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Onion Yield with Web-Based Irrigation Scheduling and Subsurface Drip Irrigation as Opposed to Trench Irrigation

Kenjal*

Department of Science and technology, Albania

Abstract

Selecting the right irrigation method will be beneficial to manage limited water supplies and increase crop profitability. The overall objective of this study was to evaluate the effect of subsurface drip irrigation and trench irrigation on onion yield and irrigation water use efficiency. This study was performed as split plots for two sites with two SDI and trench irrigation treatments and three replicates for each treatment. The total onion yield obtained with the SDI system was 93% higher than that obtained with the trench irrigation system. Onion size was 181% larger in the SDI system than in the bed system at both sites. The productivity at the giant size is also higher. At one site, the yield of giant onion was 206% higher than that of rowed onions, while at another site the onion beds did not produce giant onions and SDI had some yield. It was concluded that drip irrigation systems more than doubled yield and increased onion size while using almost half the amount of water. This is because SDI allows for more frequent watering and smaller depth with higher irrigation efficiency than trench irrigation.

Keywords: Crop; Irrigation; Agricultural productivity

Introduction

Texas is regularly affected by dry spells, including droughts that began in 2011 and lasted through 2012 and 2013, with 2012 being one of the driest years on record. These droughts often cause water shortages and impose additional restrictions that reduce irrigated areas, affecting agricultural productivity and profitability. In these cases, farmers often look for alternatives to increase yield and net profit per unit of water applied by switching to drip irrigation and implementing an irrigation scheduling strategy. The federal and state governments have implemented a number of programs to support this conversion of irrigation systems. However, many growers feel that the costs of using these water-saving technologies far outweigh the benefits of increasing vegetable production and saving water. To reduce the economic risks of farm operations, it is important to make informed decisions when choosing irrigation methods for a particular crop [1]. Farmers who continue to use traditional trench irrigation methods may benefit from inadequate irrigation and shorter trenches, or may consider using SDI for vegetables in water constrained areas if productivity and profit per unit of water increase thanks to these systems. The SDI system is necessary to ensure uniform germination and to schedule irrigation according to different irrigation strategies, such as managing onion plants with soil water stress or replacing transpiration from soil. onion. SDI can also assist in the management and regulation of onion-induced water shortages in semi-arid regions of the world. According to Camp, the yields of horticultural crops irrigated with SDI are comparable or better than those obtained with other irrigation systems in most cases. For cantaloupe, onions and carrots grown in Arizona, crop yields were very similar for SDI and trench irrigation. Slightly higher yields were observed for crops such as sweet corn and tomatoes that produced 12% and 20% higher yields when using SDI instead of a trench system [2-5]. Cabbage and zucchini grown in Arizona have an SDI yield that is approximately 350% and 35% higher, respectively, than in a bed system. Alfalfa and cotton have also shown significant benefits when applying SDI to trench or flood irrigation. Producing onions using subsurface drip irrigation (SDI) can help increase yields and allow growers to sell their produce at early spring markets, justifying the use of SDI system.

Irrigation water use

The total rainfall in the two crops is 140mm in 2012-2013 and 294mm in 2013-2014. During the 2012-2013 growing season, more than 65% of rainfall was received in the first 12 weeks from October to December, and about 72% was received in 2013-2014 during the same period [6]. The rainfall is not enough to meet the water demand for crops in both years is 409 and 411 mm, in 2012-2013 and 2013-2014, respectively, 2012-2013 needs more irrigation than in 2013-2014 season .The average bed length in this area is about 365m, but vegetable growers have reduced the bed length to 200m to save water and improve irrigation efficiency. The commercial field experiment had a trench length of 178m and an average irrigation depth applied with the trench systems of 112mm with a total of 6 irrigations. The average irrigation depth of 112mm is excessive for shallow root systems and this may explain the low irrigation efficiency for trench systems. A common problem is the decision to reduce the number of irrigations or to reduce the area of irrigation when water is limited in order to concentrate water on vegetables [7]. Farmers with SDI systems can apply occasional small irrigation but they must pump water directly from a river, have a reservoir on their farm, or are located near a canal where the water can be pumped continuously. In commercial fields located near the Rio Grande River, watering can be done more frequently with a smaller irrigation depth with the SDI system applying an average irrigation depth of 21.1 mm per irrigation, which is effective high irrigation 88.5%. Farmers water almost every week from February until harvest using the SDI system [8,9]. This outcomeed in higher irrigation frequency with the SDI system of 17 sprays compared to 6 for the trench system.

