STUDY THE PERFORMANCE OF PULSE DRIP IRRIGATION IN ORGANIC AGRICULTURE FOR POTATO CROP IN SANDY SOILS

By

ABDELRAOUF RAMADAN EID ABDELGHANY

B.Sc. Agric. Sci. (Agricultural Mechanization), Fac. Agric., Tanta Univ., 1997
M.Sc. Agric. Sci. (Agricultural Engineering), Fac. Agric., Cairo Univ., 2003

THESIS

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In

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Faculty of Agriculture
Cairo University
EGYPT

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APPROVAL SHEET

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DEDICATION

I dedicate this work to whom my heart felt thanks; to my wife and my son Mohamed for their patience and help, as well as to my parents and brothers for all the support they lovely offered along the period of my post graduation.

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The author wishes to thank ***God*** *a lot "Allah"*

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Name of Candidate: Abdelraouf Ramadan Eid Abdelghany **Degree:** Ph.D.
Title of Thesis: Study the Performance of Pulse Drip Irrigation in Organic Agriculture for Potato Crop in Sandy Soils
Supervisors: Dr. Gomaa Abdrabo Abd El-Rahman
Dr. Fathy Gad El-Ebabi
Dr. Mouhamed Talaat El-Saidi
Department: Agricultural Engineering **Approval:** / /

ABSTRACT

This study was conducted to Study the performance of pulse drip irrigation in organic agriculture for potato crop in sandy soils for saving water, saving fertilizers, increasing yield of potato, increasing the energy use efficiency, improving potato quality, decreasing the costs and increasing income under Egyptian growing conditions. factors (two drip irrigation systems, three water application rates and three types for pulse irrigation) For such purpose, the field was carried out during two summer growing seasons 2006 and 2007, in Abo-Ghaleb farm, Cairo- Alex. Rood, 60 Km away from Cairo and the soil is sandy**.**

This experiment was carried out to study the effect of two irrigation systems (surface and subsurface drip irrigation and three water application rates (50, 75 and 100% from actual irrigation requirements) and three types for pulse irrigation (2 times per day, 3 times per day and 4 times per day and time-off between pulses was 30 minutes) with continuous drip irrigation (one time per day)**.**

The following parameters were studied to evaluate the performance of pulse drip irrigation :(1) Soil moisture distribution, (2) Application efficiency "AE", (3) Clogging ratio of emitters"CRE" (4)Emission uniformity"EU" (5) Yield of potato "YP", (6) Water use efficiency of potato "WUE_{potato}"(7) Energy use efficiency "EUE" (8) Fertilizer use efficiency (9) Quality characters of potato tuber (10) Net income "NI". The most important results could be summarized as follow: **(1)** Moisture content in the root zone and Wetted soil volume (more than or equal 100% of field capacity) in root zone increased by increasing number of irrigation pulses (2) AE increased from 89% under continuous drip irrigation to maximum value where it become 94% after applying pulse technique with 4pulses at 100 % from actual water requirements under surface drip irrigation, recording an increase of 5.3%.(3) CRE decreased from 9.79% under continuous drip irrigation to minimum value, where it become 5.38% after applying pulse technique on 4 pulses at 50 % from actual water requirements under surface drip irrigation, recording a decrease 45%. (4) EU increased from 85.02% under continuous drip irrigation to maximum value, where it become 90.48 % after applying pulse technique on 4 pulses at 50 % from actual water requirements under surface drip irrigation, recording an increase 6.4 %.(5) Yield of potato increased from 4.70 (ton/fed.) under continuous drip irrigation to maximum value, where it become 6.57 (ton/fed.) after applying pulse technique with 4 pulses at 100 % from actual water requirements under subsurface drip irrigation, recording an increase 40% (6)To get maximum yield, best quality characters of potato tuber and net income, we must apply pulse technique on 4 pulses at 100 % from actual water requirements under subsurface drip irrigation.(7) In the case of water and energy limitation, we have to apply pulse technique on 4 pulses at 75 % from actual water requirements under subsurface drip irrigation.

Key words: Pulse microirrigation, Soil moisture distribution, Deficit irrigation, Water use efficiency, Clogging emitters

استمارة معلومات الرسائل التى تمت مناقشتها

الكلية / المعهد : **الزراعة** **القسم :** الهندسة الزراعية

١ - **الدرجة العلمية :** ماجستير [ ] دكتوراه [✓]

٢ - بيانات الرسالة :

عنوان الرسالة باللغة العربية : دراسة أداء الري بالتنقيط النبضي تحت الزراعة العضوية لمحصول البطاطس في الأراضي الرملية

عنوان الرسالة باللغة الأجنبية : Study the Performance of Pulse Drip Irrigation in Organic Agriculture for Potato Crop in Sandy Soils

التخصص الدقيق : هندسة الأراضي والمياه

تاريخ المناقشة : ١٦ – ٩ – ٢٠٠٩

٣ - بيانات الطالب :

الاسم : عبدالرؤف رمضان عيد عبدالغني الجنسية : مصري النوع : ذكر

العنوان : ٣٤ شارع الشهيد أحمد سرحان خلف قاعة سيد درويش – عمرانية غربية – جيزة

رقم التليفون : ٣٥٤٦٩١٢٩

جهة العمل : المركز القومي للبحوث – الدقي –الجيزة

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٤ - المشرفون على الرسالة :

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٢.	د/ فتحي جاد الأبابي	الهندسة الزراعية	كلية الزراعة	القاهره
٣.	أ. د/ محمد طلعت الصعيدي	العلاقات المائية	الشعبة الزراعية	المركز القومي للبحوث

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٥ ـ ٢ باللغة الأجنبية : بشرط ألا يزيد عن ٧ أسطر

