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Abstracts

8th ICID Micro-Irrigation Congress

October 15-23, 2011
Tehran-Iran

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Tehran-Iran

THE 21ST ICID CONGRESS ON IRRIGATION AND DRAINAGE & 62ND ICID INTERNATIONAL EXECUTIVE COUNCIL MEETING

Abstract of

The 8th International Congress on Micro-Irrigation

Innovation in Technology and Management of micro-Irrigation for Enhanced CROP and Water Productivity

15 – 23 October 2011
Tehran, Iran

Organizers:

ICID IRNCID

Iranian National Committee on Irrigation and Drainage (IRNCID)
International Commission on Irrigation and Drainage (ICID)

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THE 21ST ICID CONGRESS ON IRRIGATION AND DRAINAGE & 62ND IEC MEETING

Abstracts of Papers

The 8th International Congress on Micro-Irrigation

Innovation in Technology and Management of micro-Irrigation for Enhanced Crop and Water Productivity

IRNCID, Tehran, Iran

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Contents	Page

Preface

On behalf of the Organizing Committee, Iranian National Committee on Irrigation and Drainage (IRNCID) and International Commission on Irrigation and Drainage (ICID), I have the great pleasure in welcoming all members of ICID and participants to the 21st ICID Congress on Irrigation and Drainage, 8th International Micro – Irrigation Congress, & 62nd IEC Meeting.

To reach the main target of irrigated agriculture which is food security, different measures such as increased soil and water productivity, maximum usage of water per unit, optimum water utilization, and best usage of soil per unit area could be applied as guaranteeing solutions toward food security. To this end, the main topic of the 21st ICID Congress was selected as: "Water Productivity towards Food Security", and also the main topic of 8th Micro Irrigation Congress was selected as: Innovation in Technology and Management of Micro-irrigation for Crop Production Enhancement which shall provide an opportunity not only for gathering, exchanging, and applying experiences from all over the globe but also for the top challenge of future agriculture and water sector of the world.

The 2011 ICID Congresses are good opportunities for experts, professionals, and decision-makers of different countries to get together in Tehran, acquaint with the rich Iranian culture, visit historical beauties of this ancient country, and exchange knowledge and experience for an enhanced irrigation and drainage at the global level as well.

I wish to take this opportunity to sincerely thank the organizing committee members of IRNCID for their utmost efforts in making this event a unique memorable one in its kind my thanks also goes to all of the partners, individuals and contributors who have been quite supportive towards holding this congress.

M.R. Attarzadeh
Deputy Minister of Energy for Water and Wastewater Affairs, and
Chairman of IRNCID

Introduction

Global demand for food is likely to double in the next 25 to 30 years mainly due to population growth and change of diet. Many countries are endeavoring to achieve food security at a national level. A major portion of this new food demand would be fulfilled from irrigated agriculture. However, further expansion of irrigated lands is ironically limited by freshwater availability particularly in arid and semi-arid regions. Micro-irrigation has shown a promise to tackle such a complex and multivariable situation, by allowing higher water use efficiency, minimizing non-beneficial losses of water, reduced energy requirements for operation, and improved agro-technical practices.

Water quality is another impeding factor which has to be taken into account for further development of irrigated agriculture. Micro irrigation has demonstrated a better compatibility to use poor/ low quality waters by way of flexibility and better performance compared to other irrigation methods. However there are several bottlenecks associated with further expansion micro-irrigation which need to be reviewed and dealt with. Concerns such as adaptability to varied soil and water quality, lowering of maintenance costs, increasing of life duration of field distribution systems, innovation in technology to reduce capital costs, and developing crop specific management practices, etc.

Micro-irrigation 2011 is the 8th in the series of micro irrigation congresses. The first congress was held in 1971. This was followed by San Diego California (1974), Fresno California (1985), Aubury-Wodonga Australia (1988), Orlando Florida (1995), Cape Town South Africa (2000) and Kuala Lumpur Malaysia (2006). Micro-irrigation 2011 will be held in Tehran Iran from15th to 23th October 2011.

Objectives

- To share experiences in the use of new technologies and best management practices in drip, micro-sprinkler, and other localized irrigation systems.
- To review the status of use of micro irrigation for smallholders;
- To understand socio-economic and technological factors impeding expansion of drip and micro-sprinkler irrigation area.

Papers on Micro-irrigation are focused for the following sub-themes:

- Best management practices/ success stories of micro irrigation adoption;
- Lessons learnt from failures in up scaling micro irrigation

- Developments in Subsurface micro-irrigation;
- Low cost and low energy consuming irrigation systems;
- Automation in micro irrigation;
- Micro irrigation in greenhouses;
- Micro-irrigation for small scale farms;
- Use of low quality waters in micro-irrigation;
- Modeling, design and decision support system in micro-irrigation;
- Advances in operation and cost effective maintenance of micro-irrigation systems;
- Management and cost of micro-irrigation for large farms;
- Efficiency and productivity in micro irrigation systems
- Socio-economic consequences of the conversion of traditional systems to micro irrigation systems
- Analysis of long term sustainability of micro irrigation systems
- Technical performance and quality assessment of micro-irrigation systems.
- LCA (Life Cycle Analysis) applied to micro irrigation

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CONTENTS

Theme 1

Theme 2

Theme 3

October, 2011
Tehran-Iran

Theme 1

- Best management practices/ success stories of micro irrigation adoption;
- Lessons learnt from failures in up scaling micro irrigation
- Low cost and low energy consuming irrigation systems;

MICRO IRRIGATION IN NEPAL: AN EFFECTIVE TOOL TO FIGHT AGAINST POVERTY

Kishor Kumar Bhattarai[1]

ABSTRACT

Nepal is a small mountainous country between India and China. Per capita income is less than 460 US$ with above 80% of its population engaged in agriculture. Main agriculture products are rice, wheat, pulses, tea and sugar cane. Agriculture productivity is well below world standard.

Non Conventional Irrigation Technology Project (NITP), which develops other than conventional irrigation technology/ies and techniques, has the responsibility of promoting and developing micro irrigation in Nepal. It was established on 2004 A.D with objective to develop irrigation facility to irrigate the areas designated as non irrigable due to various reasons ranging from high development cost to non availability of sufficient quantity of water for conventional irrigation schemes. Rescuing poor from vicious cycle of poverty and uplifting women, disadvantaged and marginalized groups of people economically are the ultimate goal of this project.

Simple drip and micro sprinkler are two major application technologies being promoted by NITP as a part of micro irrigation development. Rain water harvesting, low cost water storage tanks, treadle pumps etc are other components being promoted and developed by NITP. Apart from constructing projects NITP is promoting micro irrigation through trainings, seminars, farmer tours and information dissemination through radio, T.V., pamphlets etc.

There are different types of problem associated with micro irrigation development. Drip and Sprinkler are new technologies for Nepalese farmers. Convincing farmers about effectiveness of drip and sprinkler system and changing cropping pattern which is being practiced since centuries are two among them. Farmers who are accustomed with flooding methods of irrigation have doubts about these systems meeting crop water requirement. Second major problem is farmers "fondness" for rice cultivation which has achieved

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status of culture or religion. However continuous training and motivation has changed farmer's attitude and convinced them to adopt these non conventional technologies and switch over to high value crop farming.

Another major problem associated with micro irrigation system is its capacity. As these systems are designed for very small area big farmers who are leaders in vegetable farming are not attracted towards it leaving field to small poor farmers. Lack of budget, undue influence in prioritizing and selecting project, number of projects compared to available budget are other major problems faced by micro irrigation development initiative in Nepal.

Topography of the country, poverty level, land fragmentation etc makes it imperative to promote micro irrigation in Nepal. Nearly 800 thousand hectares of agriculture land has no other option for irrigation. With governments effort through NITP and help of I/NGOs micro irrigation is expanding and gaining ground.

Apart from stated objectives NITP has been successful in encompassing some of the pertinent sensitive issues as well. Economic independence, leadership quality, self-identity and confidence, which are key ingredients in achieving women's empowerment, are major self-satisfactory moral boosting achievements. Similarly, NITP is playing very important and effective role in lessening social discrimination, exclusion and seclusion of deprived and destitute populace. These achievements in Socio-Economic sectors and for that matter in Rights are indeed remarkable.

Development induced by NITP kind of projects are in real sense "development with human face" where most deprived, marginalized and excluded sect of people are able to reap benefit and experience positive changes brought by it. Either by government or through I/NGO with governments all out support this initiative must continue. Experience gained so far has already proved effectiveness of these types of projects in fight against poverty.

ENERGY SAVING IN PRESSURIZED IRRIGATION NETWORKS (LEYLANCHAY PRESSURIZED IRRIGATION NETWORK)

Nosratollah Assadi[1], Hamed Hadidian[2]

ABSTRACT

Iran is an aired and semiarid country with great need to utilize and control all its water resources. Rapid population growth mainly in the urban areas during the past few decades in turn raised the need for cultivating extra lands, as well as, directing production patterns towards high water consuming products. Water scarcity is one of the most prominent issues of discussion worldwide concerned with sustainable development, especially in the arid and semi-arid areas. According to weather conditions and arid and semi-arid climate in the most parts of Iran, water has a major role in agricultural economy.