Onion yield and quality

Total onion production was significantly different for SDI and

***Corresponding author:** Kenjal, Department of Science and technology, Albania, E-mail: ken@gmail.com

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trench irrigation in the two locations. Onion yield was approximately 119% higher with the SDI system than with the row irrigation system in the commercial field. A similar trend was observed at the Weslaco site where SDI yielded 95% higher onion yields than the bed system. Higher onion yields can be made possible by the higher irrigation frequency of SDI systems. Onion yields obtained by Hatterman-Valenti and Hendrickson for sprinkler-irrigated onions ranged from 51.9 to 56.9 Mg ha−1 and yields obtained by Shock ranged from 43.1 to 49, 8 Mg ha− 1 for onions irrigated with SDI. In this study, the average onion yield ranged from 20.2 to 62.9 Mg ha−1 [10]. When onion yields were sorted by size, irrigation systems did not have a significant impact on small and medium yields at the commercial site, but they did affect the onion yield resources at the site. Weslaco. At the Weslaco site, the average onion yield of 24.4 Mg ha−1 for the SDI system was higher than that for the bed system and the yield for the small onion was statistically similar. Large and giant onions usually have a higher market value than small and medium onions. In both sites, the average yield of large and giant onions was higher for the SDI system than for the bed system. These differences were most noticeable in the commercial field, where the average size of large onions and giant onions from the SDI system was 206% and 168% larger than those from the row-irrigated system. At the Weslaco site, the average large onions were 182% larger for the SDI system than for the bed system. The average giant onion yield was 0.6 Mg ha−1 for the SDI system and zero for the trench irrigation system. The SDI system was larger and more massive than the trench system at both sites possibly due to higher irrigation efficiency and higher frequency of irrigation.

Discussion

The efficiency of irrigation water use is calculated by dividing the total onion production by the amount of irrigation water. In the commercial field for the 2012-2013 crop, irrigation water efficiency was 17.5 kg m−3 for the SDI system and 4.2 kg m−3 for the trench system. In Weslaco field area, irrigation is programmed using water balance method and this may be the reason why higher irrigation efficiency is observed in Weslaco field area compared to field area commerce. Irrigation efficiency is higher for the SDI system with 25.2 kg m-3 and only 6.5 kg m-3 for the trench system. In previous studies, Enciso obtained the water use efficiency of drip-irrigated onions defined as the relationship between total yield and water evaporation, not total irrigation depth varying from 11.7 to 13.7 kg m−3. Al-Jamal observed nearly similar irrigation water use efficiency in New Mexico for surface drip-irrigated onions and surface-managed irrigation under deficient irrigation conditions when applied irrigation. Use less irrigation and they explain the drip irrigation system on the amount of water irrigated to filter salt out of the root system. The sites in this experiment that received rainfall from September to November washed away the salt and prevented saltwater intrusion by a drip irrigation system. In another experiment, Ellis found that the irrigation efficiency of 10.4 kg m−3 per plot was small and that frequent irrigation was applied with surface irrigation systems in the experimental area, which was difficult, achieved on large commercial fields.

Conclusion

SDI systems allow for more frequent application at smaller irrigation depths than trench irrigation systems. Irrigation efficiency was also higher for SDI systems 81–88% than for trench systems. The irrigation water efficiency achieved with the SDI system ranged from 17.5 to 25.2 kg m−3 and from 4.2 kg m−3 to 6.2 for the trench system at both sites. . It was concluded that drip irrigation systems more than doubled yield and increased onion size while using at least 44% less water. This is because the SDI system allows for more frequent application and smaller irrigation depth with higher irrigation efficiency than the trench irrigation system. In addition, we can show that heavy rains in autumn reduce the possibility of saline intrusion.

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