

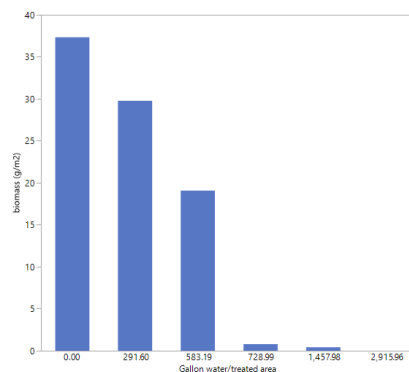
**AGRICULTURAL RESEARCH FOUNDATION  
INTERIM REPORT  
FUNDING CYCLE 2018 – 2020**

**TITLE:** Weed Control in Organic Blueberry Using Saturated-Steam and Organic Herbicides

**RESEARCH LEADER:** Marcelo Moretti, Assistant Professor and Weed Scientist, Department of Horticulture, Oregon State University

**COOPERATORS:** TJ Hafner, Agricare field manager.

**EXECUTIVE SUMMARY:** Saturated steam applied as the steamer traveled at 0.5 mph provided excellent control (>95%) of field bindweed, prostrate knotweed, and sharp-point fluvellin in the organic blueberry field. At this speed, the equipment applies 0.68 L/m<sup>2</sup> of steam, or the equivalent of 730 gallons per acre (GPA). In blueberry and other perennial crops, steam would be applied to a strip next to the crop row that is approximately one-third of the field, thus requiring 270 GPA of steam. Application at this rate requires 1.3 hours per acre using hour using 2.6 gallons of diesel for a steam boiler, 0.78 gallons of gasoline for the steam pump, and 2.3 gallons of diesel for a 40 hp tractor. Steam (250° F) is generated by a diesel boiler coupled with a gasoline pump mounted on a trailer. Operational costs including the driver (\$15/h), tractor, and steamer were calculated at \$36 per hour. Assuming an operation efficiency (maneuvering, refilling, etc.) ranging from 60 to 90%, steaming would cost between \$5 and \$80/acre. These costs are much lower when compared to hand-weeding (\$3,000/A) or organic herbicides (\$175/A) (Julian et al., 2012). Our experience indicates that water tank capacity is a bottleneck reducing efficiency of this technology; we achieved 40 to 50% efficiency with prototype equipment. Currently, the steam is applied continuously throughout the field, regardless of weed presence.



*Figure 1. Weed biomass in response to saturated steam dose (gallons per acre). Near complete weed biomass reduction was achieved with 730 gallons of saturated steam per acre. At rated equivalent to 0.5 mph with the SW900 applying to both side of the row.*

**OBJECTIVES:**

- 1) Evaluate the efficacy of saturated steam for weed control in organic blueberries alone or combined with organic herbicides. Compare operational costs and labor demand for weed management practices.
- 2) Evaluate blueberry tolerance and weed control efficacy of saturated-steam applied to plant base.

**PROCEDURES:**

Objective 1a). Steam dose response. A series of experiments were conducted to evaluate weed response to saturated steam. Six different steam rates (0 to 2,900 gallons per acre) were tested by varying the speed of operation (0 to 3 mph). Weed control and biomass were collected 21 days after treatment.

Objective 1b) A field study was conducted in the summer of 2018 to compare the weed control efficacy and costs of steam, brush weeder, and two organic herbicides: caprylic acid and ammonium nonanoate. The experimental design was a split-plot with the first application as the main plots and the second application as the sub-plot. Partial costs analysis was conducted to compare all treatments. The treatment units were 100 ft long plots. Twenty-eight DAT, the plots were sub-divided into five -20 ft sub-plots. The five treatments mentioned before were applied to the sub-plots. The design allowed comparison of all possible combinations of treatment X MMM.

**SIGNIFICANT ACCOMPLISHMENTS TO DATE:**

- 1) Effective rate of steam was identified at 730 GPA. Cost was calculated as \$45 per acre, assuming only 1/3 of the field was treated.
- 2) Brush weeder was also effective in controlling weeds. Initial tests were conducted at 0.5 mph, but it is possible to increase speed. Cost was calculated as \$32 per acre.
- 3) Organic herbicides Axex and Suppress provided partial weed control (60 to 80%) probably because the weeds were already large when treatments were applied. Cost of application ranged from \$150 per acre to over \$210 per acre depending on rate and spray volume.
- 4) Findings were presented during the 2018 Blueberry field day in Aurora, OR, the 64<sup>th</sup> North Willamette Horticulture Society in Canby, OR. A scientific presentation is scheduled for the 2019 National Weed Science Society, and then the regional Western Society of Weed Science meeting.

**ADDITIONAL FUNDING RECEIVED DURING PROJECT TERM:**

USDA NIFA Organic Transitions (ORG) RFA 2018-21 – funded \$500,000 – Co-PI

USDA Northwest Center for Small Fruit Research – funded \$50,000 (2018-19) - PI

**FUTURE FUNDING POSSIBILITIES:**

USDA Northwest Center for Small Fruit Research – pending \$50,000 (2019-20 & 2020-21) – PI.

Oregon State ARF – pending \$12,500 (2019-20) co-PI. Developing a weed sensor for saturated steam.