Soil and water resources of dry lands can be managed to sustain the productive capacity of the land and to better cope with water scarcity. Therefore, optimal use of water and applying modern irrigation techniques is inevitable.

On the other hand, in pressurized irrigation methods, water is supplied for plant in trickle and sprinkler irrigation systems. Energy supply is essential be provided by the pumping stations and in certain circumstances by the height difference between the source and location of water supply intake.

In this paper, energy usage methods for providing requirement head for Leylanchay pressurized irrigation network are studied in two cases.

1) by pumping stations
2) by Gravity Pressurized Irrigation Delivery System and using the height difference between Leylanchay reservoir dam to the beginning of pressurized irrigation network

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In the first case, water is released from dam to downstream in the river. After that, by constructing a diversion dam, water is conveys to a pump station and pump station delivers water with required pressure to main pipeline and to the beginning of farm unit in Leylanchay pressurized irrigation network.
In the second case, GRP pipe - line with 1400mm diameter and 8 kilometer length delivers water from reservoir dam to main and sub - main pipe - lines.
The main pipeline and sub - main pipelines supply water to the beginning of farm unit with suitable pressure.
An understanding of the costs of and potential returns to irrigation provide growers with better information to use in determining whether to make the large investment decision. Two cases were evaluated on 4000 ha fields in Leylanchay irrigation and drainage network. This study focused on an economic analysis of irrigation costs, both ownership and operation, using partial cost budgets of each cases. The study highlights key differences in system design, cost and input requirements to provide stockholders with the background to choose a system that gives the best returns for their operation.
A system's operating pressure affects the cost of pumping water. Higher pressure makes irrigation more expensive.
In this study, annual operation expenses i.e fixed and variable costs were estimated for each case.
This paper presents and compares total energy and water use of irrigation systems with or without pumping station with the gravity delivery system using a case study in the Leylanchay pressurized irrigation network in East Azerbaijan province in Iran. It is concluded that using the height difference between Leylanchay reservoir dam to the beginning of pressurized irrigation network consumes less energy with more water savings than using centralized pumping station. It has better irrigation scheduling, seepage and evaporation reductions, less operation and maintenance costs, energy price bargains, and less labor.

MICROIRRIGATION IN IRAN- CURRENT STATUES AND FUTURE NEEDS

Hossein DehghaniSanij[1], Mehdi Akbari[2]

ABSTRACT

In Iran, efforts were made to introduce micro irrigation system (MIS) countrywide around 1990. To promote, research effort have been made by research organization (AERI and SWRI), universities, ministry of Jahad-Agriculture, and state governments. The farmers level subsidy programme was undertaken by Ministry of Jahad-Agriculture. To tap its full potential, appropriate policies may be adopted through ensuring availability of standards materials, field-based research activities, evaluation of projects, solving the operational and maintenance problems. More attention is needed towards irrigation scheduling, system management, precise irrigation, potential advantages of MIS such as fertigation and automation, new technology such as subsurface drip irrigation. Research priorities include crop water requirement, prevention of emitter clogging, fertigation and chemigation, precise irrigation, automation, soil-water-crop-climate relationship, subsurface drip irrigation, water and energy consumption, low pressure irrigation system, sewage and saline water use and field evaluation of MIS.

Keywords: Iran, water resources, irrigation technology, micro irrigation,

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MICRO IRRIGATION TECHNOLOGIES FOR ENHANCED CROP AND WATER PRODUCTIVITY- EXPERIENCES OF ANDHRA PRADESH, INDIA

K. Yella Reddy[1], T. V. Satyanarayana[2]

ABSTRACT

The agriculture sector is the predominant consumer of water. Almost 70% of all available freshwater is used for agriculture across the world. In India, more than 80 % of the renewable water resources are used for agriculture alone. Many of the world's most important grain lands are consuming groundwater at unsustainable rates. As we have stepped into the twenty first century, the new frontier is boosting water productivity, getting more from every liter of water devoted to crop production.

Government of Andhra Pradesh has launched the Andhra Pradesh Micro Irrigation Project (APMIP) in 2003 to promote micro irrigation in large scale for sustainable development of agriculture. The major thrust was on putting the 3 million electrified pump sets in the state of Andhra Pradesh into micro irrigation. The project has so far covered more than 0.783 m ha area under micro irrigation systems in 7 years period with capital investment of Rs 24,000 million (US $ 533 million), benefiting 0.5 million farmers.

The project has helped in improving the crop productivity, saving in water and energy and creating employment opportunities. The project is contributing to an additional productivity of worth Rs 11,745 million (US $ 261 million) per annum. On annual basis, the project is helping in saving of 144 TMC of water (1 TMC = 2700 ha m), 388 million kwh of energy. On annual basis every rupee invested in

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micro irrigation pays Rs 2.4 through additional productivity. The attractive payback period of less than 2 years has influenced the bankers to provide loans to farmers to procure micro irrigation systems. The success of APMIP has lead to the extension of micro irrigation into canal commands under major lift irrigation projects in Andhra Pradesh.

A study has been conducted to develop a micro irrigation system suitable to small land holdings in sandy tracts of coastal Andhra Pradesh powered by SPV pumping unit. SPV array having 24 panels with 900W rated capacity, a monoblock centrifugal pump of 1.1 hp, laterals with inline emitters, online emitters and micro sprinklers. The hydraulic performance of 4 models of micro sprinklers was studied with the operating pressure varying from 0.51 to 0.61 kg/cm^2. The diameter of spread was found in the range of 3.7 to 5.0 m and the uniformity coefficient in the range of 40 % to 64%. At an operating pressure of 0.42 kg/cm^2 the droplet size of micro sprinkler was in the range of 0.56 to 0.78 mm. Trickle irrigation design layout is made to suit to SPV pumping system to irrigate banana crop in an area of 7200 sq m.

Key words**:** Water Scarcity, Virtual Water, Sustainable Development, Micro Irrigation, SPV Pumping System

ECONOMIC EFFECTS OF CHANGES OF SURFACE IRRIGATION TO MICRO IRRIGATION SYSTEMS IN MASHHAD PLAIN, IRAN (CASE STUDY)

Baghani[1] J, Sh. Zarea[2], khalednezhad[3]. H.R

ABSTRACT

In order to investigate the effects of changing surface irrigations to micro irrigation methods concerning water consumption, yield, water use efficiency (WUE) and its economic results, a study on 30 fields was conducted in Mashhad Plain, Iran for 2 consecutive years (2009-2010). The results of the study showed that, after changing the irrigation methods, the average amount of water used in summer's farming, and orchards decreased 27.5 percent has decreased. The mean of total yields of total products, about 36% and the average of water use efficiency 95.1% has increased. Partial budgeting and project evaluation methods were used to evaluate farms economically. Economic calculations were performed based on three main scenarios (benefit and cost calculated base on 1- increase in yield and surface cultivation, 2- increase in yield and 3- increase in yield and sales of water). The average rate of return in three scenarios, was obtained , 678, 219 and 292 percent, respectively. Although, based on the rate of return index, the products' arrangement in all scenarios has approximate similarities, but the rate of return in all scenarios, was high and economically acceptable and the changes in irrigation methods, has had a very positive impact on the livelihood and income of farmers.

Keywords: Drip irrigation, Surface irrigation. Yield, Water used, Economic evaluation, partial budgeting.

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CORN GROWTH AND YIELD AS AFFECTED BY DRIP IRRIGATION UNIFORMITY AND APPLICATION AMOUNT IN NORTH CHINA PLAIN

Hang Zhang[1], Jiusheng Li[2]

ABSTRACT

The uniformity coefficient is an important parameter for designing the drip irrigation systems, but the influence of irrigation uniformity on crop growth is still unclear. Field experiments were conducted in two growing seasons of spring corn (*Zea mays* L.) in the north China plain to evaluate the influence of drip irrigation uniformity and application amount on corn growth and yield. Three Christiansen uniformity coefficients (*CU*) of 0.66, 0.81, and 0.99 and three levels of water application at 50%, 75%, and 100% of the irrigation requirement were used. During both growing seasons, crop parameters including plant height, leaf area index (LAI), chlorophyll meter reading (SPAD reading) and dry biomass above ground were regularly measured, and the yield was recorded on harvest. The results showed that drip irrigation uniformity and application amount had insignificant influence on the mean of plant height, LAI, SPAD reading and dry biomass in both years (α =0.05). The uniformity coefficients of the crop parameters increased with spring corn growing, and their final value were larger than 0.90. The uniformity coefficients for yield along a dripline were larger than 0.93 for the three *CU* treatments tested. The drip irrigation uniformity, application amount and the interaction between the two factors had insignificant influence on the mean and the uniformity of yield (α =0.05). These results demonstrated that the drip uniformity coefficient had less important effect on the spring corn growth and yield. It suggested that the current design standard of drip irrigation uniformity coefficient (*CU*≥0.80) could be fairly lowered in the semi-humid regions, such as in the north China plain, to reduce the initial and operation costs of drip irrigation systems.

