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Effect of Nitrogen and Ethephon on Growth Parameters, Carbohydrate Contents and Bioethanol Production from Sweet Sorghum

A. Almodares · M. Usofzadeh · M. Daneshvar

Abstract Sorghum is a multiple purpose cereal that can be used for different products such as food, feed, fiber and fuel. In this study, the effects of nitrogen fertilizer and ethephon concentration on growth parameters, carbohydrate content and ethanol production on sweet sorghum were determined. Four nitrogen fertilizer (0, 100, 200, 300 kg urea ha$^{-1}$) and four ethephon concentration (0, 800, 1000, 1200 ppm) assigned as main plots and sub main plots, respectively with three replications. Results showed that plant height and plant diameter increased up to 100 kg urea ha$^{-1}$. Plants were thicker with ethephon application. Highest dry biological yield and dry stalk yield were obtained with 300 kg ha$^{-1}$ urea and 1,200 ppm ethephon. Juice volume was increased by application of urea up to 100 kg ha$^{-1}$. More urea application did increase juice volume. Juice volume was highest with the application of 1,200 ppm ethephon. Brix, total carbohydrate content and sucrose were highest with the application of 300 kg ha$^{-1}$ urea and 1,200 ppm ethephon. On contrary invert sugars were lowest at 300 kg ha$^{-1}$ urea and 1,200 ppm ethephon. Ethanol yield was highest at 300 kg ha$^{-1}$ urea and 1,200 ppm ethephon. There is a significant correlation between ethanol yield and stalk yield, juice volume, brix, total sugar and sucrose content. Based on the results, the highest ethanol yield was obtained with the application of 300 kg urea ha$^{-1}$ and 1,200 ppm ethephon.

Keywords Sweet sorghum · Ethephon · Nitrogen · Total sugar · Bioethanol · Brix

Introduction

The recent increase of global fossil fuel prices and decreasing supplies because of rising demand and increased concerns over environmental pollution associated with fossil, attempt is made to use alternative renewable fuel sources particularly in transportation. Ethanol is the biofuel currently produced mainly from maize and sugarcane. Both maize and sugarcane is consumed by human and animals. In Iran, sweet sorghum is neither used as food or feed. In addition, sweet sorghum [Sorghum bicolor L. (Moench)] having rapid growth characteristics, high biomass production and wider adaptability and is known to have great potential in ethanol production (Reddy et al. 2005). Sorghum is a C4 crop and high photosynthetic efficiency (Dolciotti et al. 1998), that can be used for sugar, ethanol, juice, feed, fuel and paper pulp production (Almodares et al. 2008; Rajvanshi 2005). To make sweet sorghum a sustainable and profitable crop, there is a need for standardization of agronomic practices.

The biomass and sugar content of sweet sorghum are important factors for industrial ethanol production. Accurate application of fertilizers and plant growth regulators can stimulate these parameters. Nitrogen is one of the major nutrients that support crop growth and is the most responsive nutrient required by sorghum (Reddy et al. 2008). Application of nitrogen fertilizer increase sweet sorghum stalk yield (Johnston 2000). Ethephon is an ethylene-generating compound that has a profound effect on plant growth and developmental processes. The response of ethephon is depends on the species, cultivar, rate and time.