Irrigation Water Use on Dry-Seeded Rice Production.

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ABSTRACT

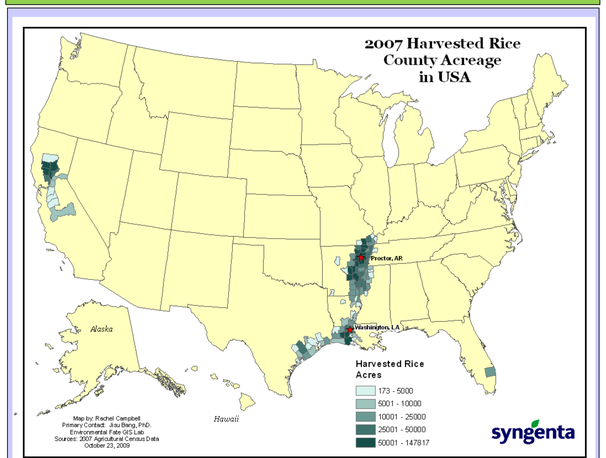
- Efficient use of irrigation water in rice production contributes to optimum management of water quality and quantity. In dry-seeded drilled rice cultivation, permanent flood may occur 4-6 weeks after planting with early flushes for facilitating seed germination.
- Irrigation water supply was quantified for two large plot studies of dry-seeded drilled rice at two locations in 2007; Washington, Louisiana and Proctor, Arkansas, USA. Water levels in paddies as well as daily weather data at experimental sites were monitored.
- Total irrigation supplied was approximately 23 inches (for 19 weeks) at the Louisiana (LA) site with a growing season rainfall of 18 inches. However, irrigation water supplied was nearly 3.5 times higher at the Arkansas site (for 16 weeks) where growing season rainfall was four inches. Net water use (NWU) was 32 inches at LA site and 72 inches at AR site, which resulted in water use efficiency (WUE) of 235 and 108 lbs/A/inch, respectively. In 2007, these sites experienced extreme wet and dry conditions, drought at AR site and wet at LA site, therefore, the range of NWU and WUE estimates can represent the rice growing area in this region.

INTRODUCTION

- Efficient use of irrigation water in rice production contributes to optimum management of water quality and quantity. In dry-seeded drilled rice cultivation, permanent flood may occur 4-6 weeks after planting (WAP). However, dry seeded drilled rice production requires water flushes (irrigation) to facilitate germination and seedling emergence[1][2]. In this cropping system, irrigation water can be saved earlier in the cropping season but dry lands can use more water than the low lying paddies. Rice growing area of USA is presented on the map below.
- Irrigation water supply for two large plots was quantified to evaluate the irrigation water needs and water use efficiency of the rice crop under dry-seeded drilled rice production. This paper presents comparison of irrigation water requirement and crop water use under two different environments.

OBJECTIVES

- To quantify water requirement of a dry-seeded drilled rice crop and to evaluate the water balance and water use efficiency on dry-seeded rice production under different environmental conditions.



MATERIALS AND METHODS

- The study was conducted at two locations using two large plots (~ 0.5 acre) of dry-seeded drilled rice;
  - Site 1: Washington, Louisiana, USA (LA Site)
  - Site 2: Proctor, Arkansas, USA (AR Site)

Water management and Weather Data Collection

- Plots were irrigated using deep wells and irrigation amounts were measured using flow meters. Two water flushes (irrigation) were provided to facilitate germination and seedling emergence in dry-seeded rice immediately after seeding (planting) and at two weeks after seeding. Water was released after holding overnight at each flush and the discharges (drainage amounts) were measured after each release. Permanent flood was established after five weeks of planting and total water supplied at each irrigation event was measured. Standing water was released approximately 2-3 weeks before harvesting the crop and the final water discharge was also measured.
- Weather data, minimum and maximum air temperature, relative humidity, solar radiation, wind speed, precipitation, and potential evapotranspiration (ETo and Pan Evaporation), were collected at the experimental sites or at nearby NOAA weather stations.
- Water level was expected to be maintained at 2 – 6 inches and was monitored using a pressure transducer with data logger and occasional staff gauge readings were used to calibrate the automatic pressure transducer.

Crop Management Data and Soil Characterization

- Crop was managed following agronomic practices common to the sites/area [1][2][3][4]. Crop/management information are provided below;

	LA Site	AR Site
Rice variety	Cocodrie	Wells
Seeding rate	2.84 mil lion seeds/A (150 lbs seed/A)	2.84 mil lion seeds/A (160 lbs seed/A)
Plot size	160’ X 150’	150’ X 150’
Date of seeding/planting	June 07, 2007	May 08, 2007
Date of permanent flood establishment	July 14, 2007	June 13, 2007
Date of final water release	October 17, 2007	August 23, 2007

- Soils were characterized at two depths, 0-3 and 3-6 inches and soil series was identified from county soil surveys.
  - LA Site – Gallion Series and AR Site – Sharkey Series

Calculations

- ETo was estimated using FAO56-PM method with software [5], for LA site data were obtained from LAIS station at Crowley Rice Station.
- Net Water Use (NWU) was measured as follows:

  NWU = Precipitation (rainfall) + irrigation – discharge
- Water Use Efficiency was estimated using average yield data reported for the varieties [3] as follows;

  WUE = Average Grain Yield (lbs/A) / NWU
- Based on the average yield reported from variety trials in 2004, 2005 and 2006, the grain yields (dry weight) were 7771 lbs/A for ‘Wells’ and 7561 lbs/A for ‘Cocodrie’ [3].