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CHALLENGES OF CONVERTING TO EFFICIENT WATER SAVING IRRIGATION IN SYRIA

Shuichi Matsushima[1], Awadis Arslan[2], Bassam Al-Husein[3]

ABSTRACT

In Syria, irrigated agriculture is crucial in terms of food security, because of the uncertainty and fluctuation of rain-fed agricultural production. On the other hand, irrigated agriculture consumes water more than 90% of the total water use in Syria so that it hinders to provide water resource to other sectors such as industry and domestic water use. Based on the request from the Government of Syria in order to spread modem water saving irrigation, the JICA (Japan International Cooperation Agency) Project of Development of Efficient Irrigation Techniques and Extension Phase I in Syria (DEITEX I) was implemented from March 2005 to March 2008 during the three years. The Project was carried out under the basic strategy that farmers should select a water saving irrigation by themselves according to their ability and awareness enhanced by "extension activities" rather than to compel them by "control or enforcement". Succeeding to the DEITEX I, DEITEX II was started on December 2009 with the project period of three and half years. Through the implementation of the DEITEX I and II Project, every concerned division of irrigation research, training and extension works for an object to promote saving water in irrigation in right harmony.

On-going DEITEX II has achieved water saving in irrigation at the farmers' level reducing water consumption at about 20% in average. The challengeable approach of realizing water saving by extension activities are going to be verified its effectiveness. It is expected to apply the similar approach of water saving in irrigation for the other countries and regions hereafter.

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APPLIED DESIGN CONCEPT: ZERO ENERGY MICROIRRIGATION SYSTEM

D. Yewalekar[1], M. Kinge[2],

ABSTRACT

Irrigation (water) is one of key function in crop production. Appropriate premeditated and designed Micro (Drip) Irrigation System results in achieving benefits like increase in yield, water savings, power stash, fertilizer stash etc. In the modern scenario, power economy is becoming very important factors in Irrigation sectors because of colossal investment & chronic cost and short fall.

An assortment trials and experiments were conducted at various parts of the world and established persuading results. The present article describes a proven concept for designing of zero energy micro irrigation system with photographs and sketch. This applied design concept is going to be very much useful for those who trust & thrust on energy conservation, environment fortification, pollution control and carbon credits.

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October, 2011
Tehran-Iran

Theme 2

- Advances in operation and cost effective maintenance of micro-irrigation systems;
- Management and cost of micro-irrigation for large farms;
- Efficiency and productivity in micro irrigation systems
- Developments in Subsurface micro-irrigation;
- Use of low quality waters in micro-irrigation;

EFFECT OF NEGATIVE PRESSURE DIFFERENCE IRRIGATION ON SOIL WETTING PATTERN

S. M. Moniruzzaman[1], Teruyuki Fukuhara[2], Yoshihiro ISHII[3], Hiroaki Terasaki[4]

ABSTRACT

Negative pressure difference irrigation (NPDI) is considered to be a highly efficient water saving method, which consists of a porous pipe and a water reservoir. The water use efficiency of the NPDI is higher than that of other irrigation methods such as surface irrigation, sprinkler irrigation and drip irrigation. In order to investigate the effect of negative pressure difference on the soil wetting pattern and water balance of the NPDI, laboratory experiments were carried out using a soil column in a temperature and humidity controlled room. The supplied water (M_{sup}), soil water storage (M_{soil}), evaporation (M_{eva}), wetted soil surface area and configuration of wetted soil around the porous pipe were measured for three different negative pressures. Empirical equations were proposed for the calculation of wetted soil volume, M_{soil} , M_{eva} and M_{sup}.
The proposed simple methodology could well reproduce the temporal variations in the wetted soil volume, water use efficiency, M_{soil}, M_{eva} and M_{sup}.

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INVESTIGATION THE USE OF NON-CONVENTIONAL WATER (SALTY AND BRACKISH) USING PITCHER UNDERGROUND IRRIGATION SYSTEM IN GREENHOUSE GROWN CAPSICUM

Gholamali Keikha[1], Mahdi Keikha, Mohammad Keikha, Shirali Keikha, Khodad Dahmarde, Fateme Keikhaei

ABSTRACT

The necessity of exploiting unconventional waters (salty and brackish) as part of water resource use in drought periods in Sistan area of scientific need and use of new methods of irrigation in the exploitation of these waters is the unavoidable . This statistical test design splitplot based on a randomized complete block with four main treatments include various levels of saline water (2-4-8-12) ds / m and two subtreatments include a capsicum cultivars Capsicum Yellow (ez-iniaez-1) and green Capsicum (colifornia wonder) in four replications using clay underground irrigation system in place Zahak Research Station in 1382 was carried out for one year. Analysis of variance obtained from this study indicates that the fruit yield, plant height and root length were significantly affected by salinity treatments. Traits such as plant height, fruit yield, as a significant number were affected. In this study, with increasing salinity from EC = 2ds / m to EC = 12ds / m yield fruit, root length, has declined. Highest performance 46/74 ton/ha with conventional water EC = 2ds / m respectively, the statistical performance of the treated fruit in salt water EC = 4ds / m in a group were statistically not significant.
Keywords: Capsico, Pitcher, Brackish, Water

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SUBSURFACE DRIP IRRIGATION

H.S.Chauhan[1]

ABSTRACT

Subsurface drip method of micro irrigation is different from surface method only in the way that the lateral pipes are buried below the ground surface unlike the same laid on the surface. It is a highly efficient method of water application, with minimum of water losses through evaporation and deep percolation, thus assisting water and nutrient conservation.

According to 1991 survey, subsurface drip was reported to be practiced only 3% of the total area covered by micro irrigation. It was practiced in the USA, Israel, China, Canada, and Poland. In the USA, it had an area of 54000, in China an area of 2500 ha, Israel 150 ha and others 2184 ha.

According to Phene (1987) in the areas of water scarcity for salinity management in salt affected area and in permeable soils, subsurface drip irrigation reduces deep percolation losses and long term sustaining ground water contamination. It has all advantages of surface drip irrigation. It increases Water Use Efficiency, and eliminates deep percolation.

This system of micro irrigation has been applied to many crops and fruits, nuts, and vine crops have been increasingly irritated by SDI. Considering the range of applicability, it has been applied to a large range of fruits, vegetables and other field crops.

The objective of the present paper is to review the experience of its application to a few fruits, such as peaches and grapes, vegetables such as tomatoes, brinjals and lettuces as well as other crops, like groundnuts, cotton, and pasture crops. The applicability and performance of SDI has been reviewed and conclusion drawn for the above crops.

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IMPROVED YIELDS WITH MULCHING ON MICROIRRIGATED VEGETABLES

H. S. Chauhan[1]

ABSTRACT

Drip irrigation has been used extensively for vegetable and fruit crops for saving water and fertilizer and improving quality of products. Similarly, mulching has been used quite a bit for moisture conservation. A combination of drip irrigation was found to improve moisture conservation and crop production quality. There are several types of mulches made of plastic sheets of various materials, thickness and color, with varying costs and overall performances. Similarly, agricultural crop residue such as paddy husk and coir pith have been often used as mulches.

in several studies at different locations it was found that drip irrigation increased total and marketable yields of tomatoes compared with unirrigated plots by 16 and 28 percent whereas mulching increased the total and marketable yields by about 24 and 20 percent respectively. Similarly, drip irrigation generally gave higher yields ranging from 40 to 53 percent and water saving of 28-54 percent. The mulching generally increased the total and marketable yields in all the years including the early yield in one year. Generally black polyethylene mulch gave better yields than the other materials.

Similarly, in various studies it was found that frequent surface irrigation of potatoes gave higher yields. Mulching along with surface irrigation gave still better yields say about 30 percent. Comparative studies showed that yields increased from 31percent to 90 percent with drip irrigation.

In a study of drip and irrigation of muskmelon with black plastic mulch indicated that the highest water use efficiency was with drip tape irrigation and plastic mulch, averaging 9.10kg-fruit per cu m of water used, and the lowest water use efficiency was found for the control treatment with 3.6 kg/m^3 of water used.

