The Economic Value of Pelargonic Acid as a Natural Herbicide in Sweet Bell Peppers

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ABSTRACT

Pelargonic acid, although not certified as organic, is naturally occurring in many plants, animals, and foods. It is also phytotoxic to plants as a contact herbicide, injuring and killing plants by destroying the cell membrane. Vegetable producers would benefit from additional herbicide options that are safe to the crop, naturally occurring, and provide effective weed control. Research was conducted in southeastern Oklahoma to determine the impact of pelargonic acid on weed control efficacy, crop injury, green pepper (*Capsicum annuum*) yields, and the cost/benefits associated with the various levels of this herbicide. The experiment included pelargonic acid applied unshielded post-directed at 5, 10, and 15 lb/a, plus an untreated weedy control and an untreated weed-free check. The 15 lb/a (9% v:v) pelargonic acid treatment resulted in the maximum smooth crabgrass control (56%) and broadleaf weed control (66%) at 1 day after the initial spray treatment (DAIT), and 33% yellow nutsedge control at 3 DAIT. Only the 15 lb/a pelargonic acid application produced greater fruit per acre (58,012 fruit/acre) and yields (10,204 lb/acre) than the weedy control (14,516 fruit/acre and 3,409 lb/acre). The highest level of pelargonic acid (15 lb/a) provided 2.8 times the gross revenue as that of the weedy control.

MATERIALS & METHODS

The experiment included 5 weed control treatments. Scythe® was applied at 3 rates, plus an untreated weedy-check and an untreated weed-free check with 4 replications.

Bell Peppers ('Jupiter') Transplanted: May 28, 2010
First Herbicide Application: June 16, 2010
Second Herbicide Treatment (8 DAT): June 24, 2010
Harvest Date: August 12, 2010

Herbicide Treatments

Scythe® (57% pelargonic acid) applied at 3% (5 lb/a), 6% (10 lb/a), and 9% volume/volume (v/v) (15 lb/a).
Weedy-Check & Weed-Free

Spray Information

Each herbicide was applied and then reapplied after 8 days.
40 gpa, 8004, 0.40 gpm, Post-Directed.

TOTAL WEED COVER

Smooth Crabgrass Weed Cover

Smooth Crabgrass (*Digitaria ischaemum* (Schreb.) Schreb. ex Muhl.) was 60% of Total Weed Cover (3 – 4 inches tall).

Broadleaf Weeds

Broadleaf Weed Cover was 38% of Total Weed Cover
Cutleaf Groundcherry (*Physalis angulata* L.) was 35% of total (2 inches tall).
Spiny Amaranth/Spiny Pigweed (*Amaranthus spinosus* L.) was 3% of the total weed cover (3 – 4 inches tall).

Nutsedge

Nutsedge (*Cyperus esculentus* L.) was 2% of total weed cover (4 – 6 inches tall).

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INTRODUCTION

As an important U.S. fresh-market vegetable crop, bell pepper domestic consumption (11 lb/person) continues to increase (Wells et al., 2013). The increasing gap between domestic production and U.S. demand provides an opportunity for increased domestic bell pepper production (Wells et al., 2013). There is also an increasing demand by consumers for more naturally produced vegetable crops. Therefore, producers growing bell peppers for markets that desire the use of more naturally occurring herbicides need alternatives that effectively provide season-long weed control. Previous research with over-the-top applications of potential organic contact herbicides determined that at effective weed control herbicide rates crop injury was detrimental to profitable yields. A potential solution to increase weed control efficacy on larger weeds and decrease pepper injury is the use of sequential post-directed herbicide applications (herbicides sprayed at the base of the crop rather than over-the-top).

OBJECTIVE

Research was conducted to determine the economic value of sequential post-directed applications of pelargonic acid on weed control efficacy, crop injury, and yields in bell pepper.

Figure 1. Impact of weed control treatments on smooth crabgrass control (%).

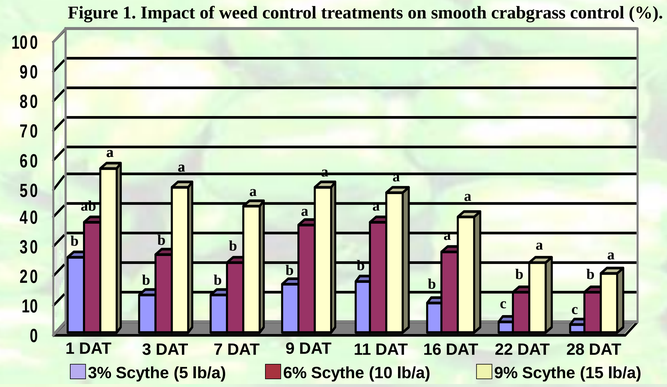

Figure 2. Impact of weed control treatments on broadleaf weed control (%).

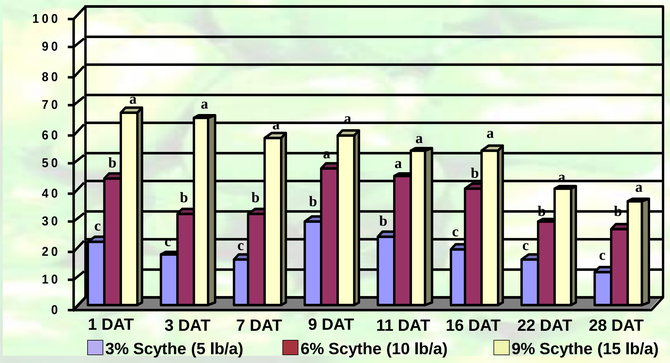

Figure 3. Impact of weed control treatments on nutsedge control (%).

