# Weed Control Using the Atarus Stinger Steamer in Plastic Culture Strawberries

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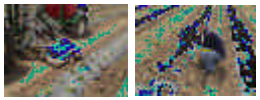
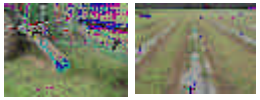
## ABSTRACT

Weeds are a chronic problem associated with organic strawberry production in Colorado. Plastic mulch helps reduce weeds within the beds of strawberries; however, the greatest weed threat comes from weeds growing at the edge of the plastic beds. Soil typically holds the plastic mulch in place and is prone to weed infestations. Mechanical cultivation, hand weeding and hoeing typically are used to control these weeds; however, there is a danger of damaging the plastic mulch, thus creating more areas for weeds to invade. The use of thermal (steam) weed control systems addresses this problem and is an alternative to mechanical cultivation and herbicides for controlling weeds. The weeds encountered in this study were kochia (*Kochia scoparia*), redroot pigweed (*Amaranthus retroflexus*), dandelion (*Taraxacum spp.*), field bindweed (*Convolvulus arvensis*), annual rye (*Lorlium multiforum*), Canada thistle (*Cirsium arvense*), hairy nightshade (*Solanum* sarrachoides), purslane (*Portulaca* oleracea), and downy brome (*Bromus tectorium*). The purpose of this study was to examine water flow, water quality, position of steam nozzles and tractor speed to determine whether steam treatments in the late spring could reduce the occurrence of weed populations spreading under the edge of plastic mulch of strawberry beds. Weeds were steamed using two trailer mounted Atarus Stinger Steamer generators. The Atarus Stinger utilizes thermal quench technology to produce 800 degrees F saturated steam. Our results indicate that two steam applications were very effective on kochia and pigweed. Steam gave good control of annual rye, downy brome and field bindweed. Good activity was seen immediately after treatment of steam on Canada thistle and dandelion; however, rapid re-growth reduced control levels from fair to poor eight days after the first steam application. Steam applications only damaged the plastic mulch when steam nozzles were positioned perpendicular to the strawberry bed. No damage to the plastic mulch was observed when nozzles were positioned parallel with the strawberry bed. The ideal water flow was 1 gallon of clean filtered water per steam generator per minute. The most cost effective speed was 1.2 mph. Steam applications showed greatest effect when ambient air temperatures were above 90 degrees. Ambient air temperatures below 50° F caused the steamer to malfunction.

## Position of Steam Nozzles



- Perpendicular to Bed
  - Damage to plastic mulch
  - Short dwell time for weed control (less than 2 seconds of steam exposure)
  - Needs fire blanket to protect crop from steam blast
  - Back pressure buildup



- Parallel to Bed
  - Little to no damage to plastic mulch
  - Longer dwell time for weed control
  - Easier to treat because you straddle the row
  - No back pressure buildup

## Under High Temperatures, Weed Control Results Are Quick To See

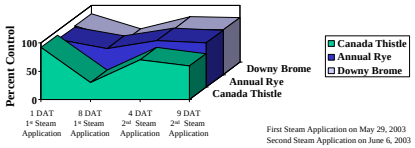
**Dandelion**

**Canada thistle**

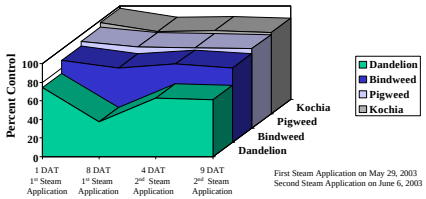
Two minutes after application of steam on May 29, 2003. Air temperature was 93° and humidity 16% at time of application.

