand weeding, as needed. Weekly visual ratings of plant development and survival were taken. Six weeks after transplanting, the above ground biomass for each seedling plot was removed and immediately weighed. Biomass weights, scaled as a percentage of biomass accumulation in the absence of broadleaf herbicide (Trt 1), were used for statistical analyses. The entire experiment was replicated in 2005 and 2006.

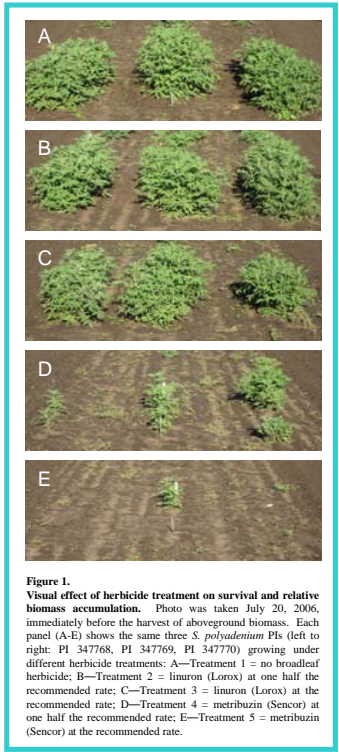


Figure 1. Visual effect of herbicide treatment on survival and relative biomass accumulation. Photo was taken July 20, 2006, immediately before the harvest of aboveground biomass. Each panel (A-E) shows the same three *S. polyadenium* PIs (left to right: PI 347768, PI 347769, PI 347770) growing under different herbicide treatments: A—Treatment 1 = no broadleaf herbicide; B—Treatment 2 = linuron (Lorox) at one half the recommended rate; C—Treatment 3 = linuron (Lorox) at the recommended rate; D—Treatment 4 = metribuzin (Sencor) at one half the recommended rate; E—Treatment 5 = metribuzin (Sencor) at the recommended rate.

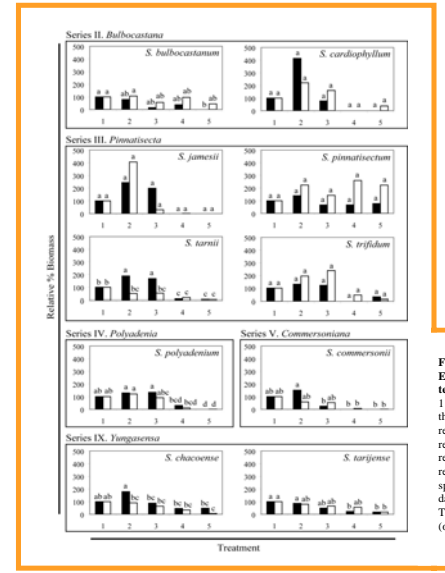


Figure 3. Effects of herbicide treatment on relative biomass accumulation in ten 1EBN and 2EBN potato species. Herbicide treatments (Treatment 1 = no broadleaf herbicide; Treatment 2 = linuron (Lorox) at one half the recommended rate; Treatment 3 = linuron (Lorox) at the recommended rate; Treatment 4 = metribuzin (Sencor) at one half the recommended rate; Treatment 5 = metribuzin (Sencor) at the recommended rate) are plotted against percent aboveground biomass relative to controls (Treatment 1). Data are presented for ten species and species are grouped to reflect series classifications. Black bars represent data from 2005; white bars represent data from 2006. Letters indicate Tukey significance levels; data with the same letter do not significantly ($\alpha=0.05$) differ from each other.

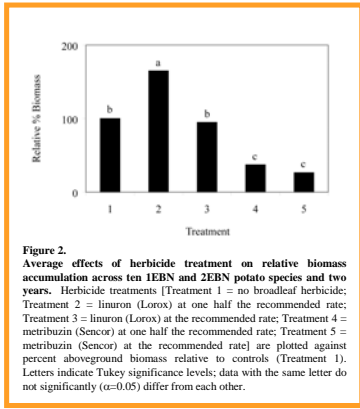


Figure 2. Average effects of herbicide treatment on relative biomass accumulation across ten 1EBN and 2EBN potato species and two years. Herbicide treatments (Treatment 1 = no broadleaf herbicide; Treatment 2 = linuron (Lorox) at one half the recommended rate; Treatment 3 = linuron (Lorox) at the recommended rate; Treatment 4 = metribuzin (Sencor) at one half the recommended rate; Treatment 5 = metribuzin (Sencor) at the recommended rate) are plotted against percent aboveground biomass relative to controls (Treatment 1). Letters indicate Tukey significance levels; data with the same letter do not significantly ($\alpha=0.05$) differ from each other.

Our Findings:

- Species' responses to herbicide treatments were variable and highly significant (Table 2)
- Negative effects of herbicide on plant survivability and growth were revealed by visual inspection (Fig. 1) and biomass accumulation (Fig. 2)
- In general, linuron (Lorox) was better tolerated than was metribuzin (Sencor; Fig. 2)
- Solanum cardiophyllum*, *S. jamesii*, and *S. trifidum* may be segregating for tolerance to linuron (Lorox), as evidenced by large standard deviations about biomass means (Fig. 3)
- No significant difference was noted in biomass accumulation for *S. pinnatisectum* for any herbicide treatment (Fig. 3); *S. pinnatisectum* tolerates both linuron (Lorox) and metribuzin (Sencor)
- Species grouped based on morphological and molecular data into a common series do not necessarily respond to herbicides in the same manner (e.g. Fig. 3, series *Pinnatisecta*)



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