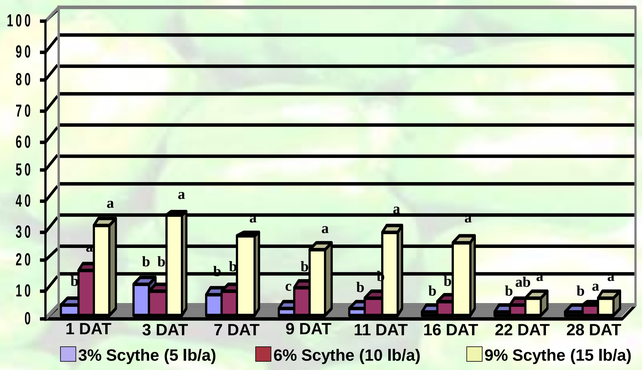

Figure 4. Impact of weed control treatments on crop injury (%).

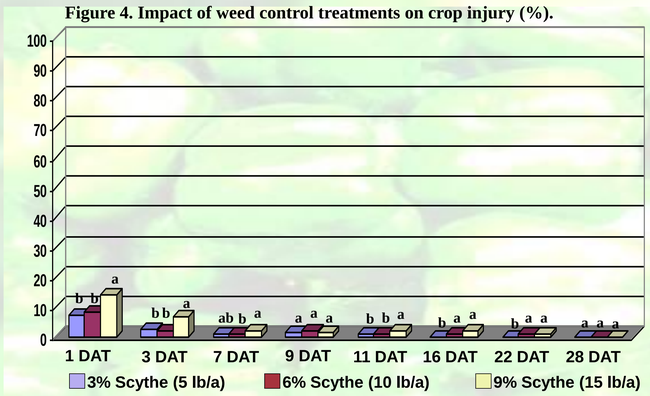

Table 1. Partial budget to determine cost effectiveness of using pelargonic acid as a herbicide in bell peppers.

Weed Control Treatment	Scythe® oz/1 gal	Tank Mix oz/40 gal	Scythe® cost/oz	Scythe® cost/acre	Yield lb/acre	Gross $/acre @$0.43/lb	Gross Less Cost of herbicide/acre	Cost of Production per Acre	Revenue Above Costs of Production
Scythe® 3% (5 lb/a)	3.84	153.6	$ 0.621313	$95.43	2,180	$ 937.40	$ 841.97	$ 4,000	($ 3,148.03)
Scythe® 6% (10 lb/a)	7.68	307.2	$ 0.621313	$190.87	2,395	$ 1,029.85	$ 838.98	$ 4,000	($ 3,161.02)
Scythe® 9% (15 lb/a)	11.52	460.8	$ 0.621313	$286.30	10,204	$ 4,101.42	$ 4,101.42	$4,000	$ 101.42
Weedy Control	-------	-------	-------	-------	3,409	$ 1,465.87	$ 1,465.87	$4,000	($ 2,534.13)
Weed-Free	-------	-------	-------	-------	30,987	$ 13,324.41	$ 13,324.41	$ 4,000	$ 9,324.41

RESULTS & DISCUSSION

Smooth crabgrass control (56%) and broadleaf weed control (66%) peaked at 1 day after treatment (DAT) with the 9% (15 lb/a) application rate (Figure 1 and 2).

Yellow nutsedge control (33%) peaked at 3 DAT with the 9% rate and declined to 6% control at 28 DAT (Figure 3).

Scythe® at 9% v/v (15 lb/a) rate also resulted in the greatest crop injury at 1 DAT (14%) (Figure 4).

The lack of weed control for Scythe® application rates of 3, 6, and 9% (5, 10, and 15 lb/a) reduced the number and weight of peppers compared to the weed-free treatment.

The 9% (15 lb/a) application rate did increase the number of peppers produced (peppers/acre) and yield (lb/acre) compared to the weedy-check producing a positive return above costs (Table 1).

CONCLUSIONS

Although weed control and crop yields increased as application rates increased, the less than satisfactory weed control (>80%) produced significantly lower pepper yields that the weed-free treatment. The 9% (15 lb/a) pelargonic acid sequential post-directed applications did significantly control weeds compared to the weedy-control, and resulted in 4 times the fruit production (fruit/acre) and 3 times the yield (lb/acre) than the weedy-control (no weed control). Therefore, the highest level of pelargonic acid 9% v:v (15 lb/a) provided 2.8 times the gross revenue as that of the weedy control. The authors suggest that pelargonic acid be applied to smaller weeds to increase the weed control to acceptable levels (80% to 90%). The use of a hooded sprayer may also reduce crop injury without a significant decrease in weed control. Another option would be the use of a suitable pre-emergence herbicide to reduce the weed population and height prior the post-emergence application of pelargonic acid. The high price for the herbicide and the low or average market price for fruit produced a breakeven situation regarding cost/benefits. Assuming the farmer would obtain a lower price for the herbicide with a volume discount and an increase in yields due to experience, quality soils, and protected or shielded herbicide application, the data indicate a positive return from use of pelargonic acid as a natural herbicide.

REFERENCES

Wells, H.F., S. Thornsbury, and J. Bond. 2013. U.S. Department of Agriculture: Vegetable and pulses outlook. 27 June 2014.