Effect of Multiple Applications of Flaming on Canada Thistle Biomass in Fallow Strawberry Production

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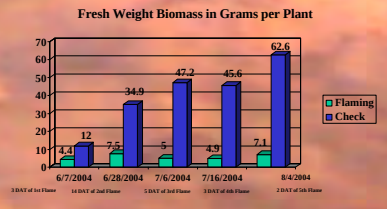
ABSTRACT

Perennial weeds are a chronic problem associated with organic strawberry production in Colorado. Crop rotation, mechanical cultivation, hand weeding and hoeing typically are used to manage these weeds. The use of thermal (flame) weed control systems addresses this problem and is an alternative to mechanical cultivation and herbicides for controlling weeds. The purpose of this study was to examine the effect of multiple flame applications on Canada thistle (*Cirsium arvense*) weed biomass in a three-acre fallow strawberry field. Weeds were flamed using the Flame Engineering TD-12 LPS Alfalfa Field Flamer. The Alfalfa Field Flamer utilizes liquid spray flaming that creates combustion at the base of the plant to produce 2000 degrees F temperatures. This flamer consumed 35 gallons of propane per acre at a cost of $40 per acre. Five flame applications were used during the growing season. Evaluations occurred within 3 to 5 days after each flame application with the above-ground portion of the plant harvested and weighed. Good activity was seen immediately after the flame treatment on Canada thistle; however, rapid re-growth continued throughout the summer, thus requiring multiple flame applications. Above ground fresh weight of Canada thistle foliage treated with just one flame application averaged a 63.3% reduction when compared to the untreated check. After the fifth and final flame application, the above-ground fresh weight of Canada thistle foliage averaged 88.6% less than the untreated check. At this time root mass was harvested and weighed. Root biomass comparisons revealed a 55% reduction in root fresh weight following five flame applications.

Effect of Multiple Applications of Flaming on Above Ground Canada Thistle Biomass



Flame Applications occurred on 6/4/04, 6/14/04, 7/1/04, 7/13/04 and 8/2/04

Graph 1

Flame Engineering TD-12 LPS Alfalfa Field Flamer Weed Control Device

MATERIALS AND METHODS

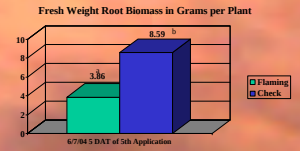
The 2.5 acre strawberry field was located at Berry Patch Farms near Brighton, Colorado. Berry Patch Farms is a certified organic operation. The day neutral strawberries were planted in the spring of 1999. Strawberries remained in this field until the spring of 2003 when the field was disked and sweet corn was planted. Following sweet corn in 2003, annual rye was planted as a cover crop on August 20, 2003. The annual rye was disked twice in May 2004 to take advantage of the green manure crop.

Weeds were flamed with a Flame Engineering TD-12 LPS Alfalfa Field Flamer that utilizes liquid spray flaming that creates combustion at the base of the plant to produce 2000 degrees F temperatures. This machine is ten feet wide and produces a wall of flame. The propane tank holds 200 gallons of propane and can treat approximately 6 acres depending on travel speed and the ambient air temperature at time of application. The speed of application (tractor speed) was approximately 3 mph. All treatments were replicated three times. Plot size was 10 feet wide by 20 feet. Weed biomass was measured from five plants randomly selected in each plot. Foliage of the freshly harvested plants was weighed, and data was analyzed using Analysis of Variance and Least Significant Difference.

