**ABSTRACT**

Utah State University has been heavily involved in research regarding increasing vertical mixing in open channel raceways using delta wings with the hopes of increasing biomass production. Proper analysis of the mixing effects of the delta wing have been verified through CFD, ADV, and PIV efforts, but does this increased vertical mixing help improve the overall growth of the algae? Preliminary experimentation of these delta wings in commercially built raceway ponds to grow algae has been tested and proven to increase algal production in a *Chlorella Vulgaris* strain by 25-30%. These results are very encouraging as research is pushed along to optimizing this production method.

**EXPERIMENTAL SETUP**

Algal growth experiments were conducted in the research greenhouse at the Solar BioInnovations Center located on Utah State University’s Innovation Campus. This environment allowed operation of well-controlled experiments. The facility has a chilling system that was used to regulate the raceway water temperature, via cooling coils, amidst the wide range of temperature variation within the greenhouse.

Two professionally manufactured raceways were used for side-by-side growth experiments. One raceway contained three delta wings and the other did not have delta wings. The main parameters are as follows:

- **Greenhouse temperature range:** 60 – 100 °F
- **Raceway water temperature range:** 70 – 75 °F
- **Water depth:** 10 in.
- **Average velocity of water:** 25 cm/s
- **Delta wing spacing:** 1.5 ft from bend, 2.5 ft, 2.5 ft, 1.5 ft from bend
- **Delta wings:** 3
- **Algae strain:** *Chlorella Vulgaris*

For comparison purposes, it can be seen that the raceway with the delta wings lead to denser algal biomass. In the results section, how much a difference the delta wings make is shown.

**RESULTS**

**Experiment 1**

- **Date:** 8/13/12 – 8/23/12
- **Dry Wt. grams/L**
- **Increase:** 25.45%

**Experiment 2**

- **Date:** 8/24/12 – 9/3/12
- **Dry Wt. grams/L**
- **Increase:** 29.63%

**CONCLUSIONS & FUTURE WORK**

After the conduct of these experiments, it is shown that the delta wings increase algal productivity when using a *Chlorella Vulgaris* strain by 25-30%. Seeing as these are promising results, further experimental studies will be done to optimize algal productivity per energy consumption. In order to better understand the effectiveness in increasing algal growth using delta wings, multiple growth experiments will be designed to test the overall efficiency of this production method.

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