APPLICATION OF MECHANIZED IRRIGATION FOR RICE PRODUCTION

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SUMMARY

Rice, an important staple crop throughout the world, has typically been produced under the same traditional methods for the last 2,000 years or more. The global need to conserve water and various other resources has led to exploring the production of rice under mechanized irrigation. Beginning with a brief history of the development of cultural practices of irrigating rice, this paper will focus on the argument that mechanized irrigation will physiologically and economically work for growing rice. The discussion will be on the general requirements to produce rice with mechanized irrigation such as seed, fertilizer applications, and herbicides. Information will be presented on products available and market acceptance. In closing this work will focus on future issues surrounding the use of mechanized irrigation for rice production and the continued growth and interest in this opportunity.

INTRODUCTION

Rice is one of the most important crops grown around the globe. Produced in over 114 countries, it supplies a major source of nutrition for a large portion of the earth's population (International Rice Research Institute (IRRI), 2008). While some countries previously dependent on rice have become more developed, approximately 750 million people still depend on a stable source of rice from day to day (IRRI, 2006).

Rice has historically been grown in paddies or terraced fields, and now with the evolution of laser leveling, many rice growing areas in the United States have moved to precision leveling or zero grade. It has long been thought that all rice growing areas require ample amounts of water (flood) to maintain the four- to five-inch water level throughout the main growth stages of a rice plant's life cycle. The flood method has the dual purpose of providing weed control and water for plant growth. However due to increasing constraints to available water – both surface and ground changes need to be considered in production techniques for rice (Massey, 2009). Recently, both in the United States and internationally, rice farmers have begun relying heavily on herbicide treatments for weed control in an effort to conserve water by reducing the amount of flood water applied. Other methods are also being implemented to reduce water usage for rice production, which include side inlet and furrow irrigation, as well as reduced flood water levels (Vories, 2006). All of these have one thing in common – they still depend on some form of flood irrigation.

Center pivots would seem a logical choice to irrigate rice as they have successfully irrigated all other grain crops. Center pivot irrigation on rice has been tried by individuals and researchers since the early 1980s. In these attempts, water was saved but the use of center pivots did not meet economic expectations (Deterling, 1983). This was due to a variety of reasons, including weed pressure, wheel tracks, and other management issues (McCauley, 1985). No serious innovations in rice irrigation were implemented until interest was renewed in the late 1990's due to water constraints.

In the early 1990s a Brazilian farmer realized that due to continued water shortages, he needed to make some changes if he wanted to continue to produce rice (Arns, 2007). Working with an agronomist, he tried several alternatives including a traveling gun, reducing the amount of flood water applied, and a small Valley center pivot. Soon it became apparent that the most economically viable solution for his operation was use of the center pivot. A few years later, he had reached a point where he had developed a plan about how to grow rice on his farm under the center pivot. Ever since, he has produced rice profitably under the original center pivot and has expanded his center pivot production area to between 85 and 130 hectares annually. It is this success that has encouraged Valmont to develop a 'formula' for producing rice under mechanized irrigation machines.

DISCUSSION

What, if anything, has changed since the attempts to grow rice with center pivots in the 1980s? Let's discuss the changes in the terms of agronomics, irrigation equipment, and management.

A common problem of center pivot irrigated rice has been weed control; it has been questionable due to the soil being exposed, unlike flooded rice soil, which is typically always covered with water. Through recent trials, however, it has been proven that weed control can be obtained (Bennett, 2009). Obviously every field is site specific and not one chemical regime works everywhere, but based on crop scouting at the United States and Brazilian trials, pre-emergent chemicals and post-emergent herbicides have been applied and have achieved good control. Some advantages of center pivot irrigated fields is the ability to apply water as needed which allows the soil to dry out prior to the use of ground rigs for application, as well as the option to use the center pivot to activate the herbicides.

Another contributor to weed control has been the development of hybrid rice. Just as other agricultural production seeds have rapidly advanced, so has rice been bred for higher yields, disease resistance, and resistance to particular herbicides. The major advancement of hybrid rice not only offers conventional variety characteristics, but also adds an aggressive early season vigor that encourages tillering and canopy development. The crop canopy has been found to be especially important with sprinkler irrigated rice in order to reduce weed pressure throughout the growing season. Hybrid rice has proven to deliver higher yields and improved weed control in flooded rice, and continues this momentum with pivot irrigated rice. Equally important is the disease resistance, particularly Blast, that has been bred into hybrid rice. While hybrid rice seed is not required to sprinkler irrigate rice, it does provide some distinct advantages over varieties.

The next topic for discussion is the consideration of what has changed in irrigation equipment. Center pivots and linear equipment continue to evolve in several areas – controls, drive units, and sprinkler packages. These are important considerations for rice production under center pivots. The controls have improved, allowing for automatic adjustments in application depths which reduce the number of trips the farmer must take to the field. In addition, the incorporation of GPS technology has improved position information. The drive units have changed with the development of reliable and dependable flotation options, such as base beams with three wheels, four wheels, and tracks. These adjustments address one of the key problems that have occurred in the past - center pivots getting stuck. The third important change is improvements in sprinkler packages and hardware; these allow the machine to economically and reliably apply water away from the wheel tracks.

Lastly, improvements in management have changed to meet the unique requirements of producing rice under mechanical move irrigation equipment. It is understood that irrigating rice is not the same as irrigating other crops, and a unique approach needs to be taken. The exceptional characteristics of the rice plant require different thought about when to irrigate and the required application depth. Production trials continue to determine optimum irrigation depths and scheduling. Another management concept is the advantage of using the center pivot or linear machine to apply fertilizers, which improves efficiency while minimizing application costs (Stevens, 2008).

CONCLUSIONS

Recent results with rice production under center pivots have been successful for specific individuals. Different producers have their own reasons for using mechanized irrigation. For the Arnses in Brazil, conserving 50% or more of their water typically used in their flooded fields and the ability to still produce a good rice yield are the drivers. Other growers want a viable alternative crop that has the potential for positive economic return on fields that are not suitable for traditional rice production methods. Using center pivots and linears reduces the amount of land leveling required, thereby minimizing the amount of water needed for production and easier rotation to other crops.

Work needs to continue to better understand the actual water needs of rice and the irrigation requirements by growth stage, what type of flotation options are needed for which soil type, chemigation and fertigation and seeding rates to name a few to reach the point where growers can reliably anticipate achieving their economic goals when using mechanized irrigation for rice production.

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