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Title: Developing an Integrated Management Tool to Predict Hairy Nightshade Growth in Snap Beans

Project leader

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Summary

- Hairy nightshade (HNS) removal for 3 weeks after planting (WAP) eliminated berry production in all plantings except the 2nd planting in both years of the study.
- Four weeks of removal was needed when beans were planted on May 21 of 2003 and May 19 of 2004 to eliminate berry production.
- Plants flowered slower in early plantings but degree day requirements did not differ significantly for the time to first flower.
- HNS seedlings that emerged from May 20 to June 3 had the greatest potential to produce berries that could significantly impact crop quality.

Introduction

Raptor herbicide effectively controls weeds in snap beans; tolerance is acceptable and weed control is very good. Disadvantages of using Raptor are cost and crop rotation restrictions. Raptor controls black and hairy nightshade (HNS) very well, but in some cases, Raptor may not be needed because nightshade may have emerged too late to produce berries or seeds. The difficulty is predicting when Raptor is needed based on the potential for nightshade berry production. The objective of this study was to determine when intervention with postemergence herbicides or cultivation would preclude hairy nightshade berry or seed production.

Procedures

Snap beans were planted every two weeks beginning on May 7 and May 4 in 2003 and 2004, respectively. Treflan was applied and incorporated before snap beans were planted to eliminate grasses and broadleaves, but allow emergence of hairy nightshade. Within each planting, five treatments were applied to plots with four replications. Treatments included removal of HNS seedlings until 2, 3, 4 and 5 weeks after planting and a treatment without HNS removal. Removal of seedlings at these intervals allowed determination of the potential of HNS to produce berries or seeds after the four different planting dates. For instance, seedlings that emerged 2 weeks after planting represent seedlings that would have emerged after a cultivation or postemergence herbicide applied at 2 WAP. After the seedling removal period was complete, the first emerged seedling was flagged and all other competitors removed for the duration of the crop. Seedlings were located in the middle 1/3 of the area between 30 inch bean rows. When snap beans reached approx. 55-60% 1-4 sieve by weight, HNS plants were pulled, weighed, and berries stripped. Berries were weighed and graded according to snap bean sieve size (Table 1). Seeds were extracted from 1-2 berries of each size class for each harvested plant, counted and stored at 35 F for 4 months. (Seeds were germinated at 86/70 F after at least 6 months in cold storage). Temperature was measured at the top of the snap bean canopy and data used to predict the number of degree days (base 40 F) needed for nightshade to produce berries.

Table 1. Snap bean sieve sizes and conversions.

Sieve size	Bean diameter	
	1/64"	mm
1	< 14.5	< 5.8
2	14.5 - 18.5	5.8 - 7.3
3	18.5 - 21	7.3 - 8.3
4	21 - 24	8.3 - 9.5
5	24 - 27	9.5 - 10.7
6	27 - 30	10.7 - 11.9
7	30 ->	11.9 ->

Results

Days to Flowering. The number of days to development of a fully opened flower differed slightly between years and ranged from 37 to 48 days depending on the planting date (Table 2). The length of time was longer for the earlier planting dates.

Degree days to flowering. The number of degree days (DD) to first flower differed depending on year and planting ($F_{1,3}$= 3.4; P=0.03, year x planting date; Figure 1) and ranged from 459 in 2004 to 541 in 2003. The inconsistency between the two years was primarily due to the difference in degree days required to produce a flower in the first planting (Figure 1). Increasing the removal period increased the degree day requirements to first flower (Table 3), but this estimate was confounded by different emergence dates.

Table 2. Effect of year and planting date to first flower.

