EFFECT OF NITROGEN FERTILIZATION AND PLANT DENSITY ON PRODUCTIVITY AND QUALITY OF SWEET SORGHUM

By

Montasser Abd El Rauof Gomaa
B.Sc. Agric.Sci. (Agronomy), Fac. Agric., EL-Azhar Univ., Assiut 2002

THESIS

Submitted in partial fulfillment of the Requirements for the Degree of

MASTER OF SCIENCE

In

Agricultural Sciences
(Agronomy)

Department of Agronomy
Faculty of Agriculture
Cairo University
EGYPT

2013

APPROVAL SHEET

EFFECT OF NITROGEN FERTILIZATION AND PLANT DENSITY ON PRODUCTIVITY AND QUALITY OF SWEET SORGHUM

M.Sc. Thesis
In
Agric. Sci. (Agronomy)

By

Montasser Abd El Rauof Gomaa
B.Sc. Agric.Sci. (Agronomy), Fac. Agric., EL-Azhar Univ., Assiut 2002

APPROVAL COMMTTEE

Dr. IBRAHIM HANAFY El-GEDDAWY.....
Head of Research of Sugar Crops Res. Inst., A.R.C, Giza

Dr. MAHMOUD ABDEL RAHIIM HASSANEIN .....
Professor of Agronomy, Fac. Agric., Cairo University

Dr. BADAWY SAYED HASSANEIN RAMADAN .....
Professor of Agronomy, Fac. Agric., Cairo University

Dr. EL-SAYED ABDEL-AZIZ MAHMOUD .....
Professor of Agronomy, Fac. Agric., Cairo University.

Date: / / 2013

SUPERVISIO SHEET

EFFECT OF NITROGEN FERTILIZATION AND PLANT DENSITY ON PRODUCTIVITY AND QUALITY OF SWEET SORGHUM

M.Sc. Thesis
In
Agricultural Sci. (Agronomy)

By

Montasser Abd El Rauof Gomaa
B.Sc. Agric.Sci. (Agronomy), Fac. Agric., EL-Azhar Univ., Assiut 2002

SUPERVISION COMMTTEE

Dr. EL-Sayed Abdel-Aziz Mahmoud
Professor of Agronomy, Fac. Agric., Cairo University

Dr. Dr. Badawy Sayed Hassanein Ramadan
Professor of Agronomy, Fac. Agric., Cairo University.

Dr. Mohamed Abu-Bakr Bekheet
Head of Research of Sugar Crops Res. Inst., A.R.C, Giza

Name of Candidate: Montasser Abd El Rauof Gomaa **Degree**: M.Sc.

Title of Thesis: Effect of Nitrogen Fertilization and Plant Density on Productivity and Quality of Sweet sorghum

Supervisors: Dr. EL-Sayed Abdel-Aziz Mahmoud
Dr. Badawy Sayed Hassanein Ramadan
Dr. Mohamed Abu-Bakr Bekheet

Department: Agronomy **Branch:**

Approval: / /

ABSTRACT

Yield response of sweet sorghum (*Sorghum bicolor, L.*) to nitrogen rates (60, 80, 100 and 120 kg/fed.*) and plant density (40, 46.7, 54 and 70 thousand plants/fed) was studied during 2008 and 2009 seasons at Sohag Governorate, Egypt. Results revealed that increasing N rate up to 120 kg/fed significantly increased growth traits in terms of Leaf area/plant, LAI, number of leaves/plant, number of internodes, stalk diameter and stalk length, throughout the growing season as well as quality traits (Brix, reducing sugars and juice extraction %), while sucrose and purity% responded to 100 kg N thereafter they decreased with further addition of N. Stalk yield increased by 14.12 and 15.52%, syrup yield per ton of stalks by 18.55 and 15.83%, syrup yield per fed by 35.46 and 33.91% and sugar yield by 26.29 and 33.59% and forage yield by 16.82 and 5.48 as N rate increased up to 120 kg/fed in both seasons, respectively .

Increasing plant density from 40000 up to 70000 plants/fed depressed sweet sorghum growth as well as juice quality traits, while stalk length increased with dense sowing. 70000 plants/fed gave the highest yields of stalks, syrup and sugar yield per fed. The highest stalk yield resulted from 120 kg N + 70000 plant/fed, while the highest syrup and sugar yield resulted from 100 kg N + 46.7 thousands plants/fed., the highest forage yield resulted from 40000 plant fertilized with 120 kg N/fed.