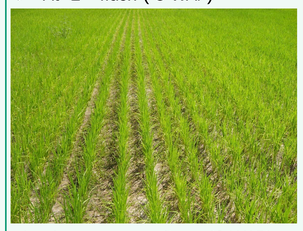
RESULTS AND DISCUSSION

- Field and crop status at different stages at two sites.

LA Site

➢ At 1st flush - after seeding

➢ At 2nd flush (3 WAP)



➢ At permanent flood (6 WAP)

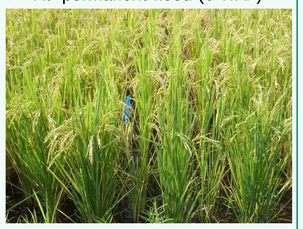
➢ At 14 WAP

AR Site

➢ At 1st flush - after seeding

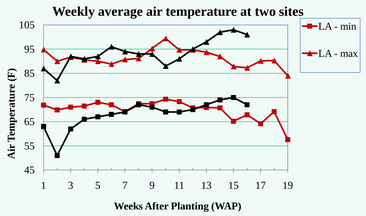
➢ At 2nd flush (3 WAP)

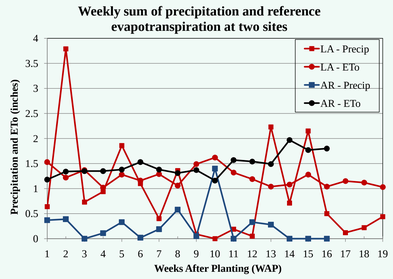
➢ At permanent flood (6 WAP)



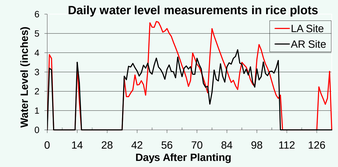
➢ At final water release (16 WAP)

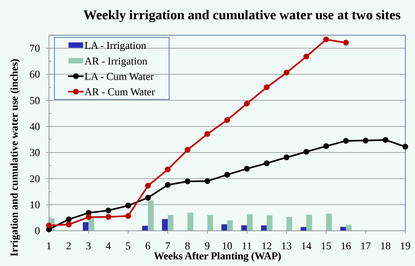
- In 2007, LA site experienced a wet summer with well distributed rainfall while the AR site had a severe drought. Weekly weather data summaries are given below.





- Water level in rice plots, weekly irrigation and cumulative water supply.





- Soil characterization data for both sites are presented below.

Location	Soil Depth (inches)	USDA Textural Class	Sand %	Silt %	Clay %	Organic Matter %	pH	CEC (meq/100 g)	Bulk Density (Disturbed) (g/cc)	Water Holding Capacity (%) (Disturbed) at	
										1/3 Bar	15 Bar
LA Site	**0 - 3**	**Silt Loam**	**19**	**64**	**17**	**1.8**	**5.8**	**11.6**	**1.16**	**23.8**	**9.1**
	3 - 6	**Silt Loam**	**20**	**63**	**17**	**1.3**	**6.0**	**10.6**	**1.12**	**25.4**	**8.6**
AR Site	**0 - 3**	**Clay Loam**	**31**	**32**	**37**	**2.8**	**6.8**	**24.3**	**1.14**	**33.4**	**20.2**
	3 - 6	**Clay**	**21**	**38**	**41**	**1.9**	**7.1**	**23.2**	**1.14**	**38.6**	**21.4**

- Comparison of water balance and water use efficiency

	LA Site	AR Site
Total ETo (inch)	23.3	23.5
Total Pan Evap (inch)	25.1	36.0
Total Precipitation (inch)	17.5	4.1
Total Irrigation (inch)	22.9	77.1
Total Drainage (inch)	8.2	9.0
Total NWU (inch)	32.2	72.1
WUE (lbs/A/inch)	234.8	107.8
Duration (weeks)	19	16

CONCLUSIONS

Total irrigation water supplied was 23 inches (for 19 weeks) at the Louisiana site with a well distributed rainfall of 18 inches compared to 77 inches of irrigation and four inches rainfall at the Arkansas site (for 16 weeks). Net water use was 32 inches at LA site and 72 inches at AR site resulting WUE of 235 and 108 lbs/A/inch, respectively. Well distributed rainfall at the LA site kept the irrigation water requirements much lower than that of AR site, hence the resultant two-fold WUE at the LA site. Since the two sites experienced extreme wet and dry conditions this year, the NWU and WUE estimates can be well representative of the dry-seeded drilled rice grown in this region.

References:
[1]. LSU AgCenter. Rice Production Best Management Practices (BMPs) Pub. 2805 .
[2] . Louisiana Rice Production Handbook.
[3]. LSU AgCenter. Rice Varieties and Management Tips 2007. Pub. 2270.
[4]. Wilson, C. E., J. W. Branson, and C. H. Davis, Jr. Computer Technical Series – RICESEED. Coop. Extension Service, Div. of Agriculture, Univ. of Arkansas.
[5]. REF-ET Reference Evapotranspiration Calculator Ver. 2.0 Windows. Programmed at Utah State University and at the University of Idaho.