



Sago Pondweed Control in Irrigation Canals: Comparing Simulated Canal Trials to Field Applications

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Objective: Apply results of simulated canal studies to field treatments, to determine whether combinations of **Clearigate**[®] algaecide/herbicide or **Citrine Ultra**[®] algaecide/herbicide with dipotassium endothall will effectively restore flow by controlling obstructive aquatic plants.

Background: *Operational non-flowing water treatments with **Clearigate** algaecide/herbicide or **Citrine Ultra** algaecide/herbicide combined with endothall have shown promising results in controlling various pondweeds and filamentous algae at low range labeled dosage rates. Flowing water treatment evaluations were conducted to determine dose and contact time requirements for these combinations and individual products when used in canals.*

Simulated Canal Studies

Sago pondweed plants were transferred to a simulated irrigation canal system in the Colorado State University Greenhouse and the following treatment combinations were applied:

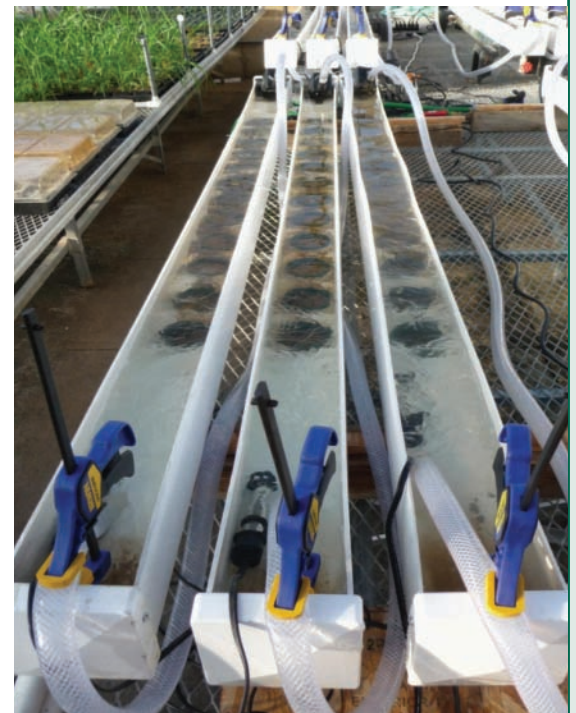
- Untreated Control
- endothall (1 ppm)
- endothall (2 ppm)
- **Clearigate** (0.5 ppm copper (Cu))
- **Clearigate** (1 ppm Cu)
- **Citrine Ultra** (0.75 ppm Cu)
- endothall (1 ppm) + **Clearigate** (0.5 ppm Cu)
- endothall (1 ppm) + **Clearigate** (1 ppm Cu)
- endothall (1 ppm) + **Citrine Ultra** (0.75 ppm Cu)
- endothall (2 ppm) + **Clearigate** (1 ppm Cu)

