Assessing Nitrogen Rates for Organic Bell Pepper Production Subjected to AirJection® Irrigation

Namratha Reddy[1], Dave Goorahoo[1,2], and Diganta Adhikari[2].
[1] Department of Plant Science, [2]Center for Irrigation Technology, California State University, Fresno

INTRODUCTION

•With rising interests in organic farming in the United States and in California, there is a need for more research to be conducted to optimize nutrient and water use efficiencies.

•AirJection® irrigation is a system of incorporating air into the sub surface drip irrigation (SDI) and has proven to increase yield and quality of vegetables in conventional farming (Goorahoo et al., 2001; Adhikari and Goorahoo, 2004; and Bhattarai et al. 2004).

•There exists a need to investigate the impact of AirJection® irrigation on the nitrogen uptake by the plants in organic systems.

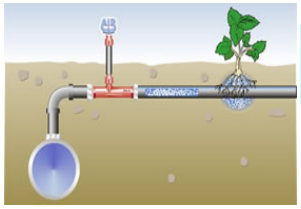


Fig.1: Picture showing the method of injecting air into the sub-surface drip irrigation system with the help of Mazzei® injector.

Refer to accompanying poster by Goorahoo et al. 2007 for principle of operation.

OBJECTIVES

- Overall Goal: To optimize water and nutrient use efficiency in organic farming systems.
- This Phase: To determine the impact of four rates of N when subjected to AirJection® irrigation on yield and quality of organic Bell Peppers;

Ho: N rate and AirJection® irrigation do not affect the yield and quality of Organic grown Bell Peppers.

MATERIALS AND METHODS

•Study was conducted in an organic plot at CSU-Fresno Agricultural Laboratory (UAL) on 5ft x 50ft beds.

•The experiment is a split plot design comprising of 8beds representing 4 replications of AirJection® irrigation and no-air treatments (control) as the main treatment, and N rates as subplot treatment (Fig. 2).

•Four rates of N ranging from 30, 60, 90 and 120 lbs/acre were applied as commercially available organic fertilizer (12-0-0) derived from feather meal.

•Soil moisture and oxygen levels, plant canopy characteristics and physiological processes, tissue sampling, and harvest data collected until 101 days after transplanting (DAT).

MATERIALS AND METHODS CONT'D

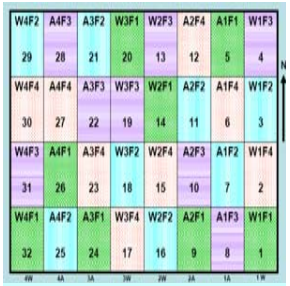


Fig. 2: A typical field layout of the experiment showing the main plot and sub-plot treatments.

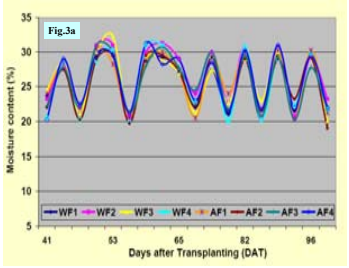
- Soil moisture: Hydrosense® at 20cm before and after irrigations.
- Oxygen: Apogee sensors at 15cm.
- Photosynthesis (PN), transpiration (T) rates and in-situ soil respiration (SR): at 59, 67 and 87 DAT using a CIRAS-2.
- Plant height and width: 53 DAT and every 7 days thereafter .
- Petiole sampling: 1" diameter of fruit (46 DAT) and 3/4th size of the fruit (65 DAT) for Nitrate ion concentration using the Ion Selective Electrode Method.
- Harvest: Yield and count at 53 DAT and every 7days thereafter.
- Shoot and root samples: At the end of cropping season (101 DAT). Fresh and dry weights were taken to calculate shoot to root ratio.

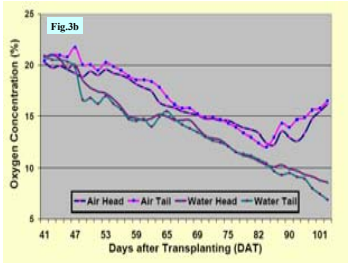
Transplanting organic Bell Peppers

Measurement of photosynthesis using CIRAS-2

Measurement of soil respiration using CIRAS-2

RESULTS





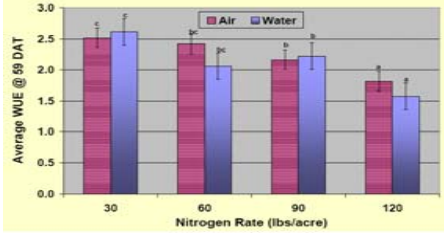


Fig. 4: WUE calculated as ratio between PN and T at 59 DAT at four rates of N

Dependent Variable: Average Height at 60 DAT(cm)