Year	Planting date	Obs.	Days to flower	
			Mean	SE
2003	1	4	48	0.5
2003	2	4	42	0.0
2003	3	4	38	1.8
2003	4	4	36	0.0
2004	1	7	46	0.2
2004	2	8	46	0.7
2004	3	8	40	0.6
2004	4	8	37	0.5

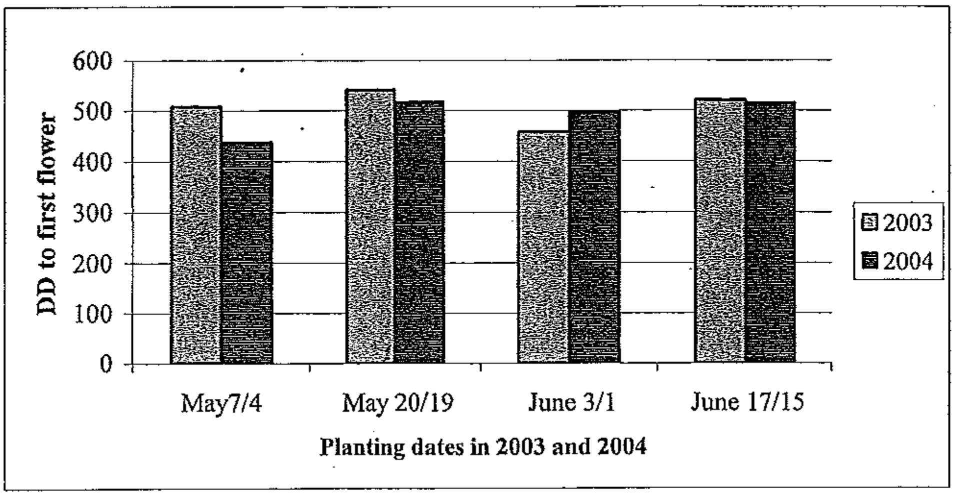

Figure 1. Effect of planting date on degree days to first flower in 2003 and 2004. F= 3.4; P= 0.03 for year x planting effect (0 weeks of removal only). Number of observations was 4 in 2003 and 8 in 2004.

Table 3. Effect of removal period on degree days to flower and 5 mm berry production.

Removal period	First flower			Berry with 5mm diameter		
	Obs.	Degree days		Obs.	Degree days	
No removal after planting	47	498	b	47	683	a
2 weeks of removal	42	506	b	32	690	a
3 weeks of removal	10	586	a	2	684	a

DD to 5 mm berry. Data for the degree days needed to produce a 5 mm berry were pooled across the 0-3 week removal periods because: 1) there was only a slight indication of an interaction between planting date and removal period (F = 2.6; P = 0.06); 2) the effect of planting date was highly significant (F = 8.4; P < 0.0001); and 3) there was no effect of removal period on DD needed to produce a 5 mm berry (Table 3).

There was no difference between years for the number of DD required to produce a 5 mm berry (P = 0.40). When averaged over years and planting dates, 698 DD were required in 2003 and 679 required in 2004 to produce a 5mm berry, an average of 685 DD. However, the number of degree days needed to produce a 5mm berry differed slightly between years and planting dates (F = 3.7; P = 0.02) (Figure 2). Fewer degree days were required at the first planting to produce a 5 mm berry than at the second, third, or fourth plantings.

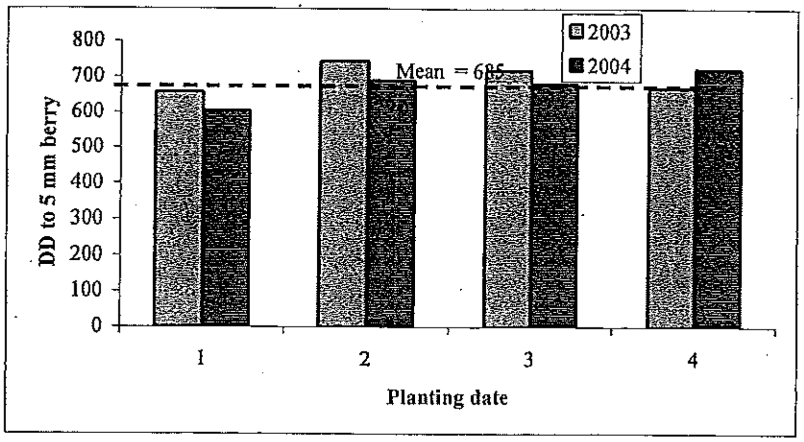

Figure 2. Effect of planting date and year on the number of degree days needed to produce a 5 mm berry.