Plants exposed for 4, 8, or 12 hours after treatment

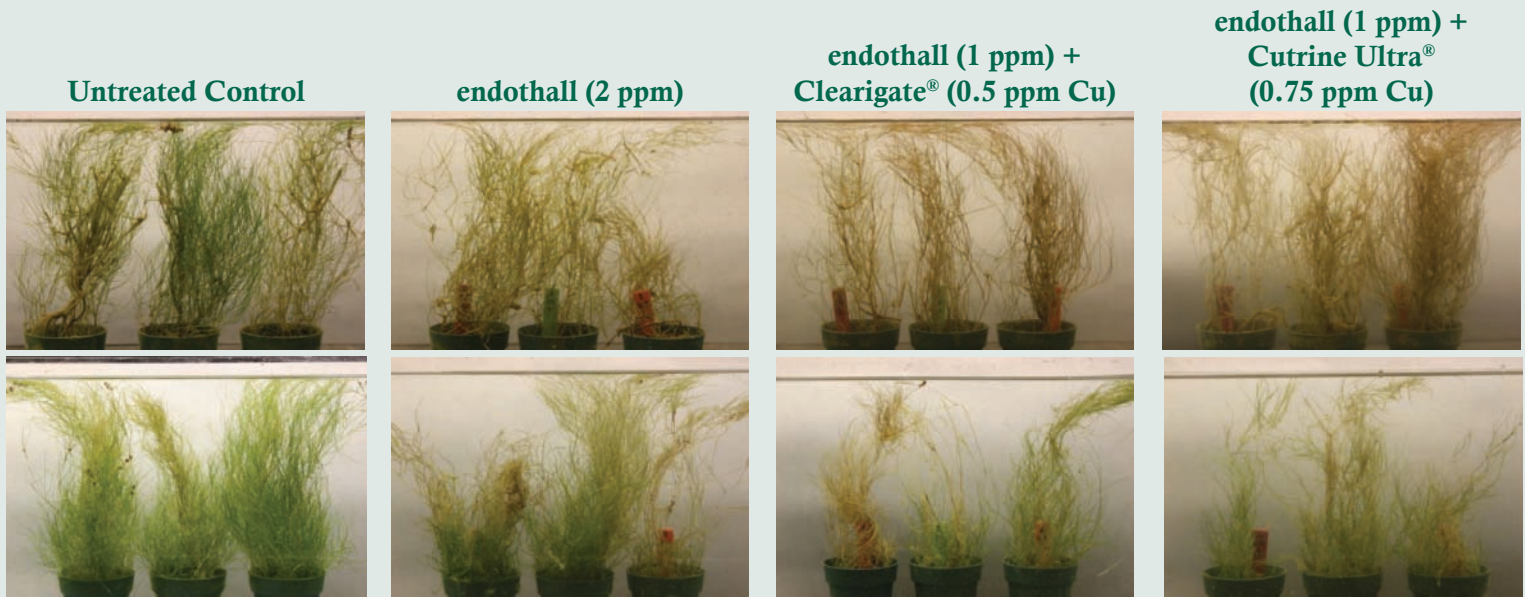
Photo taken at 1, 2, and 4 weeks after treatment (WAT)

Plants harvested at 30 days after treatment (DAT)

Following harvest, plants were dried for 48 hours at 60C, and dry biomass recorded



Results of Simulated Canal Studies on Sago Pondweed

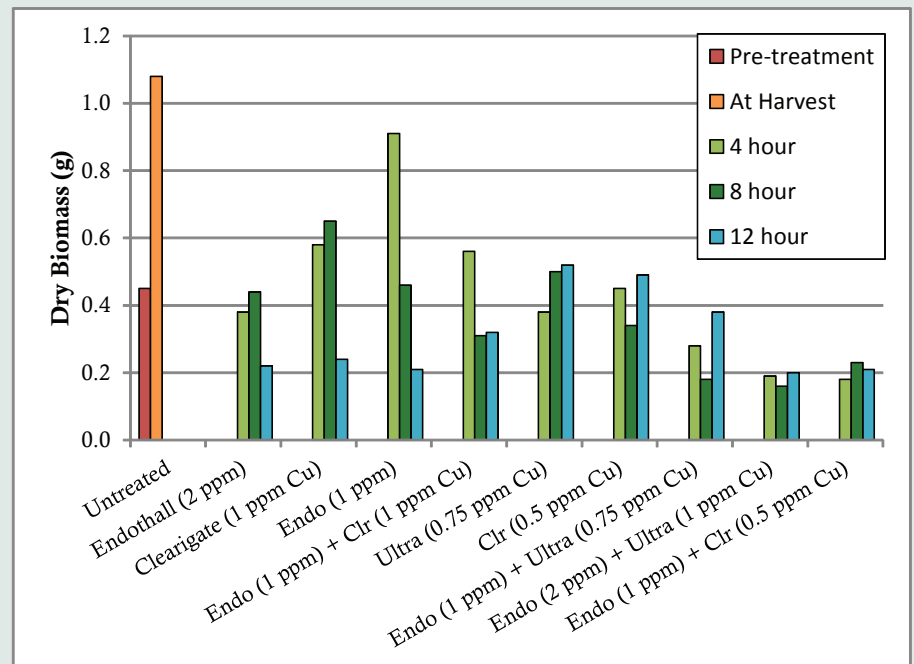


Top row of photos taken 1 WAT, bottom row taken 4 WAT. Within each photo 4, 8, and 12 hour exposures are shown (left to right).