This study was conducted to Study the performance of pulse drip irrigation in organic agriculture for potato crop in sandy soils for saving water, saving fertilizers, increasing yield of potato, increasing the energy use efficiency, improving potato quality, decreasing the costs and increasing income under Egyptian growing conditions. This experiment was carried out to study the effect of two irrigation systems (surface and subsurface drip irrigation and three water application rates (50, 75 and 100% from actual irrigation requirements) and three types for pulse irrigation (2 times per day, 3 times per day and 4 times per day and time-off between pulses was 30 minutes) with continuous drip irrigation (one time per day)**.**The most important results could be summarized as follow: To get maximum yield, best quality characters of potato tuber and net income, we must apply pulse technique on 4 pulses at 100 % from actual water requirements under subsurface drip irrigation. In the case of water and energy limitation, we have to apply pulse technique on 4 pulses at 75 % from actual water requirements under subsurface drip irrigation.

Key words: Pulse microirrigation, Soil moisture distribution, Deficit irrigation, Water use efficiency, Clogging emitters

٦ - **<u>أهم النتائج التطبيقية التى تم التوصل إليها</u> :**

(لا تزيد عن سطرين لكل منها)

للحصول علي أعلي إنتاجية وأنسب صفات جودة لدرنات البطاطس وتحقيق أعلي صافي للدخل يجب تطبيق العوامل التالية: الري علي ٤ نبضات عند إضافة ١٠٠% من الإحتياجات المائية الفعلية تحت نظام الري بالتنقيط التحت سطحي٠

في حالة محدودية المياه أو الطاقة أو كلاهما يجب تطبيق العوامل التالية: الري علي ٤ نبضات عند إضافة ٧٥ % من الإحتياجات المائية الفعلية تحت نظام الري بالتنقيط التحت سطحي ٠

٧ – ما هى الجهات التى يمكن أن تستفيد من هذا البحث :

(اذكر هذه الجهات مع شرح أهمية البحث لهذه الجهة بما لا يزيد عن أربعة سطور لكل جهة)

٧ – ١ طالبي الدراسات العليا في كلية الزراعة – جامعة الفاهره والكليات المناظرة والمتخصصين في مجال هندسة الأراضي والمياه.

٧ – ٢ الجهات القائمة بالأبحاث في مجال الري.

٧ – ٣ الشركات الخاصة العاملة في شبكات الري لأنظمة الري الضغطي.

٧ – ٤ وزارة الزراعة والتي يمكن من خلالها تطبيق نتائج البحث بين المزارعين.

٨ – هل توجد علاقة قائمة بإحدى هذا الجهات : **نعم** [✓] **لا** [ ]

فى حالة نعم اذكر هذه الجهات :

٨ – ١ الجهات القائمة بالأبحاث في مجال الري والمتخصصين في مجال هندسة الأراضي والمياه.

٨ – ٢

٨ – ٣

ما هى طبيعة العلاقة :

مشروع بحثى [✓]

تعاون أكاديمى [ ]

مشروع ممول من جهة ثالثة [ ] (اذكر ما هى :)

أخرى [ ] (تذكر)

٩ - <u>هل توافق على التعاون مع جهات مستفيدة من خلال الجامعة :</u>

لا ☐ **(لماذا)**

نعم ☑

(I) لتطبيق البحث : ☑

(II) لاستكمال البحث : ☐

(ج) أخرى ☐ **(تذكر)**

١٠ - <u>هل تم نشر بحوث مستخرجة من الرسالة فى مجلات أو مؤتمرات علمية</u>

(تذكر مع جهة النشر و المكان و التاريخ)

١٠ – ١ المجلة المصرية للهندسة الزراعية – Vol. 26 No. (2) (ابريل – ٢٠٠٩)

١٠ - ٢

١٠ - ٣

١١ - <u>هل سبق التقدم لتسجيل براءات اختراع</u> (تذكر مع الجهة و المكان و التاريخ)

لا

١٢ - <u>هل توافق على إعطاء البيانات المذكورة فى هذه الاستمارة لجهات أخرى</u>

نعم ☑ لا ☐

توقيع الطالب :

توقيع المشرفين :

- أ. د/ جمعه عبدربه عبدالرحمن
- د/ فتحي جاد الأبابي
- أ. د/ محمد طلعت الصعيدي
-

وكيل الكلية (المعهد) للدراسات العليا و البحوث : التاريخ

CONTENTS

INTRODUTION

Pulse irrigation is applied all over the world because it has positive effects on increasing yield, improving quality, saving water, reducing clogging emitters and reducing consumption energy…etc.

Drip irrigation, nowadays, is the most efficient plant watering system. In order to get a better and more efficient use of water, we combined between drip irrigation and pulse technique. Pulsing irrigation refer to the practice of irrigating for a short period then waiting for another short period, and repeating this on-off cycle until the entire irrigation water is applied (Eric et al., 2004).

Pulse drip irrigation was used with organic agriculture to get a major utilization from organic agriculture. Organic farming covers agriculture systems that implement the environmentally, socially and economically sound production of food and fibers. The production of organic agriculture products without inputs of chemical pesticides and fertilizers has become a profitable area of farming as consumers become more concerned about possible effects of chemicals.

Potatoes are largest horticultural export in Egypt. Organic production of potatoes is growing in Egypt now to take place in the European market and to have the consumer who is willing to pay high price for a healthy safe product. In most recent years the Euros united has accounted for about 70% - 90% of Egyptian potato exports. In 2004 the total value of potato exports to the Euros united was about 65 million Euros, about 43.5% of Egypt's agricultural exports to the Euros united (Brian, 2001).