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THE EFFECT OF SALINE WATER UNDER SUBSURFACE DRIP IRRIGATION ON COTTON

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ABSTRACT

Water is the most vital input in agriculture and has made a significant contribution in providing stability of food grain production. With increasing demand for water in non-agriculture sectors and continuously increasing pressure on water resources, good quality water and its availability for irrigation are becoming a serious concern. One of the most common water quality concerns for irrigated agriculture is its salinity. Efficient management of saline water depends on soil properties, climate, water quality, choice of crop and crop rotation and farm water management capabilities. Surface and subsurface drip irrigation (SDI) can be very effective in achieving higher irrigation application efficiency and water distribution uniformity. Besides keeping the foliage dry during irrigation, light and frequent water application can result in a small wetted zone with a possibility of dilution for leaching of salt. In order to study the effect of saline water under subsurface drip irrigation on yield and yield components of cotton, an experiment was conducted at Precision Farming Development Center, Water Technology Center, Indian Agricultural Research Institute (IARI), New Delhi with loamy soil. Experimental design was strip split plot with 3 replications with 4 levels of saline water (EC_1= ground water (2-2.5 dS/m), EC_2= 5 dS/m, EC_3=8 dS/m and EC_4=11 dS/m) as main plot and 3 types of drip irrigation system (surface, subsurface at 15 cm depth and subsurface at 30 cm depth) as sub plot. The results showed that there was no significant difference

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on cotton yield among EC_1, EC_2 and EC_3, while EC_4 affected the cotton yield significantly. The yield decreased 37.3% with irrigation water having EC_4 as compared to the one with EC_1. The highest yield was recorded in EC_2 treatment which was 12.7%, 15.07% and 79.8% more than EC_1, EC_3 and EC_4 treatments, respectively. Treatment of EC_4 had lowest mean boll weight, earliness percentage and boll number per plant than in EC_1 and EC_2 treatments. Salinity of different levels had no significant difference on mean boll weight and earliness percentage but had significant difference on boll number per plant. Subsurface drip irrigation decreased yield, mean boll weight and boll number per plant than surface drip irrigation but increased earliness percentage.

Keywords**:** Subsurface drip irrigation, Drip irrigation, Saline water and Cotton

BELL PEPPER RESPONSE TO SURFACE AND SUBSURFACE DRIP IRRIGATION

Qinghua Kong[1], Guangyong Li[2], Meng Guoxia[3]

ABSTRACT

A two-year field experiment was conducted in 2007 and 2008 to investigate different bell pepper responses to subsurface drip irrigation (SDI) and surface drip irrigation (DI) under four nitrogen levels: 0, 75, 150, and 300 kg/ha N (N_0, N_{75}, N_{150}, and N_{300}, respectively). Irrigation interval was set at 4 d. Bell pepper yield under SDI was significantly higher than that under DI by 4% in 2007 (13% in 2008). Water consumption under SDI was lower than that under DI by 6.7% in 2007 (7.3% in 2008). Meanwhile, root length density under SDI was obviously higher than that under DI by 11.8% in 2007 (12.5% in 2008). The percentage of root length below 10 cm soil depth under SDI were higher than that under DI by 7%, proving that SDI promotes crop root growth and enhances downward root development. Soil N residue under SDI was lesser than that under DI. Lastly, SDI with N application of 150 kg/ha is recommended as an optimal fertigation practice in improving bell pepper yield and water use efficiency, as well as, in NO_3^--N leaching.

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RESTRICTIVE IRRIGATION UNDER SUBSURFACE DRIP IRRIGATION IN A MEDITERRANEAN CLIMATE: MODELLING: APPLICATIONS TO A LOAMY SOIL WITH CORN

Mailhol, J.C., Ruelle, P., Dejean, C. [1]

ABSTRACT

This work deals with the analysis of conditions under which subsurface drip irrigation (SDI) can play a major role in water savings while insuring an acceptable crop yield level. Technical solutions for water savings have been implemented during 2 irrigation seasons (2008-2009 at Cemagref institute (Montpellier, SE, France) for a corn crop. They refer to buried drip irrigation. The later, even under the severe 2009 drought appears as very promising in terms of water productivity. This work focuses on the soil water and transfer under drip irrigation in relation with crop production. At this end, PILOTE, a crop model have been adapted to the specificity of the irrigation system and associated with the 2D numerical code Hydrus-2D. For the latter a special attention was paid to the root system behaviour under restrictive water conditions in view of proposing an adapted modelling approach for these conditions. Indeed, the presence of heterogeneous soil water content zones, exacerbated by the restrictive water application conditions, forces the plant adopting compensating processes to match the climatic demand. In other words, plant removes its water uptake capabilities to soil zones where water is more available. In the last Hydrus-2d version the compensated root water uptake process has not been implemented yet. Such a model version is not able to mimic this physiological behaviour, and consequently underestimate actual evapotranspiration, an essential condition for a correct yield prediction. When pedo-climatic conditions contribute to a good

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installation of the root system, PILOTE, an adapted lumped crop model regarding the root water uptake process, allows a satisfactory prediction of AET and corn yields. Considering the narrow relationship existing between Yield and actual evapotranpiration, such a relationship established by PILOTE in the application context, associated with the generic numerical code Hydrus-2D could be used to expand the domain of validation of PILOTE.

Keywords: Subsurface Drip Irrigation, crop model, Hydrus-2D, water productivity, actual evapotranspiration.

RESPONSE OF FRAGRANT PEAR GROWTH TO DIFFERENT MICRO-IRRIGATION CONDITIONS

Zhao Zhi[1], Huang Xingfa[2], Wu Yang[3], Wang Wei[4]

ABSTRACT

The situation that water is becoming increasingly scarce and micro-irrigation can enhance water use efficiency is recognized worldwide. Until now, the Korla fragrant pear trees were irrigated by traditional flood irrigation in the west of China, so there is great potential to cut down agricultural water use. The response of fragrant pear trees to micro-irrigation management under field conditions in Xinjiang Uygur Autonomous Region was conducted in 2009. There were four irrigation approaches: (1) surface drip irrigation; (2) subsurface drip irrigation; (3) micro–sprinkling irrigation; (4) traditional flood irrigation. Three micro-irrigation treatments were fully irrigated to the 80% ET every week during the whole growing season. Soil water potential, vegetative growth, production and fruit quality were measured in this experiment. Micro-irrigation treatments could save 700mm of total irrigation water, 50% of that with flood irrigation. Results indicated that pear fruit yield and fruit quality were slightly influenced. In particular, the VC content of pears at micro-sprinkler treatment exceeded 60% of that with flood irrigation, at the level of 0.24mg/100g. Wherefore, changing the inefficient irrigation method to micro-irrigation is necessary for Korla fragrant pear in Xinjiang region.

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REGULATOR RESERVOIR IN PRESSURIZED IRRIGATION NETWORKS (CASE STUDY MOSALLASE GIVI IRRIGATION NETWORK)

Nosratollah Assadi[1], Hamed Hadidian[2]

ABSTRACT

Efficient use of both water and energy resources are vital for productivity increase in agriculture, simultaneously maintaining environmental sustainability. Soil and water resources of arid and semi-arid regions can be managed to sustain the productive capacity of the land and to better cope with water scarcity. In this context, optimal use of water and applying modern irrigation techniques such a pressurized irrigation are needed. In pressurized irrigation system running energy expenditure is high. Energy can be supplied by pumping and in some cases by gravity when there is a good head difference between, say a reservoir and the intake of the pressurized irrigation network.

Mosallase Givi irrigation and drainage network is located in northwest of Iran in Ardebil province. Givi reservoir dam was constructed on Givi river is the source of water for the network. Project area is about 4500 ha and according to the limitation of water and soil resources, just about 2200 ha can be covered by trickle irrigation system. Since Givi project area is in a steep mountainous region. The head difference between the point of water diversion from the Givi reservoir and the irrigation network is about 180 m.

In this paper, two approaches were studied in designing of Givi irrigation network. In the first approach the design was based on sub-main and main pipe lay out from the reservoir to the farm. In second approach at the beginning of each sub main pipe a regulator reservoir was planned to store and supply water to the farms located at the downstream of the sub main pipe.

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After comparing these approaches, the second approach was found better due to less operation and maintenance costs, better irrigation scheduling and less total capital costs.
Keywords: Pressurized irrigation, Energy need, Regulating reservoir, Mountainous region.

THE IMPACTS OF DRIP TAPE IRRIGATION ON WATER USE EFFICIENCY OF SUNFLOWER IN ROTATION WITH WHEAT

Amir Nourjou[1]

ABSTRACT

As the competition for the finite water resources on earth increases due to growth in population and affluence, agriculture is faced with intensifying pressure to improve the efficiency of water used for food production. The study was carried out to improve water use efficiency (WUE) and water productivity (WP) on sunflower, using split–plot design on base of randomized complete blocks with two different cultivation management (Sw:sunflower after wheat, Ss:only sunflower), 3 irrigation treatments (Is-60: furrow irrigation and rows 60cm, It-50: drip irrigation and rows 50cm, It-60:drip irrigation and rows 60cm) in 3 replications in Meandoab Agricultural Research Station in production season 2007-2008. Irrigation treatment significantly affected seed yield. Although the highest seed yield (5.10 t ha-1) was obtained from It-50 treatment, increasing 23.3% in compared with Is-60 treatment, the effect of main factor on oil content was significant at P≤5% but irrigation treatment didn't have any significant effect on it. Sw treatment significantly (P≤1%) increased WP and WUE. Water use efficiency and water productivity were increased by 18.9% and 18.1% in treatment of Sw. Maximum water productivity was 0.761 Kg m-3 in treatment of It-50. The research results revealed that the drip irrigation system could be used successfully for irrigation of sunflower crops under the arid climatic condition of west Azerbaijan for improving WP and WUE.