Berry production. Removal period was the primary factor influencing berry production ($F = 56$, $P = 0.0001$) with a slight interaction between years ($F = 5.4$, $P = 0.01$). Berry production averaged 230, 25, and 0.4 berries per plant for the 0, 2, and 3 week removal treatments, respectively (Figure 3). A similar trend was noted for berries that exceeded sieve size 2 ($F = 63$, $P < 0.0001$ for effect of removal period; $F=3.7$, $P = 0.0067$ for interaction effect between year and removal period). However, no 2 sieve berries were recorded if HNS was removed from plots for 3 weeks in 2004 (Fig. 4).

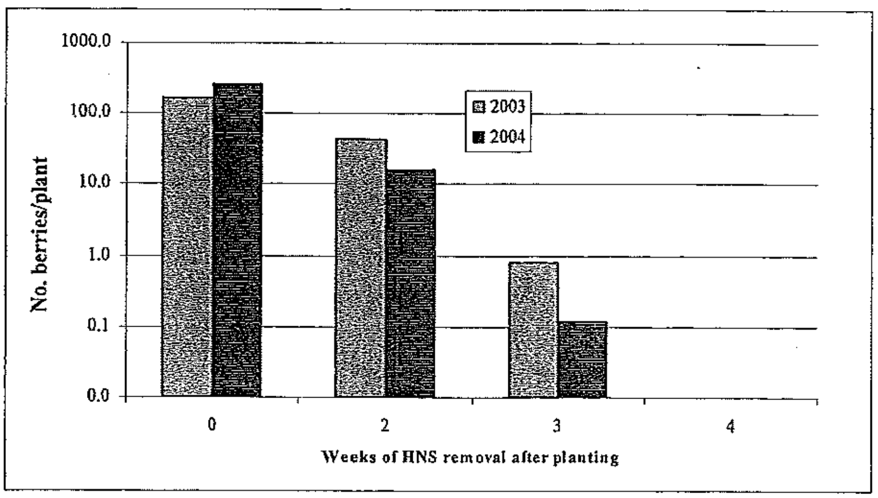

Figure 3. Effect of removal period on <u>total number</u> of HNS berries produced at harvest. Note logarithmic scale.

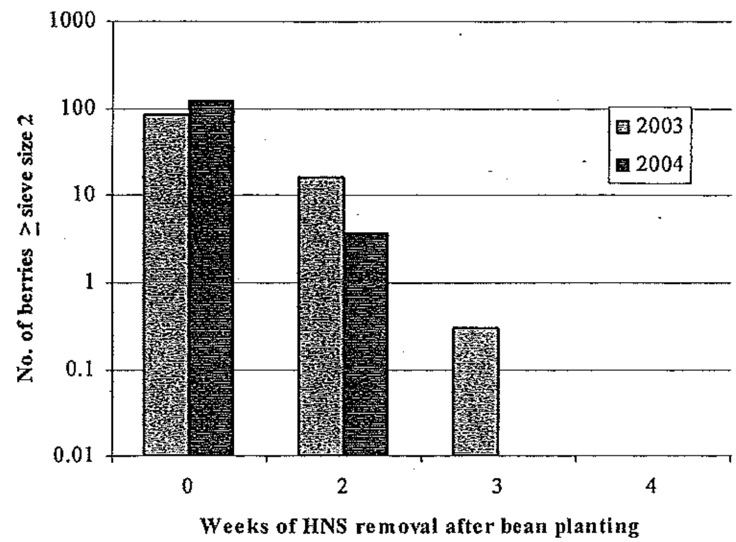

Figure 4. Effect of removal period on total number of HNS berries ≥ sieve size 2 produced at harvest. Note logarithmic scale.