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	24163.2	1	24163.281	2420.892	.000
	Error	32.42	3	10.807(a)		
Block	Hypothesis	32.422	3	10.807	.700	.612
	Error	46.289	3	15.430(b)		
Irrigation	Hypothesis	1.758	1	1.758	.114	.758
	Error	46.289	3	15.430(b)		
Irrigation * Block	Hypothesis	46.289	3	15.430	1.951	.158
	Error	142.383	18	7.910(c)		
NRate	Hypothesis	3.906	3	1.302	.165	.919
	Error	142.383	18	7.910(c)		
Irrigation * NRate	Hypothesis	22.461	3	7.487	.947	.439
	Error	142.383	18	7.910(c)		

a MS(Block) b MS(Irrigation * Block) c MS(Error)

Table 1: ANOVA for average plant height at 60 DAT.

Fig.3a: Soil moisture profile maintained within the top 8 inches throughout the crop growth period.

Fig.3b: Oxygen concentration at 6 inches depth in aerated and non-aerated plots at the head and tail ends throughout the crop growth period.

*email addresses of authors: nammi@csufresno.edu ; dgooraho@csufresno.edu ; diganta@csufresno.edu

RESULTS CONT'D

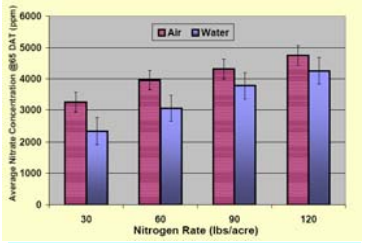


Fig. 5: Average Nitrate concentration at 65 DAT

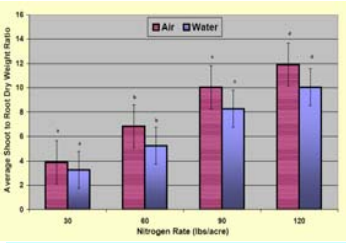


Fig. 6: Average shoot to root dry weight ratio at 101 DAT.

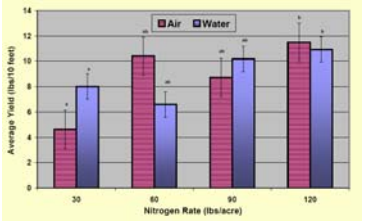


Fig. 7: Average pepper yield per 10 feet at four rates of N.

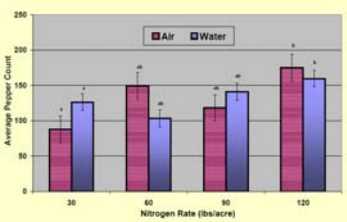


Fig. 8: Average pepper count per 10 feet at four rates of N.

SUMMARY AND FUTURE WORK

•Compared to plots receiving water only, the AirJection® irrigated plots demonstrated enhanced soil aeration at similar moisture levels (Fig. 3a and 3b).

•N rates had a significant effect on the WUE at 59DAT (P≤ 0.05) (Fig. 4) with similar plant canopy (Table 1).

•Both AirJection® irrigation and N rates had a significant effect on Nitrate concentration at 65 DAT, equivalent to 3/4th size of the fruit (P≤ 0.05) (Fig. 5).

•The average shoot to root dry weight ratio was also significantly effected by AirJection® irrigation and N rates (P≤ 0.05) (Fig. 6).

•Results from data analyzed to date have shown that N rates had a significant effect on yield and count of Bell Peppers (P≤ 0.05) (Fig. 7 and 8).

•Future work involves repeating the experiment for a cool season crop i.e. organic Broccoli from September to December, 2007.

•Additional experiments with different organic N formulations and additional N rates are currently being considered.

References:

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•Bhattarai, S., Huber, S., and Midmore, D. J. 2004. Aerated subsurface irrigation water gives growth and yield benefits to zucchini, vegetable soybean and cotton in heavy clay soils. Annuals of Applied Biology. 144:285-298.

•Goorahoo, D., Carstensen, G., Zoldoske, D.F., Norum, E., and Mazzei, A. 2001. Using air in subsurface drip irrigation (SDI) to increase yields in bell pepper. In Proc. of the Irrigation Association Technical Conference, San Antonio, Texas, pp. 95-102.

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