Discussion of Simulated Canal Studies

- Simulation indicated interaction between endothall and the chelated copper formulations
- Interaction was highly significant when comparing the reduction in sago pondweed biomass resulting from the 4 hr exposure to endothall (1 ppm) and endothall (1 ppm) + **Clearigate** (0.5 ppm Cu)
- endothall (1 ppm) + **Clearigate** (0.5 ppm Cu) and endothall (1 ppm) + **Citrine Ultra** (0.75 ppm Cu) treatments for as little as 4 hrs reduced sago pondweed biomass to a level equivalent to 2 ppm endothall for 12 hrs
- Lower application rates or shorter exposure times using this combination could reduce herbicide loading into canals
- Addition of copper herbicides to endothall treatments could provide added algae control
- Field validation will be required to determine if these combination treatments are commercially viable
- This herbicide combination may dissipate at different rates down the canal.

Mean sago pondweed biomass 30 DAT.



Field Canal Studies and Results: 3 locations evaluated

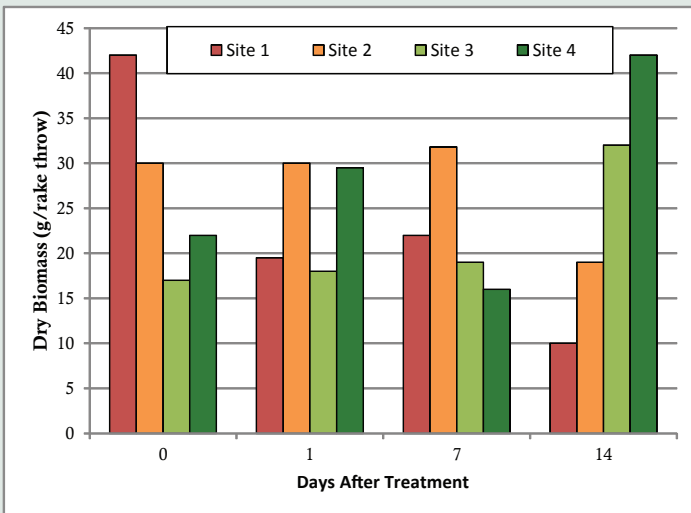
Lupton Bottoms Ditch

Location: Fort Lupton, Colorado

Treatment: Clearigate® (0.75 ppm Cu) + endothall (1 ppm) for 6 hours (10 cubic feet per second (CFS))

Evaluated 4 sites, labeled Site 1 - 4 for 0.15, 0.95, 2.00, and 3.85 miles downstream, respectively

Note: endothall at Site 1 was 0.89 ± 0.06 , but by Site 3 the copper concentration went from 0.82 ppm down to 0.48 ppm, and by Site 4 was reduced 73% to 0.22 ppm



Discussion:

Observed heavy infestation topping out the canal

Except for the first mile, control was not acceptable primarily due to loss of copper.



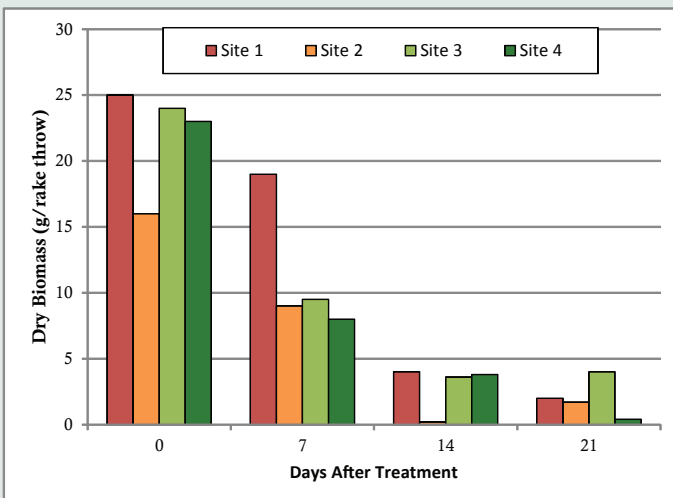
Grand Valley Irrigation

Location: Grand Junction, Colorado

Treatment: Clearigate (0.5 ppm Cu) + endothall (1 ppm) for 8 hours (42 CFS), (bump copper treatment (0.25 ppm) at 3.70 miles)

