

Spray dynamics of Low energy precision application (LEPA) Irrigation Nozzles using biochar and water solution for water conservation

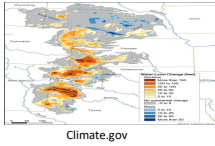
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BACKGROUND

The Ogallala aquifer depletion calls for means to retain water

- During irrigation, water can be conserved
- The Sprayhead Sprinkler is a reliable option for Center Pivot LEPA applications.
- Biochar have good water retention capacity and drought resiliency in crops

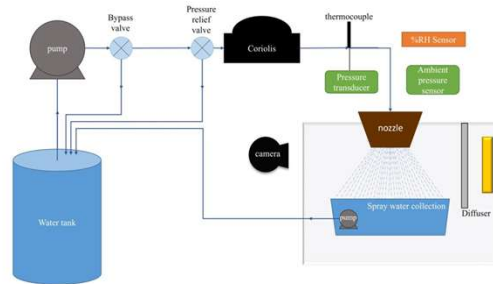


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Shonnards

EXPERIMENTAL SCHEMATIC



Stallbaumer-Cyr et al (2024)



10psi pressure regulator Senninger spray Nozzle configuration

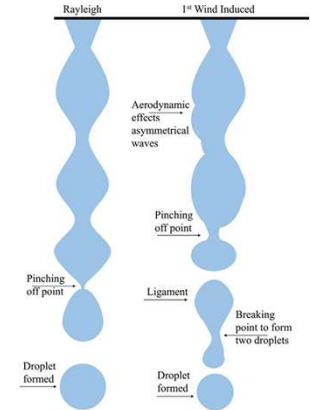


6psi pressure regulator Senninger spray Nozzle configuration



Senninger spray Nozzles in field

METHOD



Stallbaumer-Cyr et al (2024)

$$L_b = 19.5d_{jet}We^{0.5}(1 + 30h)^{0.85}$$

$$We \sim \frac{1}{\sigma}, Oh \sim \frac{1}{\sqrt{\sigma}}$$

L_b = Break up length

d_{jet} = Diameter of the jet

We = Weber Number

Oh = Ohnesorge Number

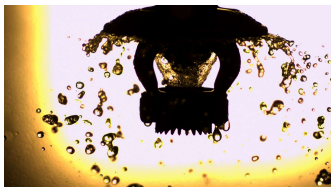
σ = Surface tension

OBJECTIVES

- Experimentally investigate the flow characteristics/spray dynamics of biochar-water solution in irrigation nozzles used by Midwest farmers
- Understand how this set up can improve water retention on soil and increase crop yield or reduce excessive water usage
- Impact of adding biochar on irrigation water droplet sizes/distributions, spray break up

Biochar-water can be dispersed on farms using existing irrigation nozzles with minimum water loss

RESULTS



Water, 6psi, Nozzle #8, Design GPM=1.11 GPM, Actual GPM =0.961GPM



0.5% Biochar + Water, 6psi, Nozzle #8, Actual GPM=1.01GPM



0.125% X gum + Water, steady GPM close to water alone



0.05% X gum + water+ biochar, GPM was steady, but feels very close to water

CONCLUSIONS

- Biochar-water solution reduce spray sheet break up because it has high surface tension and can withstand shear stress by air
- Spray makes it to the intended crop

FURTHER DIRECTIONS

- Investigate effect of biochar on droplet size in LEPA nozzles
- Study other flow effects
- Apply laboratory findings to greenhouse and field



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