## Efficacy of Steam on Selected Weeds Over Time

Control Trend After Two Steam Applications




## Control Trend After Two Steam Applications




## MATERIALS AND METHODS

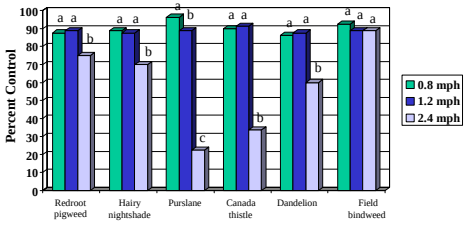
The strawberry field was located at Berry Patch Farms, near Brighton, Colorado. Berry Patch Farms is a certified organic operation. Weeds were steamed with two Atarus Stinger Steamer generators that utilize thermal quench technology, use 11 gallons of propane per hour and use 2 gallons of water per minute to produce 800 degree F saturated steam at 75 psi. This machine holds 211 gallons of water, which allows about two hours of steaming operation. All experiments had 4 replicates. The percentage of weed control was assigned to each plot, with a treatment average derived from this information. Statistical data was analyzed using Analysis of Variance and Least Significant Difference.

The efficacy of steam experiment on kochia (*Kochia scoparia*), redroot pigweed (*Amaranthus retroflexus*), dandelion (*Taraxacum spp.*), field bindweed (*Convolvulus arvensis*), annual rye (*Lorlium multiforum*), Canada thistle (*Cirsium arvense*), and downy brome (*Bromus tectorium*) was initiated on May 29, 2003, with the first steam application. Air temperature was 94° F and humidity was 16%. Weed size at time of application varied from ½ to 8 inches depending on weed species. The second steam application was applied on June 6, 2003. Air temperature was 60° Fahrenheit, and humidity was 16%. Weed size at time of application varied from 1 to 10 inches depending on weed species. Treatments were evaluated for effects on weeds May 30, June 6, 10 and 15, 2003. Each plot consisted of one strawberry bed 380 feet long on six-foot centers. Application speed was set at 1.2 mph.

The speed of application (tractor speed) experiment investigated 0.8 mph, 1.2 mph and 2.4 mph treatments. A single steam application was applied on July 25, 2003. Air temperature was 77° F and humidity was 29%. The weeds encountered in this experiment were redroot pigweed (*Amaranthus retroflexus*), hairy nightshade (*Solanum* sarrachoides), purslane (*Portulaca* oleracea), Canada thistle (*Cirsium arvense*), dandelion (*Taraxacum spp.*), and field bindweed (*Convolvulus arvensis*). Weed size at time of application varied from 3 to 12 inches depending on weed species. Each plot consisted of one strawberry bed 380 feet long on six-foot centers. Treatments were evaluated for effects on weeds on July 26, 2003.

## Effect of Tractor Speed on Weed Control

1 Day After Application (7/26/03)




Speed of tractor effect on each weed species (p=0.05)

The Atarus Stinger with the steam nozzles positioned parallel to the strawberry bed.

Clean edge effect along the plastic bed created by the steam treatment.

## DISCUSSION AND CONCLUSION

The Atarus Stinger steam weed device was evaluated during the entire growing season of 2003 and required only one person to operate it effectively. The amount of water usage for each steam generator was tested at flows of 0.74 to 2.1 gallons per minute. Research showed that the one gallon per minute was the most cost effective. Water must be filtered to prevent algae and sand from plugging water nozzle orifices. Propane usage varied from 10.8 to 11.3 gallons per hour to operate the two steam generators of the Atarus Stinger. The current 75-gallon propane tank allows 6.8 hours of use. Early in the spring we observed erratic propane flow rate if ambient air temperatures were below 50° F. When operating the Atarus Stinger above 55° F, no propane flow problems were observed. The position of the steam generator nozzle to the strawberry bed was directly related to the amount of damage done to the plastic mulch. Damage to the plastic mulch was greatest when steam generators were positioned perpendicular to the strawberry bed. No damage to the plastic mulch was observed when generators were positioned parallel with the strawberry bed. The speed of steam application depended on the size, species and population of weeds as well as the ambient air temperature at the time of application. The most cost effective speed was 1.2 mph. Steam application efficacy was best when weeds were small and ambient air temperatures were above 90° F. Multiple steam applications were very effective on kochia and pigweed. Steam gave good control of annual rye, downy brome and field bindweed. Good activity was seen immediately after treatment of steam on Canada thistle and dandelion; however, rapid re-growth reduced control levels from fair to poor four days after the second steam application. Based on results experienced in this study, the steam treatment using the Atarus Stinger weed control device 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 based on treating both sides of the six-foot centered strawberry beds was $22.03. This is based on 15.3 gallons of propane per acre at $1.44 per