Austin Journal of Irrigation

Open Access

Austin Publishing Group

Research Article

Response of Potato to Water Stress in Southern Serbia

Pejić B[1]*, Aksić M[2], Mačkić K[1] and Šekularac G[3]
[1]Department of Field and Vegetable Crops, Faculty of Agriculture, University of Novi Sad, Serbia
[2]Faculty of Agriculture, Lešak, University of Kosovska Mitrovica, Serbia
[3]Faculty of Agriculture, Čačak, University of Kragujevac, Serbia

***Corresponding author:** Pejić B, Department of Field and Vegetable Crops, Faculty of Agriculture, University of Novi Sad, Dositej Obradovic Square 8, Serbia

Received: July 28, 2015; **Accepted:** October 06, 2015; **Published:** October 23, 2015

Abstract

An investigation was carried out on alluvium soil type in the river valley of Southern Morava, Southern Serbia during the seasons of 2008 and 2009, aiming to determine the response of potato to soil water deficit, using yield response factor. The values of yield response factor were derived from the linear relationship between relative seasonal evapotranspiration deficits and relative yield loss. Values of seasonal crop response factor of 1.14 indicate that potato is moderately sensitive to soil water stress in the climatic conditions of the Southern Serbia. Seasonal evapotranspiration was 495.0 mm and 291.2 mm in irrigated and rain-fed conditions respectively. A linear relationship was found between seasonal evapotranspiration and tuber yield. Potato yield in the variant with irrigation was 48.31 t ha^{-1} or 88.3% higher than in the variant without irrigation.

Keywords: Irrigation; Potato; Yield Response Factor

Introduction

Production of potato (Solanum tuberosum L.) takes a very important place in world agriculture, with a production potential of about 368 million t harvested and 19.3 million ha planted area with an average yield of 19.1 t ha^{-1} [1]. Potato production ranks fourth in the world after rice, wheat and maize [2]. In Serbia potato is grown at about 77,000 ha with an average yield of 10.2 t ha^{-1}, and total production of 786,000 tones. In southern Serbia potato crop land is 55,000 ha with an average yield of 9.2 t ha^{-1}, and total production of 55,000 tones [3]. The yield of potato in Serbia is fourth times lower than this achieved in the leading potato growing countries (Germany 45 t ha^{-1}, France 45 t ha^{-1}, Belgium 44 t ha^{-1} [1]). The low yields are the consequence of inadequate management practices, insufficient amount and unfavorable arrangement of precipitation in the growing season and inappropriate irrigation scheduling applied. In Serbia potato is cultivated under both irrigated and non-irrigated conditions. Portable sprinkler irrigation systems are commonly used. Due to the unpredicted amount and distribution of precipitation in the growing season, irrigation in Serbia is mainly supplemental. It is used primarily to supplement infrequent or irregular precipitation during drought periods [4].

Profitable management of irrigated potato requires skill and the best known management practices [5-9]. If shortage of readily available water in the soil, in the growing season, is eliminated by irrigation it is possible to achieve high and stable yields of potatoes, at the level of 40-50 t ha^{-1} or higher [9-11].

Several authors and research groups reported results of experiments aimed at determining optimum soil moisture under different environmental and technical conditions. Bošnjak and Pejić, Milić et al., Pejić et al. [8, 9, 12], found that the lower limit of optimum soil moisture for potatoes is 70% of field water capacity when this crop is grown in a soil with medium texture. Wright and Stark, King and Stark, Costa et al. [13-15] indicated that maximum yield of high quality potato tubers could only be achieved if the soil's available water in the maximum active root zone would not drop below the 50% limit.

A preliminary step to a more intensive exploitation of the available agro-ecological conditions or to the development of irrigation schedules for any crop implies a study of crop requirements for water, that is, the evapotranspiration (ET) for any particular crop. To fully utilize the genetic yield potentials of potato and achieve high and stable yields, it is necessary to gain knowledge of the crop's capabilities under conditions of dry farming and irrigation. Many factors can affect the amount of ET occurring in any particular crop. These include plant, soil, cultural and environmental factors [16]. The applied irrigation system can also affect the ET of a crop under specific conditions [10, 17]. Under no limiting irrigated conditions, daily ET rates for individual vegetable crops are directly related to the meteorological processes affecting evaporative demand and to the existing stage of growth development or percent crop coverage [18]. Any estimation of ET requirements for growing crops must be accompanied by a description of the associated conditions. The duration of the total growing season and the time of the year during which crops are grown have an enormous influence on the seasonal crop water need. According to FAO [19] to get high yield of potato, with the total growing season of 120-150 days, 500-700 mm of water used on evapotranspiration is needed. Kiziloglu et al. [7] recorded seasonal evapotranspiration of potato 445.2 mm for the yield of 26.43 t ha^{-1} in semiarid climatic conditions of eastern Turkey. A seasonal ET of 470 mm for potato, irrigated with portable sprinklers, in the Vojvodina region, the northern part of Serbia was reported by [9].

Drought tolerance is defined as the ability of plants to live, grows, and yields satisfactorily with limited soil water supply or under periodic water deficiencies [20]. The actual evaluation of stress related to the yield due to soil water deficit during the potato growing season can be obtained by the estimation of the yield response factor (K_y) that represents the relationship between a relative yield decrease (1–Ya/Ym) and a relative evaporation deficit (1–ETa/ETm) [21]. For $K_y \leq 1$ the plant is tolerant, for $K_y \geq 1$, the plant is sensitive to water stress. Doorenbos and Kassam [22] estimate that the average value of K_y is 0.7 during the potato growing season. Vaux and Pruitt [23]

Citation: Pejić B, Aksić M, Mačkić K and Šekularac G. Response of Potato to Water Stress in Southern Serbia. Austin J Irrigat. 2015; 1(1): 1001.