The experiment of flaming on Canada thistle (*Cirsium arvense*) was initiated on June 3, 2004, with the first flame application. Air temperature was 79° Fahrenheit and humidity was 27%. Canada thistle weed size at time of application varied from 3 to 12 inches. The Canada thistle population averaged over 15 plants per 4.9 square feet. Other weeds present in this field during the course of this study were kochia (*Kochia scoparia*) and redroot pigweed (*Amaranthus retroflexus*). The second flame application was applied on June 14, 2004. Air temperature was 84° Fahrenheit, and humidity was 23%. The third flame application was applied on July 1, 2004. Air temperature was 74° Fahrenheit, and humidity was 25%. The fourth flame application was applied on July 13, 2004. Air temperature was 85° Fahrenheit, and humidity was 39%. The fifth and final flame application was applied on August 2, 2004. Air temperature was 91° Fahrenheit, and humidity was 27%.

Evaluations of plant root biomass were taken on August 7, 2004. The root biomass was measured by randomly selecting 5 plants per plot. Plants selected were dug up, using the root crown as a reference point measuring 6 inches of roots below this point. Each harvested 6-inch piece of freshly harvested root was immediately weighed and data was analyzed using Analysis of Variance and Least Significant Difference.

Effect of Multiple Applications of Flaming on Canada Thistle Root Biomass



Flame Applications occurred on 6/4/04, 6/14/04, 7/1/04, 7/13/04 and 8/2/04

Graph 2

Symptoms Immediately After Flame Application

DISCUSSION AND CONCLUSION

The Flame Engineering Alfalfa Field Flamer device was evaluated during the entire growing season of 2004 and required only one person to operate it effectively. Propane usage averaged 35 gallons per acre to operate the ten-foot wide boom of the Flame Engineering Alfalfa Field Flamer. The 200-gallon propane tank allows about six acres to be treated. The speed of flame application averaged 3 mph.

The first biomass evaluation occurred on June 6, 2004, three days after the first flame treatment. Canada thistle visual injury was rated at 53.3%. Fresh weight biomass of flamed foliage showed a 63.6% reduction when compared to the untreated check. Evaluations of plant foliage biomass on June 24, 2004, ten days after the second flame application, showed a 78.6% reduction in the flamed treatment compared to the untreated check. Evaluations of plant foliage biomass on July 6, 2004, six days after the third flame application, showed an 89.4% reduction in the flamed treatment compared to the untreated check. Evaluations of plant foliage biomass on July 16, 2004, three days after the fourth flame application, showed an 89.2% reduction in the flamed treatment compared to the untreated check. Summer rainfall stimulated emergence of kochia (*Kochia scoparia*) and redroot pigweed (*Amaranthus retroflexus*), just after the fourth flame application. Evaluations of plant foliage biomass on August 7, 2004, five days after the fifth flame application, showed an 88.6% reduction in the flamed treatment of Canada thistle compared to the untreated check (Graph 1). The kochia (*Kochia scoparia*) and redroot pigweed (*Amaranthus retroflexus*) were completely controlled by the fifth flame application.

Evaluations of plant root biomass taken on August 7, 2004, showed a 55% reduction in the flamed treatment of Canada thistle root biomass compared to the untreated check (Graph 2).

Flame application efficacy was best when weeds were small and ambient air temperatures were above 90° F. Multiple flame applications were very effective on kochia and pigweed. Good activity was seen immediately after a flame treatment on Canada thistle; however, rapid re-growth reduced control levels from good to poor within ten days after the flame application. Based on results experienced in this study, flaming weeds using the Flame Engineering Alfalfa Flamer provided excellent activity on small annual weeds and good to fair activity on deep-rooted perennial weeds. Multiple applications are needed to provide season long management of weeds. The propane cost per acre was $40. This is based on 35 gallons of propane per acre at $1.14 per gallon.

On August 13, 2004, the field was disked and strawberry beds were formed using black plastic mulch. Strawberries were planted on August 16, 2004. The rows between the strawberry beds were planted with crested wheatgrass variety 'Ephriam', intermediate wheatgrass variety 'Oahe' and pubescent wheatgrass variety 'Luna' on August 30, 2004. Research will continue in 2005 to determine if the multiple flame treatments applied in 2004 followed by planting a fall grass cover crop will reduce Canada thistle populations in 2005.