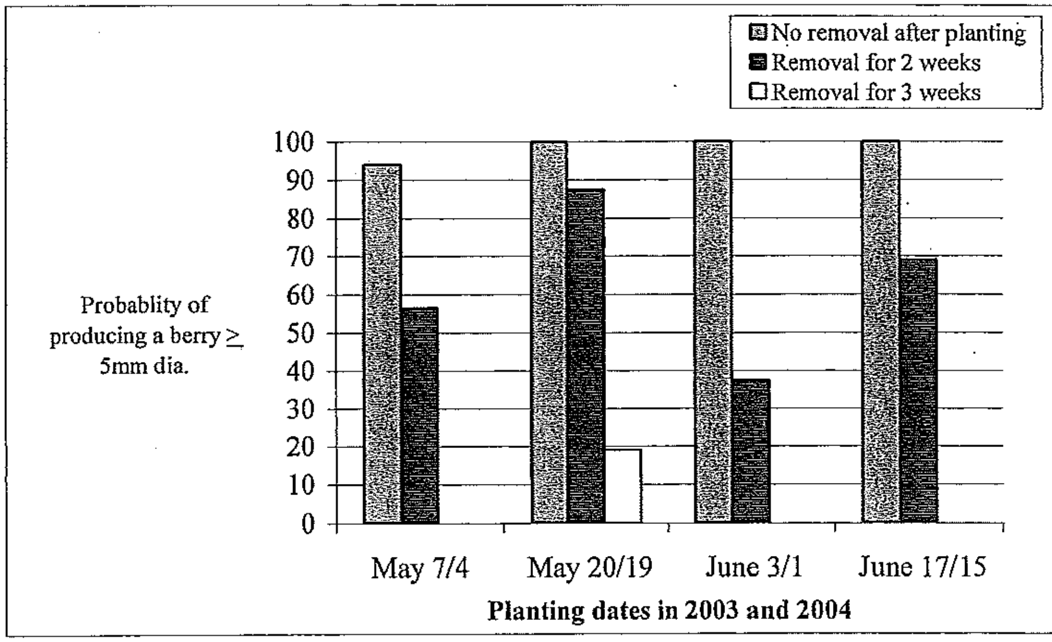

Figure 5. Effect of planting date and removal period on the probability of producing a berry ≥ 5 mm in diameter. Data are average of two years.

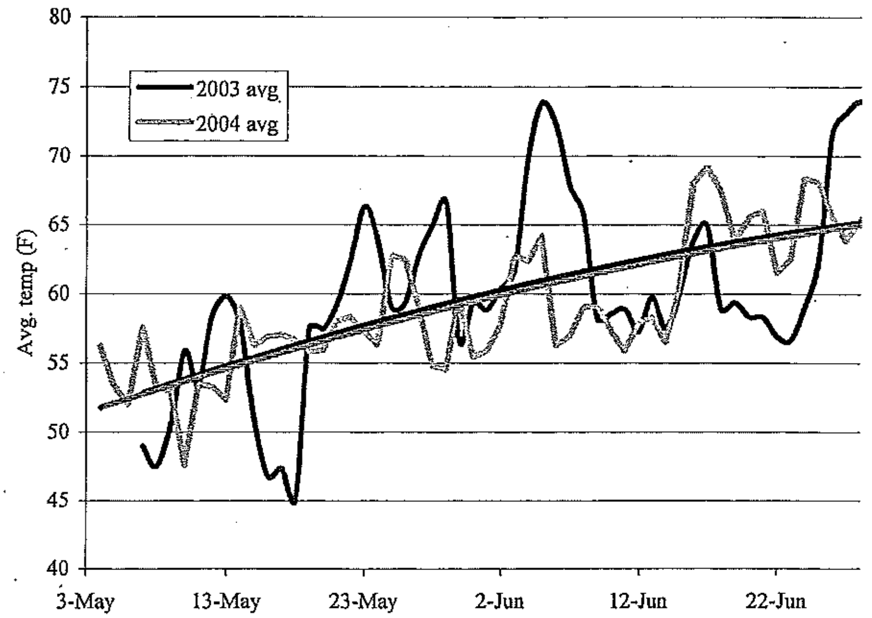

Figure 6. Average temp ((max+ min)/2) and trend lines for the first 6 weeks after planting in 2003 and 2004.