Crop Sciences
University of Illinois at Urbana-Champaign

Management of Irrigated Soybean

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Introduction

Though irrigated soybean [*Glycine max* L. (Merr.)] only make up a small portion of total U.S. soybean production, interest has been generated due to the potential for high yields and production. Effectively using irrigation alone or with other production practices is one approach producers may use to more actively manage soybean, even in those areas where rainfall is often adequate.

Objective

From 2012 to 2014, we examined the effect of supplemental irrigation on soybean grown in productive silt loam and silty clay loam soils. Water was applied during times of precipitation deficits to eliminate potential water stress. Water management in conjunction other production practices were looked at to investigate how irrigation might interact with limitations of other management factors.

Figure 1. Non-irrigate (left) and Irrigated (right) soybeans September 2012 at Urbana, IL

Study Design and Sites

- The study was designed as a split-split-plot, with irrigation (with and without) assigned to main plots , seeding rate to sub-plots, and in-season inputs to sub-sub-plots.
- Randomized complete block arrangement of irrigation treatments with four replications used.
- The study took place at Urbana in east central Illinois from 2012 to 2014.
- Experimental units consisted of plots 7, 38-cm rows 8 m long.

Materials and Methods

- Irrigation was applied to supplement rainfall (Table 1). In 2012, 2013, 2014 242, 176, and 48 mm were applied respectively.
- Three seeding rates were planted; however, only the two common to all three years were analyzed.
- In-season inputs included a treatment of fungicide and insecticide, fertilizer, a combination of the previous two treatments and a control.
- Fungicide and insecticide treatments included Headline® (pyraclostrobin) fungicide and Warrior II® (pyrethroid) insecticide applied at their labeled rates at R1 and again at R3 .
- Fertilizer applications included a combination of nitrogen (52 kg ha^{-1}) as urea spread at V5 and R3 and a combination of macro- and micronutrients applied as foliar sprays of Task Force® 2 (4.67 L ha^{-1}) at both R1 and R3.
- The center 1.5 m (4 rows) of each plot was harvested using a plot combine and yield corrected to 87% dry weight.

Table 1. Monthly rainfall by year

Month	Urbana 2012	2013	2014	Ave.†
	----------mm----------			
May	90	118	105	124
June	46	135	229	110
July	14	88	203	119
August	142	12	36	100
September	142	13	89	80

† 30 Year Averages from 1981 to 2010 (Illinois State Water Survey)

Results

Table 2. ANOVA by year of soybean yield for main effects and interactions. In-season inputs included arrangements of fertilizer and a combination fungicide and insecticide

Fixed Effect	Urbana 2012	2013	2014
Irrigation (I)	*	*	NS
Seeding Rate (S)	NS†	*	NS
I*S	NS	NS	NS
In-season Inputs (M)	NS	*	NS
I*M	NS	NS	NS
S*M	NS	NS	NS
I*S*M	NS	NS	NS

* Significant at the P = 0.05 probability level
† NS = not significant at P = 0.05

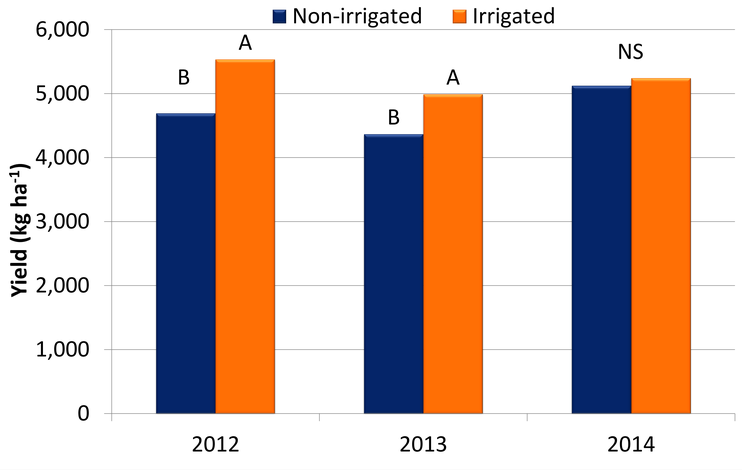

Figure 2. Soybean yield response to irrigation in each year. Mean separations were made within year at α = 0.05.

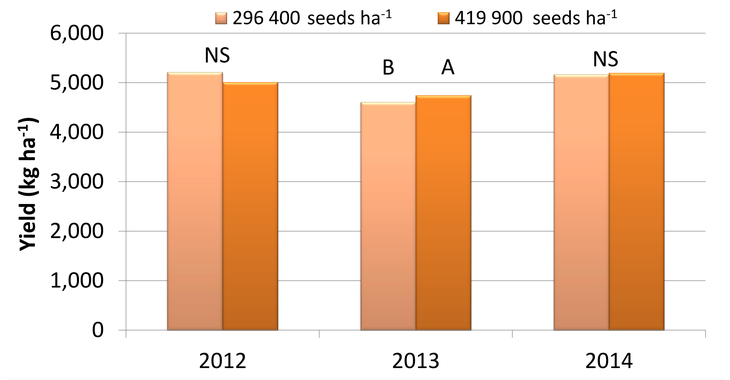

Figure 3. Soybean yield response to seeding rate in each year, averaged across irrigation treatments. Means were separated at α= 0.05.

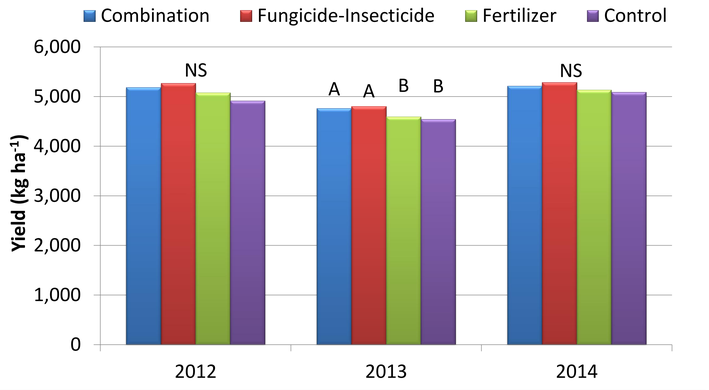

Figure 4. Soybean yield response to in-season inputs for each year, averaged across irrigation treatments. Different letters atop bars indicate significantly different yields at α=0.05.

Summary and Conclusions

- Yield responses to irrigation were 843 and 624 kg ha^{-1} in 2012 and 2013 (Figure 2), respectively. Averaged across all three years, irrigation increased yields by 529 kg ha^{-1}, or 11.5%.
- Irrigation was most effective in increasing yields when two consecutive months of the growing season had rainfall well below normal (2012, 2013); there was no response in 2014, when only a single month had well below-normal rainfall (Table 1).
- In 2013, increasing the seeding rate from 295 400 to 419 900 seeds ha^{-1} increased yield by 135 kg ha^{-1} (Table 3) and spraying a combination of fungicide and insecticide increased yields by 355 kg ha^{-1} (Table 4).
- The lack of interaction between irrigation, seeding rate, and in-season treatments (Table 2) suggests that minimizing water as a yield limitation does not consistently move other factors – seeding rate, foliar disease and insect pressure, or plant nutrient supply – into position of most-limiting factor.

Acknowledgements

We thank the Illinois Soybean Association for partial funding for this work. We acknowledge with gratitude the willing and able assistance in plot establishment and care by Jason Niekamp and personnel of the UI South Farm.