Keywords: sunflower, drip irrigation, furrow irrigation, water use efficiency, water productivity

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SOIL EVAPORATION IN SURFACE AND SUBSURFACE DRIP IRRIGATION IN A MAIZE FIELD

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ABSTRACT

Evaporation reduction is one of the advantages of drip irrigation. A research was conducted in summer 2009 at experimental station of AERI, Karaj-Iran on maize field to measure soil surface evaporation by BREB method in two irrigation systems of surface and subsurface drip irrigation systems. In surface drip irrigation, the drip tapes placed in nearest place to the crops and along the crop rows and in subsurface drip system, drip-tapes placed 0.15 m below soil surface under the crop rows. Four components of soil surface energy balance including net radiation reaching soil surface (R_{ns}), soil surface heat flux (G), sensible heat flux (H_s) and soil latent heat flux (λE_s) were calculated and discussed in two systems. Daytime average of energy balance components in terms of (w/m^2) and also soil surface evaporation in terms of (mm/day) were calculated in both irrigation systems. During measurement period, net radiation values ranged between 304 to 333 w/m^2 which caused net radiation reaching the soil surface ranged between 67 to 107 w/m^2 in both systems. As it was expected R_{ns} values decreased with crop growth and leaf area index (LAI) increased later in crop development period. Soil heat flux accounted for about 36 to 53% of R_{ns} in surface drip irrigation and about 17 to 25% in subsurface drip irrigation. As it was shown, daytime soil heat flux values were greater in surface drip irrigation.

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As it was shown, λE_s accounted for about 41 to 63% of R_{ns} in surface drip irrigation while it was about 56 to 71% in subsurface drip irrigation. It was observed that the ground in both surface and subsurface drip irrigation became wet but reverses direction of moving water in subsurface system, may contribute to more evaporation in subsurface drip irrigation. Accordingly, subsurface drip irrigation systems on depth of emitter lateral line should be taken into more consideration.

EFFECT OF DRIP IRRIGATION AND PLASTIC MULCH ON YIELD AND EARLY HARVEST OF MUSKMELON UNDER SEMI-ARID CLIMATE CONDITIONS

Akbari,[1] M., Zaraei[1] G., Sadre Ghaen[2] and Farhadi[3], A.

ABSTRACT

The experiments were conducted on the clay loam soil part of Esfahan in central part of Iran in the middle of March-July for 2 years to evaluate the yield of muskmelon (Cucumis Melo Var Reticulatus) under mulched, irrigation level and irrigation system treatments. Rainfall is erratic and meager during the crop season in Esfahan region; therefore, muskmelon crop only can be grown with irrigation. Actual evapotranspiration for muskmelon crop was estimated by using a standard class A pan located close the experimental site and net daily irrigation requirement was estimated after subtracting effective rainfall. The trials involved three treatments: two kinds of irrigation systems (surface and drip irrigation), two levels of irrigation amount (75 and 100 percent of irrigation water requirement) and three levels of mulches (black, transparent plastic mulches, and without mulch as a control). The experiment was arranged in a split-split-plot design and consisted irrigation systems in the main plots, irrigation level as subplots and mulches level as sub-subplots. In 2000, average yield from surface and drip irrigation systems are 66 and 62.5tha^{-1}, respectively. While in 2001, fruit yields for the same systems was 46.1 and 46.3tha^{-1}. The results show that water use efficiency for surface and drip irrigation were 4.8 and 11.2 kg m^{-3}, respectively. Statistical analysis of the yield data indicated no significant ($P > 0.05$) difference between years and irrigation systems. But, water use efficiency in drip irrigation system was 2.5 times higher than that of for surface irrigation. The highest muskmelon yields from surface and drip irrigation systems were obtained at full irrigation treatments (received 100% of irrigation water requirement). Bigger fruits were obtained with optimum irrigation amounts for both of

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the irrigation systems. Therefore, the best irrigation system was drip irrigation system due to yield precocity, decreasing the water consumption and increasing the water productivity. Higher yield and better crop growth was observed in the mulched plots, which might be due to conservation of soil moisture. Application of black and transparent plastic mulched significantly ($p < 0.05$) increased the muskmelon fruit yield precocity, available soil moisture and decreased irrigation times particularly in early growth season and greatly controlled the weeds. Significantly, ($p < 0.05$) higher water use efficiency was recorded in the mulched plots compared with the non-mulched plots under the same irrigation treatment. This result shows that, applying the drip irrigation system, irrigation management and plastic mulches can optimize the water consumption. Therefore, drip irrigation system and mulching were recommended for growing muskmelon in the region under limited water availability.

Keywords: Muskmelon, Plastic mulch, Drip irrigation, Esfahan, Iran

APPLICATION OF BRACKISH WATER IN SUBSURFACE DRIPIRRIGATION SYSTEM ON PISTACHIO ORCHARDS

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ABSTRACT

Irrigation systems with higher efficiencies such as microirrigation systems are developing since last decade to achieve higher water use efficiency. At the same time, quality of water is decreasing in those areas due to overwithdrawal from the water resources. In Kerman province, the salinity of water increased to more than 10 dS/m in some area mainly due to water overwithdrawal. Therefore, application of saline water for irrigation of pistachio orchards is now inevitable, which contributed to increase in salt accumulation in soil surface and soil degradation. The main purpose of this study was the use of saline water in subsurface dripirrigation system (SDI) of pistachio orchards. The research was conducted during 2005-2008 on 12 year old pistachio trees. The drip-lines with self-cleaning and pressure compensating drippers were placed in two depths of 50 and 70 cm based on the fertilizer channel depth for pistachio trees. Emitters flow rate was 3.6 l/hr and 75 cm apart. Treatments consisted of two drip-line depths, and three irrigation levels of 100% (I_1), 75% (I_2) and 50% (I_3) of pistachio water requirements, with three replications, based on a completely randomized block experimental design. Salinity of irrigation water was 8.1 dS/m and irrigation water was applied in a 10 day - interval. According to the results, there was no significant impact of irrigation water treatment on pistachio yields. Annual applied irrigation water for I_1, I_2 and I_3 was 2050, 3065 and 4010 m^3/ha and water use efficiency of pistachio was 1.1, 1.2 and 2.0 kg/m^3 respectively.

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Pistachio quality characteristics improved compared with pistachio trees irrigation by a surface irrigation system. Salinity increased near the soil surface by decreasing in depth of drip-line setup.

PRESSURE VARIATION IMPACT ON DISCHARGE CHARACTERISTICS OF POROUS PIPES

A. Janani[1], T. Sohrabi[2], H. Dehghanisanij[3]

ABSTRACT

Porous pipe is a lateral pipe introduced for subsurface micro irrigation. A laboratory study was conducted to investigate the effect of operating pressure on the discharge characteristics of porous pipe. Three - meter of porous permeable.
Porous pipe is a lateral pipe introduced for subsurface micro irrigation. A laboratory study was conducted to investigate the effect of operating pressure on discharge characteristics of porous pipe micro irrigation. The equation of emission rates and the pressure, emission variation along the pipe, emission variation of pipe by time, coefficient of variation, and emission variation were tested in different pressures of 3.5, 7, 10.5, 14, 17.5, and 21 meter. Experimental results showed that emission rate decreased by time and after 5 hours, the emission rate at different pressures is approximately declined 10 to 20 percent. The relationship between pressure and discharge rate was linear with high correlation coefficient.

Keywords: porous pipe, micro irrigation, discharge characteristics

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EFFECT OF SURFACE AND SUBSURFACE DRIP IRRIGATION METHODS AND IRRIGATION FREQUENCY ON COTTON YIELD AND WATER USE EFFICIENCY

M. Jolaini[1], Gh. Zarei[2]

ABSTRACT

This study was conducted to determine the impacts of irrigation frequency and drip irrigation method and their interactions on yield, water use efficiency and quality characteristic of cotton in Kashmar Agricultural Research Station in Razavi Khorasan Province. The study was done during 2006-2008 years. Experimental design was two factor completely randomized design with four replications. Design treatments included irrigation frequency (2, 4, and 6 day) and drip irrigation method (surface and subsurface drip irrigation). The combined analyze showed that irrigation method had significant effect on Yield and Water Use efficiency (P≤ 0.01). There was significant difference between yield in surface drip and subsurface drip irrigation (3074 and 3988 kg/ha, respectively). Water use efficiency in subsurface drip irrigation was 0.349 kg/m^3 that was greater than surface drip irrigation. Yields in different irrigation frequency had no significant difference and for 2, 4, and 6 days irrigation frequency were 3491, 3725 and 3364 kg/ha, respectively. The highest water use efficiency and yield were obtained in subsurface irrigation method with 4 days irrigation frequency (4315 kg/ha and 0.375 kg/m^3, respectively). However, the least water use efficiency and yield was obtained in surface irrigation method with 2 days frequency (3107 kg/ha and 0.265 kg/m^3, respectively). In general, subsurface drip irrigation whit 4 days irrigation frequency was selected and recommended as the best treatment.