*fed = 4200 m^2

Keywords: sweet sorghum, nitrogen, plant density, juice quality, stalk yield, syrup yield.

ACKNOWLEDGEMENT

First of all, prayerful thanks to ALLAH for helping me to finish this work. I would like to express my gratitude and appreciation to ***Dr. EL-Sayed Abdel-Aziz Mahmoud*** *Professor of Agronomy, Faculty of Agriculture, Cairo University for his unlimited help, valuable supervision, suggesting the problem, kind guidance and valuable advice throughout the course of the present investigation and also many thanks for his revision of this manuscript.*

Sincere thanks are due to Dr. ***Badawy Sayed Hassanein Ramadan****, Prof. of Agronomy, Faculty of Agriculture, Cairo University, for his supervision, spring guidance, encouragement, counsel, understanding and constructive criticism which have vitally contributed to this study.*

Sincerest thanks are due to Prof. Dr. ***Mohamed Abu-Bakr Bekheet*** *Head of Research of Agronomy, Sugar Crops Research Institute ARC, Egypt for his supervision and help during conducting the trails and writing this thesis*

At last but not least, l would like to thank my father and my wife, for creating the suitable circumstances, encouragement and assistance during this study.

Montasser Abd El Rauof Gomaa

CONTENTS

INTRODUCTION

Sweet sorghum or sorgho [*Sorghum bicolor var Saccharatum,* Moench, (L.)] is adapted to tropical and subtropical regions, has high biomass production, low water requirements and has short growing season. It can be used for different products such as food, feed, fiber and fuel.

In Egypt, the crop is grown on a small scale as a summer forage crop and has a potential future for sugar production. However, Information, is few on its cultural practices as a dual- purpose crop for sugar and forage.

It is estimated that syrup manufactured from sugarcane is processed from about 5% of the total cultivated area (325 thousand fad.[*]). Therefore, the economic importance of introducing sweet sorghum cultivation could be realized from saving about 80 000 tons of sugar, moreover, producing black honey (treacle) and/or Golden syrup from sweet sorghum will save about 16 thousand of sugar cane which tended toward sugar productions.

On the other hand, very few preliminary studies revealed the suitability of growing sweet sorghum in Egypt as a source of syrup which is considered a popular used as a food in bakeries and factories.

Nitrogen is a mineral element essential for sweet sorghum growth, which, by far, has the greatest influence on juice quality and syrup production, also plant density is an important agronomic factor affecting yield and juice quality of sweet sorghum.

---

[*] **Sugar Crops and sugar production in Egypt. Sugar Crops Conucil. Jan. 2013**

This investigation was carried out to determine the optimum rate of nitrogen and optimum plant density and their interaction that could maximize yield and juice quality traits, of sweet sorghum.

REVIEW OF LITERATURE

In order to present the major points concerning the response of sweet sorghum plants to the investigated cultural practices (nitrogen and plant density) the available review of literature will be classified in two topics.

1.Effect of nitrogen fertilization

2. Effect of plant density

1-Effect of nitrogen fertilization

Bradford and Soileau (1985) studied the effect of two levels of dolomitic limestone/ha (0 and 8 tons/ha) beside NPK combinations on yield of sweet sorghum. The N rates were 0, 54, 90 or 180 kg N/ha, phosphorus rates were 30 or 90 kg P/ha. and K rates were 40 or 120 kg K/ha. They found that lime significantly increased yields of fresh and dry biomass and juice sugar extracted from stalks. In non limed soil, biomass and sugar yields decreased with high N in the presence of low PK, but not with high P or K. In limed soil the highest dry biomass and sugar yields occurred with 90 or 180 Kg N + 90 Kg P + 120 Kg K/ha.

More and Birajdar (1986) studied the effect of 50, 100 and 150 Kg N/ha. on sweet sorghum as urea. They found, plant dry weight increased with increasing N rate at all growth stages. Average grain and fodder yields increased in the range of 2.66 to 8.45 ton/ha with increasing N rate.

Souza *et al*. (1987) in Brazil, studied the effect of N or P alone or in combination on the yield of sweet sorghum. They found, low yields were obtained in the absence of N or P Application of 75 and