Evaluated 4 sites, labeled Site 1 through 4 for 0.00, 1.00, 3.68, and 3.70 miles downstream, respectively

Note: endothall at application was 0.79 ± 0.05 , and remained high by Site 2 at 0.77 ± 0.04 , but copper concentration, applied at 0.50 ppm, was reduced to 0.25 ppm by Site 3 (bump treatment increased copper to 0.49 ppm by Site 4)



Discussion:

By 21 DAT, sago pondweed biomass decreased 90%

Possible reasons for greater success at this location:

- Bump treatment raised copper back up to 0.50 ppm
- Sago pondweeds were smaller at application compared to Lupton Bottoms Ditch location, and had less biomass relative to the CFS

Endothall concentration showed to be a little low, indicating the excellent sago pondweed control was due to the benefits of adding copper

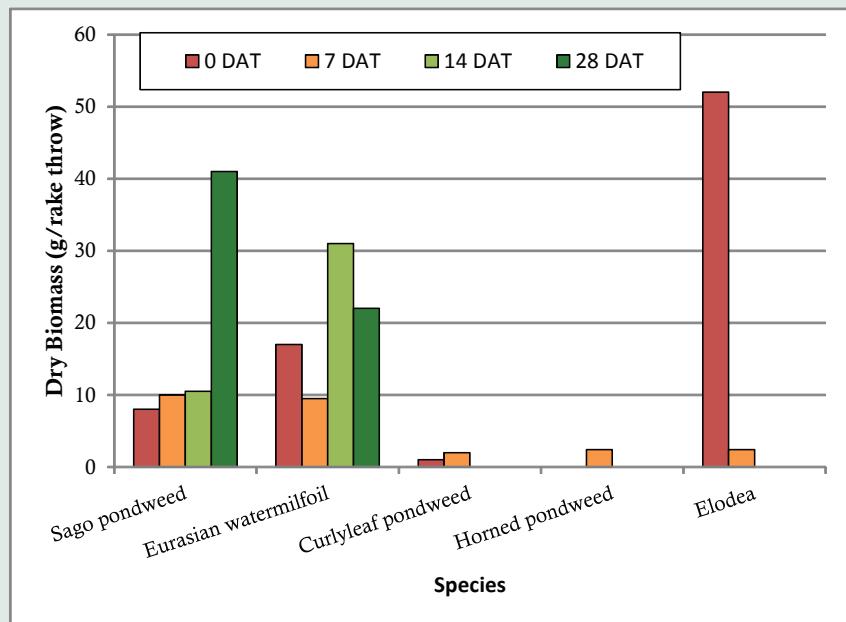


Leggett Ditch

Location: Boulder, Colorado

Treatment: **Citrine Ultra**[®] (1 ppm C) + endothall (1 ppm) for 6 hours (40 CFS)

Note: endothall at application was 0.90 ± 0.07 , and copper concentration, applied at 1 ppm, was reduced to 0.60 ppm by mile 1.45, and to 0.29 ppm by 3.97 miles



Sago pondweed, Eurasian watermilfoil, curlyleaf pondweed, horned pondweed and elodea control results.

Discussion

Curlyleaf pondweed, horned pondweed and elodea were completely controlled 14 DAT

Possible reason for poor sago pondweed control at this location:

- Greatest amount of sago pondweeds were at last 2 sampling points, where copper concentration was already down to 0.29 ppm

Speculation that endothall use may result in dominant weed shifts makes this combination treatment potentially useful

Conclusions

- The results of the greenhouse study provided good evidence for an interaction between endothall and the chelated copper formulations (**Clearigate**[®] herbicide and **Citrine Ultra** herbicide).
- In canals, a bump station will probably be needed to achieve acceptable control because copper absorption by sago pondweed significantly reduces copper ppm around 3 - 4 miles downstream
- Dense plant biomass will significantly reduce copper travel downstream and effectiveness
- Combination treatments appear to be practical for 6 - 8 miles of canal
- Combination treatments may provide faster burndown than endothall alone, but the impact on long-term control has not been determined as sago pondweed showed some regrowth 4 WAT at the Leggett Ditch location
- Further trials are required (adjust rate, target other aquatic plants, use of other herbicides including **Harpoon**[®] aquatic herbicide as a combination treatment with endothall)