Keywords: Cotton, Irrigation frequency, Drip irrigation, subsurface irrigation, Water use efficiency

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EFFECTS OF MOISTURE REGIMES AND PLASTIC MULCHING ON TOMATO IN SURFACE AND SUBSURFACE DRIP IRRIGATION METHODS

M. Jolaini[1], Gh. Zarei[2], A.R. Saffari[3]

ABSTRACT

Tomato is the most important vegetable crops which generally grows under surface irrigation method. In this method, the major proportion of irrigation water is lost by surface evaporation and deep percolation, resulting in lower irrigation efficiencies. Recentlydue to worldwide aridity and water shortage, there is tendency of farmers to apply drip irrigation for water saving in agriculture. The objective of this paper is determining the impacts of plastic mulching, drip irrigation methods and different amount of applied water and their interactions on yield, water use efficiency and quality characteristic of tomato. This study was conducted during 2006-2008 in Torogh Agricultural Research Station in Razavi Khorasan Province. The soil texture was silty loam and loam in 0-40 and 40-80 cm, respectively. Experimental design was randomized complete blocks design in split split plot with three replications. Treatments included different amount of applied water (60, 80 & 100% water requirement) in main plot, drip irrigation methods (surface and subsurface) in sub plot and mulching (without mulching & plastic mulch) in sub-sub-plot. Results showed that irrigation moisture regime, irrigation method and mulch treatments had significant effectson yield and WUE ($P \leq 0.01$). Yield in 60, 80 and 100% of water consumption was 31.14, 54.58 and 62.27 ton/ha, respectively. This difference was significant. The highest WUE (7.88 kg/m^3) was obtained at 80% moisture regimes and followed by 60 and 100% of moisture regimes with 5.93 and 7.23

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kg/m^3, respectively. However, there was a significant difference between yield in surface and subsurface dripirrigation methods (43.38 and 55.27 ton/ha, respectively). WUE in subsurface dripirrigation was 7.93 kg/m^3 and greater than surface drip irrigation (6.12 kg/m^3). Yield in plastic mulching and without mulching treatments were 55.64 and 42.71 ton/ha, respectively. Application of mulch increased WUE about 30%. Also, when water saving vegetable growth, yield and economics return were taken into account, then an irrigation level of 80% through subsurface dripirrigation along with plastic mulch will be considered optimal.

Keywords: Tomato, Plastic mulching, Dripirrigation, Subsurface irrigation, Water use efficiency.

EFFECTS OF IRRIGATION FREQUENCY AND WATER CUT-OFF IN DRIP TAPE IRRIGATION ON YIELD AND WATER USE EFFICIENCY IN POTATO CULTIVARS

M. Jolaini[1], M. Kazemi[2], Gh. Zarei[3]

ABSTRACT

Increasing demands for water and promoted awareness of the role of irrigated agriculture in water quantity and quality protection mandate improved irrigation water and nutrient management. This is particularly true for a high-value, water-sensitive crop like potato that requires large nitrogen fertilizer inputs. The objectives of this paper are to evaluate the impacts of irrigation frequency and irrigation cutoff on yield and water use efficiency (WUE) of potato cultivars, using drip-tape irrigation system. This study was conducted during 2006-2008 years in Razavi Khorasan Agricultural and Natural Resources Research Center (Iran). Experimental design was randomized complete blocks design (RCBD) in split-split-plot with three replications. Design treatments were included irrigation frequency (2, 4, and 6 day) in main plot, irrigation cutoff (full irrigation, irrigation cut-off only in initial growth stage) in sub-plot and potato cultivars (Almera, Agria, Sante and Sinora) in sub-sub plot. Results showed that irrigation frequency and irrigation cut-off had no significant effect on yield and WUE. The effect of cultivar on yield and WUE was significant. Among cultivars, the most yield and WUE belonged to Agria. Three other cultivars (Almera, Sante and Sinora) were in the second level, while the yield of Almera was a little more than Sante and Sinora. In general, regarding treatments and its interaction effects on yield and WUE, it was concluded that the highest and the least yield and WUE belonged to dripirrigation with 2 day irrigation frequency without cut-off in Agria cultivar, and

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dripirrigation with 6 day irrigation frequency with water cut-off in Sinora cultivar, respectively.

Keywords: Potato, Irrigation frequency, irrigation cutoff, Driptape irrigation, Water use efficiency (WUE).

DRIP IRRIGATION SCHEDULING OF CITRUS ORCHARD IN TUNISIA

Abdelkader Hammami[1], Hafedh Jamil Mellouli[2]

ABSTRACT

Drip irrigation scheduling of Clementine mandarin grove (planted since 1978) was carried out at citrus orchard located at Cap Bon on the Mediterranean coast of Tunisia, with **layered soil (**sandy on sandy clay loam). The irrigation scheduling program was monitored using a simple method based on soil water status among the prospected rooting zone (soil water balance and potential) coupled with crop water requirements determination, during three years, from 2005 to 2007.

From the obtained results, the following conclusions would be drawn:

- Prospecting showed that Clementine root system was located by 65% in the top soil surface layer and the remaining part is located in the subsequent layer with a particular root concentration (25%) within the layer's transition zone. No roots have been observed growing deeper than 1.00 m.
- Soil moisture characterization is useful to identify the water retention and to establish the frequency of soil watering,
- Soil water potential associated to soil moisture measurement represents a suitable way to estimate water deficit and irrigation scheduling,
- Irrigation triggering should be conducted in two phases. During the "flowering-June physiological fruit drop" period (February - June) the irrigation should be triggered when the 0.25 m deep tensiometer reading reaches 10 x 10^{-3} MPa (0.1 bar) while during the period of "fruit growth-

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ripening" (July-October) the tension would be 15 x 10^{-3} MPa (0.15 bar). These critical levels of soil water tensions could be recommended in order to establish an irrigation scheduling of citrus cultivated on low water retention sandy soils

- The following three dimensional regression model could describe the seasonal soil moisture distribution, within the root zone under drip irrigation:

$$\mathbf{Z = 0.054 + 0.873\ 10^{-3}\ x - 0.23\ 10^{-5}\ x^2 - 0.00163\ y + 0.258\ 10^{-4}\ y^2 - 0.83\ 10^{-6}\ x\ y}$$

$$\mathbf{(r^2=0.82^{**})}$$

θ: Soil moisture content (m^3m^{-3}), x: Root zone thickness (cm) and . y: time (day of the year).

The obtained results, has given in hand materials for the dissemination of the tested methodological approach. When used properly, it can enhance the irrigator's chances of success.

Keywords: Drip Irrigation scheduling; citrus; soil water status; crop water requirements.

ECONOMIC COMPARISON OF SURFACE AND SUBSURFACE DRIP IRRIGATION METHODS AND IRRIGATION INTERVAL ON COTTON YIELD

Shojaat Zare[1]

ABSTRACT

This study was conducted to compare economically, two irrigation methods, surface and subsurface drip irrigation systems with different irrigation intervals, on cotton yield. Necessary data obtained from a research project conducted in Kashmar Agricultural Research Station in Khorasan Razavi province. During 2006-2008, design treatments were included irrigation interval (2, 4 & 6 day) and drip irrigation methods (surface and subsurface drip irrigation). Partial budgeting method was used for economic comparison.

Results indicated that all treatments have gross marginal benefit bigger than one, and net marginal benefit is positive too. So, in order to select economic irrigation method, rate of return index was used. Finally, after comparing both treatments, subsurface irrigation method with 4 days interval with %122 rate of return, obtained as the better irrigation method.

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IMPACT OF DRIP AND LEVEL BASIN IRRIGATION ON GROWTH AND YIELD OF WINTER WHEAT IN THE NORTH CHINA PLAIN

Wang Jian-dong[a,b,*], Gong Shi-hong[a,b], Xu-Di[a,b], Yu Ying-duo[a,b], Ma Xiao-peng[a,b2]

ABSTRACT

Optimum irrigation water management is essential to sustain high winter wheat (*Triticum aestivum* L.) yields and to increase its water-use efficiency (WUE) in view of the serious constraints in the water-resource situation in the North China Plain (NCP). A field experiment was conducted for 3 consecutive years (2007-2009) to study the effects of different irrigation methods and schedules on crop growth, yield and WUE of winter wheat (*Triticum aestivum* L.) in the NCP. In this research work, water-saving irrigation methods, including the level-basin irrigation (BI) and drip irrigation (DI), were selected, and four irrigation schedules were designed for BI and DI methods, respectively. These initiated irrigation at 25%, 40%, 50% and 60% of water depletion of the field capacity (FC) across the reviving to booting growth stages, was designated as B1, B2, B3 and B4 for the BI method and D1, D2, D3 and D4 for the DI method, respectively.

