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A Review Paper on Enhancing Water Productivity and Yield of Drip Irrigated Onion using Deficient Irrigation, Fertigation and Mulching

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Abstract: ***Water is the most important and critical input in man's life especially in agriculture. The pressure for the most efficient use of water for agriculture is intensifying with the increased competition for water resources among various sectors with mushrooming population. Water productivity and onion yield therefore, needs to be assessed through integrated practice of drip irrigation involves exposing plants to certain levels of water stress during either a particular growth period or throughout the whole growth season. The optimum level of production can only be obtained by conducting an economic analysis of cost – benefit ratio of input and output.***

Keywords: Deficit irrigation, Onion mulching, yield

1. Introduction

Water is an extremely important part of our lives. It is used for irrigation and various domestic purposes. Moreover, all ecosystems on Earth cannot sustain life without the use of water. On an average, 70 percent of freshwater withdrawals worldwide are currently used by Agriculture sector (FAO Water Report, 2011). This use of water is expected to reach as much as 95 percent in developing countries (FAO Water Report, 2012).

All surface methods of water application give very low water use efficiency while pressurized methods of irrigation like trickle irrigation are most suitable for horticultural and vegetable crops and give very high water use efficiency ranging from 80% to 95% (Howell TA, 2003). It also has the potential to optimize and reduce water use in irrigated systems (FAO, 1985). Rising demand for water, calls for changes in the management of irrigation and scheduling to improve crop water use efficiency thus, saving the scarcely available water for agriculture. Water use efficiency can be improved at three levels, which comprise of reduction of water footprint per unit of production at the user level, economical and efficient allocation of water at the catchment level and smart virtual water trade at the international level, (Hoekstra *et al*., 2005).

Population growth and climate change demands increase in food production and reduction in amounts of water used for agriculture. Deficit irrigation has been proposed as a strategy to maintain and increase yield while reducing the use of water in agriculture; however, it has not been widely adopted (Liuyang *et al*., 2020). The crops under deficit irrigation are subjected to a certain degree of water stress during either specific growth stages or throughout the whole growing season, without significant reduction in yields compared with the benefits gained through diverting the saved water to irrigate other crops (Kipkorir *et al*., 2001). Deficit irrigation as a water saving technology that utilizes water resources efficiently was therefore, a suitable option for investigation under this study.

2. Deficit Irrigation

Bhagyawant *et al*. (2015) studied yield response factor (Ky) for onion during summer season of 2012 and 2013 under deficit irrigation and ascertained that the seasonal Ky was 1.58, 1.48 and 1.54 during the seasons of 2012, 2013 and the mean of both 2012 and 2013 respectively. Ky indicated a linear relationship between the decrease in relative water consumption and the decrease in relative yield. The Onion yield were higher with less water stress and decreased with increase in water stress, showing the response of yield with respect to the decrease in water consumption. Thus, explaining the decrease in yield due to per unit decrease in water consumption.

Rop *et al.* (2019) studied about deficit irrigation. Water is the most important component of the photosynthesis process and its scarcity directly limits growth of plants hence, agricultural production. In a water limiting scenario, water productivity is maximized whereas incomes are optimized. Water productivity and onion yields therefore, need to be assessed through integrated practice of drip irrigation, deficit irrigation and use of mulches to determine the level of production at which income is optimized. Deficit irrigation involves exposing plants to certain levels of water stress during either a particular growth period or throughout the whole growth season. The optimum level of production can only be obtained by conducting an economic analysis of cost - benefit ratio of input and output.

Stewart *et al*. (1977) indicated that crop yield obtained under various deficit irrigation levels when fitted to the linear crop yield response functions, showed that cotton, maize, wheat, sunflower, sugar beet and potato were well suited to DI practices imposed throughout the growing season. The crops also included common bean, sugar cane, groundnut and soybean where reduced evapotranspiration was limited to certain growth stages. With DI of 25 percent, WUE was found to be 1.2 times of that which was achieved under normal irrigation practices. Irrigation scheduling based on DI, demands careful evaluation to ensure that the

increasingly scarce supplies of irrigation water resource is efficiently utilized.

Abdul *et al.* (2019) carried out a study to evaluate the influence of sowing methods and mulch on water productivity of wheat under deficit irrigation and they found that application of maize stover as surface mulch improved wheat yield. Similarly, irrigation under both full irrigation and 20% deficit irrigation resulted in increased wheat yield, yield components and water productivity with non significant difference.

Ramalan *et al.* (2010). Conducted a study during the 2008/2009 dry season to evaluate the effect of deficit irrigation and different mulch covers on water use and yield of drip irrigated onion (Bombay Red cultivar). The set up comprised deficit irrigation at four levels (0, 25, 50 and 75% of Total Available Water) and four different types of mulch covers (bare soil or no mulch, clear plastic, black plastic and straw mulch) combined in a randomized complete block in three replications. The results indicated that onion bulb yield reduced with rise in levels of water stress. In contrast, both irrigation water use efficiencies and crop water use increased as water deficit level increased. It was concluded that mulching significantly increased bulb yield while reducing water use thereby increasing water productivity.

Ali *et al. (*2007) studied field experiment was conducted for 3 consecutive years to study the effects of water deficit on yield, water productivity and net return of wheat. Yield attributes were affected by deficit irrigation treatments although they are not statistically different in all cases. The grain and straw yields were significantly affected by treatments. The highest grain yield was obtained with the no - deficit treatment. Differences in grain and straw yield among the partial - (single - or two - stage deficit) and no - deficit treatments are small and statistically insignificant in most cases. The highest water productivity and productivity of irrigation water were obtained in the alternate deficit treatment (T7), where deficits were imposed at maximum tillering (jointing to shooting) and flowering to soft dough stages of growth period, followed by single irrigation at crown root initiation stage. Under both land - and water - limiting conditions, the alternate deficit strategy (T7) showed maximum net financial return. The results will be helpful in policy planning regarding irrigation management for maximizing net financial returns from limited land and water resources.

B Encgalave 2016 Deficit irrigation (DI) improves water productivity and irrigation management practices resulting in water saving by maintaining soil moisture content below optimum level throughout growth season. Field study was carried out on clay loam soil at Melkassa Agricultural Research Centre, Ethiopia with the objectives to estimate water productivity of onion and evaluate the effect of water deficit on onion yield and quality using drip irrigation. The experiment contained five DI treatments of 90%, 80%, 70%, 60%, and 50% Crop water use (ETc) and the control (100% ETc) laid out in RCBD design with three replications. Irrigation water was applied at allowable soil moisture depletion (p=0.25) of the total available soil moisture throughout the crops growth stage. Statistical analysis revealed that plant height was not affected by the level of DI while, leaf number, bulb diameter, marketable bulb yield and total bulb yield had shown a highly significant.

This study will be useful for deciding the optimum level of onion productivity and water productivity for use of fertigation to use of onion crop production. With respect to saving water in the event of scarcity whereas land is unlimited.

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