The results indicate that irrigation methods and schedules had globally significant effects on crop growth and yield of winter wheat. The total irrigation amount or irrigation schedules significantly influenced plant heights and LAI ($P_{0.05}$ level), and irrigation amount or irrigation schedules also had significant effects on winter wheat grain yields ($P_{0.05}$ level) for both irrigation methods, and there were no statistically significant differences in terms of average yields and mean WUE for the adequate irrigation treatments under both irrigation methods ($P_{0.05}$ level). Further, the DI method had a significant advantage of improving

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yield and WUE compared with the BI method ($P_{0.05}$ level) under the condition of deficit irrigation and no significantly different seasonal ET. In addition, without irrigation system investment consideration, the D3 treatment or 326 mm seasonal ET was recommended for winter wheat irrigation in the NCP, which saved 35% irrigation water meanly during 2007-2009 with only 13% decrease in winter wheat yield compared with B1, and the optimum controlled soil water content at effective rooting depth range in this study for winter wheat irrigation in the NCP was: 50% FC-75% FC at the reviving to booting growth period, 75% FC-FC at booting to heading stage and 55% FC-70% FC at the milking to maturity stage.

Keywords: Winter wheat (Triticum aestivum L.); drip irrigation; level basin irrigation; irrigation schedule; water use efficiency

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Theme 3

- Automation in micro irrigation;
- Micro irrigation in greenhouses;
- Micro-irrigation for small scale farms;
- Modeling, design and decision support system in micro-irrigation;
- Fertigation in microirrigation;

AUTOMATION IN MICRO IRRIGATION

Naser Valizadeh[1]

ABSTRACT

Seventy years ago the world population was 2.5 billions, while the resources were sufficient to feed all. Nobody was worried about drought and famine, as they believed someday it would rain and there were enough groundwater too. Now population is about 7 billions, and the irrigated area is doubled.
With limited water resources, the world has to find a solution to produce more crops with the same available water while more than one billion of people suffer hunger.
In micro irrigation, water is distributed using a hydraulic pipe network that conveys water to the plant area so that crop water requirement is met with a minimum of water loss.
Micro irrigation is adoptable from minimum up to full automation, so that a farmer can closely monitor ferti – irrigation.
In Iran, about 900,000 ha out of 8.5 million ha irrigated lands are equipped with pressurized irrigation systems from which, 50% is drip or micro irrigation system.
Automation could be simple with selection of a self cleaning dripper or automated head control, backwash, timer, solenoid valve to sophisticated automation applying soil moisture sensors, compact meteorological station, remote control, software, transmitters such as bluetooth, sms, infrared, satellite, central irrigation control and data registration.
Automated micro irrigation saves water, fertilizer, energy, and labor through proper planning , operation and maintenance. Thus, automation invariably contributes to a long term sustainability in micro irrigation system.
This article explains capability, advantages, and innovations aspect of automation in micro irrigation systems.

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DEVELOPMENT AND EVALUATION OF MOBILE DRIP IRRIGATION

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ABSTRACT

Replacing the sprinklers on a centre pivot or linear move irrigation machine by using polyethylene “PE” tubes with emitters to convey irrigation water directly to the soil surface converts a normal sprinkler system to mobile drip irrigation (MDI) system. The idea of the MDI consists of the advantages of stationary drip irrigation (low pressure requirements up to 50 kPa and low evaporation losses) and the advantages of centre pivot or linear irrigation machines (cheaper than drip irrigation) and its success in the irrigation of many crops. The length of drip tubes will depend on water requirements and the distance from pivot point. For the same area, the MDI system needs less than 2 % of the polyethylene tubes that would be needed in a stationary drip irrigation system. Replacing sprinkler with dripper will reduce the energy and water consumption of 70 % and 20 %, respectively, as compared with the centre pivot.

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MICROIRRIGATION IN GREEN HOUSE

H. S. Chauhan[1]

ABSTRACT

Green house is a complex microclimate system control structure. The important functions are controlling, humidity, temp, light, air velocity and the other variables including moisture supply to plants. The substratum may be natural or artificially constructed. Then different crops have different physiological and growth requirement. Then the subject requires dealing with the aspect f micro irrigation, which may be drip, drip-tape, with different variations, micro-sprinklers and overhead micro sprayers.

Micro irrigation has to be done for crops grown in green house. There does not seem to be ample literature narrowing the study variables to arrive at some simple conclusions.

To investigate interaction the variables of these two complex systems and to arrive at some meaningful conclusion of utility is not an easy job. The attempt generally is to study the water requirement and yield increase of some important crops grown in greenhouse as compared to their performance in open field. Commonly irrigation is provided by furrows overhead sprinklers, micro sprinklers or drip irrigation. Micro-irrigation thus has to be done for crops grown in green house depending on the crops, climatological conditions imposed and method of application the water requirement, would differ.

The present paper is a review paper giving an insight of the use of micro irrigation in greenhouses, with special reference of works in Japan.

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IMPACT ASSESSMENT OF THE MICRO-IRRIGATION UNDER LIMITED (SCARCE) WATER AVAILABLABILITY IN SMALL AND MARGINAL FARMERS HOLDINGS OF KARNATAKA, INDIA

Ramana Gowda[1], krishnamurthy[2], Venkata Reddy

ABSTRACT

India is emerging as a leading country in the World adopted Micro-irrigation system to improve the productivity of the land, water and crop yields. The Central Government supported by providing subsidy to an extent of 50 percent to the farmers for adopting Micro-irrigation system in Agriculture and Horticulture crops. This project was implemented in the state of Karnataka for perennial Fruit and Plantation crops.

Of the total sample 59 percent and 32 percent were working well and satisfactorily respectively, while 9 percent were poor performance due to bad maintenance. Thus, 91 percent of the farmers were getting good services resulting in good crop growth. The other feedback from the beneficiaries were the micro-irrigation system work very well during water scarcity period and also insufficient areas. The additional area ranging from 30 to 40 percent may be brought to irrigation when they adopt micro-irrigation. The additional benefits are saving investment on weeding and the other field operations to some extent.

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MODEL OF THE SOIL WETTING SHAPE UNDER DRIP IRRIGATION ON SLOPING LANDS BY USING DIMENSIONAL ANALYSIS TECHNIQUE

Farhad mirzaei[1], R.S. Sharif Nia[2]

ABSTRACT

A little number of studies has been done concerning slope effect in wetted onion- shaped. And no relation has been presented to estimate it. In the present research, a series of farm experiments in treatment and necessary and enough repetitions conducted and collecting experimental data, and analyzing them and using dimensional analysis technique, an equation presented to estimate distribution of water in the soil diameter which is function of dropper discharge, infiltration rate of water in soil, volume of irrigation water and slope of lands. The performance Evaluation of the model was carried out with statistical parameters, by maximum error (MXE) mean error (ME) and root mean square error (RMSE). Optimal quantity of error mean square error is zero and it is when all of predicted quantities and measurement are equal to each other. Quantity of this index is 0.043.And this is representative of well adaptation between measured quantities and simulated quantities. Also, maximum error which its optimal quantity is zero and its high quantity is representative of the worst state of model performance and quantity of this index is 0.027 therefore; it is a good representative of model work. The minimum quantities of error is 0.063 and its quantity is in relatively good area. Statistical comparison indicated that the model can express the wetted soil shape well. Thus, in brief, we can say that presented equation is able to satisfy for soil with a specific texture, emitter with specific discharge and required water volume for irrigation and land with different slopes, wetted soil diameter and consequently its wetted area with high accuracy.

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TISSUE IRRIGATION - A NEW DIMENSION IN MICRO - IRRIGATION

S. Bhaskar[1] , Mukund Joshi[2]

ABSTRACT

A new dimension in drip irrigation was achieved during a field study in 2007-08 at GKVK, University of Agricultural Sciences, Bangalore by successful insertion of micro tube emanating from lateral pipes in to the xylem tissues of monocot stems to supply them the water directly. This new method was termed as tissue irrigation, because water was directly supplied to xylem tissues, instead of supply through the soil. Such a system of irrigation is expected to meet the water demand of the crop without any sort of loss including minimal evaporation and percolation expected under conventional drip irrigation. To test this novel idea, a perennial crop of coconut with a well grown trunk was chosen. Besides distinctly demonstrating the technical feasibility of such an irrigation technique, the study indicated that water requirement of the crop could be reduced by 85 per cent as compared to surface irrigation and 47.5 per cent compared to conventional drip method. In this new method of irrigation, efforts were to essentially connect the suction in the plant tissues to the water supply in micro tube and new method was found to be independent of power requirement. Because the water movement in tissues was directly governed by the extent of suction in the tissues, which in turn is dependent on varying levels of vapor

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pressure deficits experienced by the leaves. This obviated necessity of operating head.

The tissue irrigation is a cost effective, power independent, climate controlled and highly economical method of drip irrigation easily adoptable in perennial monocot plants with large trunks.

PERFORMANCE OF NUTRIENT SOURCES AND ITS LEVELS ON HYBRID BHENDI UNDER DRIP FERTIGATION SYSTEM

P.P.Mahendran[1], D.Arulkumar, A.Gurusamy, V.Kumar

ABSTRACT

Field experiment was carried out at AICRP- Water Management block, Agricultural College and Research Institute, Madurai during Kharif 2009 to study the effect of drip fertigation on growth, yield, quality and economics of hybrid bhendi (M-10). There were eight treatments replicated four times in Randomized Block Design. All the growth and yield parameters were substantially enhanced by drip fertigation treatments compared to surface irrigation with soil application of recommended dose of fertilizers. Drip fertigation of 100 per cent RDF as water soluble fertilizers (WSF) exhibited better plant height, number of branches, days taken for first flowering, root characteristics and dry matter production. As a consequence of better growth, yield attributing characters like number of pods per plant, pod length, pod girth and pod weight were increased under drip fertigation of 100 per cent RDF as WSF. Further, every increment in the level of nutrients by fertigation from 50 to 100 per cent recommended dose of fertilizers brought out corresponding increase in the above parameters. Drip fertigation of 100 per cent RDF as WSF registered significantly higher pod yield which amounted to 65 per cent yield increase over surface irrigation with soil application of recommended dose of fertilizers

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The hybrid bhendi quality parameters *viz.,* crude protein, mucilage and ascorbic acid contents were significantly increased with increasing fertigation levels. Significantly lower crude fibre was noticed in the treatment with drip fertigation of 100 per cent RDF as WSF. The fertilizer dose with drip fertigation of 100 per cent RDF as WSF resulted in higher plant nutrient uptake and availability of soil nutrients at various growth stages of crop growth owing to easily available form of applied nutrients. Further, drip fertigation integrated with liquid biofertilizers and humic acid created favourable condition for multiplication of beneficial microorganisms in the rhizosphere region.

The nutrient mobility study revealed that fertigation treatments maintained higher concentration of available N and K around root zone of bhendi compared to surface irrigation with soil application of recommended dose of fertilizers where most of the nutrients moved to deeper layer due to leaching fraction of applied fertilizers. Fertigation of P at various levels also resulted in more available P at all soil layers compared to soil application of fertilizers. The resource use efficiency parameter *viz*., partial factor productivity declined with increasing levels of fertigation. The water use efficiency was higher under drip fertigation of 100 per cent RDF as WSF. Though the initial investment cost on drip fertigation system was more, drip fertigation of 100 per cent RDF as WSF resulted in higher net returns.

From the foregoing, it is concluded that drip fertigation of 100 per cent RDF as WSF at six days interval would be an ideal practice to achieve higher income as compared to traditional method of applying fertilizers with surface irrigation.

STUDY ON THE INFLUENCE OF IRRIGATION REGIMES AND FUSTIGATION LEVELS ON SUGARCANE UNDER SUBSURFACE DRIP FUSTIGATION SYSTEM

Gurusamy. A., P.P. Mahendran S. Krishnasamy, V.Kumar

ABSTRACT

Field investigations were carried out at the central farm, Agricultural College and Research Institute, Madurai, Tamil Nadu during 2008-09 and 2009-2010, to elicit information on the influence of irrigation regimes and fertigation levels on sugarcane under subsurface drip fertigation system. The experiments were laid out in Split Plot Design with three replications. The main plots treatment consisted of three subsurface drip irrigation regimes viz., 75 per cent Etc (I_1), 100 per cent Etc (I_2) and 125 per cent Etc (I_3). The subplot treatment consisted of six fertigation levels viz., 75 per cent RDF as commercial fertilizers (F_1), 100 per cent RDF as commercial fertilizers (F_2), 75 per cent RDF – 50 per cent commercial and 50 per cent water soluble fertilizers (WSF) (F_3),.
100 per cent RDF – 50 per cent commercial and 50 per cent WSF (F_4), 75 per cent RDF as WSF (F_5) and 100 per cent RDF as WSF (F_6).The sugarcane variety CO 86032 was used for this study. Subsurface drip irrigation was given once in 3 days and fertigation was given once in 6 days.
Tiller production and number of millable canes were higher in drip irrigation at 125 per cent Etc along with fertigation of 100 per cent RDF as WSF (I_3F_6) which was comparable with 125 per cent Etc along with 75 per cent RDF as WSF (I_3F_5) in both plant and ratoon crop. The combination of drip irrigation at 125 per cent Etc with 100 per cent RDF as WSF registered higher cane and sugar yield but it was comparable with 125 per cent Etc along with 75 per cent RDF as WSF in both crops. Surface irrigation with soil application of fertilizers recorded lower cane and sugar yield when compared to subsurface treatments. The subsurface drip irrigation regime of 125 per cent Etc registered higher total water use followed by 100 per cent Etc and 75 per cent Etc in plant and ratoon crops. The treatment combination of 75 per cent Etc along with 100 per cent RDF as WSF

(I_1F_6) recorded higher WUE and water productivity. Higher net return was recorded in 125 per cent Etc with 75 per cent RDF as water soluble fertilizers in plant crop however in ratoon crop, higher net return was observed in 125 per cent Etc with 100 per cent RDF as WSF. Higher BC ratio was associated with drip irrigation at 125 per cent Etc in combination with 100 per cent RDF as commercial fertilizers followed by drip fertigation of 75 per cent RDF as commercial fertilizers at 125 per cent Etc in both crops.

Keywords: Subsurface drip irrigation regimes, Dip fertigation, cane yield, water use efficiency, water productivity

MICRO-SPRINKLER IRRIGATION AND FUSTIGATION AND LAND CONFIGURATION AS A BEST MANAGEMENT TECHNOLOGY PACKAGE FOR GROUNDNUT

R. Vijayalakshmi[1], V. Veerabadran[2], K.Shanmugasundram[3], V.Kumar[4]

ABSTRACT

Field experiments were undertaken to study the effect of micro-sprinkler irrigation with fertigation under different land configurations on groundnut pod yield and water use efficiency at Agricultural College and Research Institute, Madurai, Tamil Nadu during June-September, 2002 and January-April, 2003. Soil application of fertilizers in surface irrigation was scheduled at 0.80 IW/CPE ratio with 6 cm depth under two types of land configuration. Micro-sprinkler irrigation was scheduled once in three days with two levels of irrigation (100 % ETc and 75 % ETc) and two methods of fertilizer application (soil application and fertigation) under two types of land configuration (check basin and broad bed and furrow). It was found that micro-sprinkler irrigation scheduled at 100 % ET_c recorded total water saving of 28 - 31per cent while micro-sprinkler irrigation scheduled at 75 % ET_c registered total water saving of 32 - 38 per cent over surface irrigation. Micro-sprinkler irrigation at 100 % ET_c with fertigation under broad bed and furrow registered the highest pod yield (3776 - 3844 kg/ha) and water use efficiency (8.57 - 9.47 kg/ha-mm) in both the crops.

Keywords: Micro-sprinkler, Fertigation, Land Configuration, Groundnut, Water Use Efficiency

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DEVELOPMENT OF A SOFTWARE FOR AUTOMATIC DESIGNNING OF PRESSURIZED IRRIGATION SYSTEMS

Sa'eed Ojaghloo Shahabi[1], Majid Vazifedoust[2]

ABSTRACT

Agricultural water use in Iran is now faced with two major problems: lack of fresh water and low efficiency. In the agricultural sector, development of pressurized irrigation systems can be an appropriate policy in coping with these problems. With growing water scarcity, a large portion of Engineering - Technical development in the coming years will be assigned to the designing of pressurized irrigation systems. Development of under pressurized irrigation requires the development of various engineering tools. However, what is remarkable is role models and software engineering in speed of data analysis, design capability and minimizing human errors in calculation.

This paper reflects the technical characteristics and capabilities of a developed model (FARMWAT) by irrigation students of Guilan University. The model automatically design pressurized irrigation systems with high efficiency. The programming language of model is written under windows Visual Basic 6.0. The model has capability of drawing the layout of irrigation system, receiving the required data in the design, receiving the land topography, data analyzing and reporting of designed parameters for the user. FARMWAT, using its graphics and editing tools, allows user to enter or edit the required input data of irrigation system. After drawing the desired system, by clicking on each tube, users are allowed to view and edit the user information of each tube. The design requirements are limited to the water, soil and plant characteristics (such as soil depth, soil salinity, final infiltration rate, total available moisture stored in the root zone, water use efficiency, during the growing season...), and profile system installations (such as available water and nominal pressure of sprinkling, base

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height of sprinkles, as well as, number and diameter of each pipe ..). Data analysis in the model is including: Determination of land's topography changes during each pipe, hydraulic calculations of system and computing of system parameters. Currently, this software is capable of designing a sprinkler irrigation system type wheelchair (wheel move). It is clear just by adding the subroutines related to data analysis, FARMWAT can be used to model all kinds of possibilities in irrigation systems. Model's outputs can be summarized as irrigation depth, irrigation interval, daily settlement period lateral, lateral number and number on them by sprinkling, discharge of each lateral, dynamic pressure and total incoming discharge for the whole system.

Capabilities in precision applications such as AutoCAD and Excel show all of their facilities to serve for processing, editing and recording data received from the user. Communicating with the user requires a mechanism that can be a first step in the success of any software. FARMWAT is claimed to be complete user friendly software. This model and its features improve the quality of irrigation designs and level of education in irrigation systems, as well as, enable students and experts to get benefit of its facilities.

OPTIMIZATION OF WATER AND NUTRIENT REQUIREMENT FOR YIELD MAXIMIZATION IN HYBRID RICE UNDER DRIP FERTIGATION SYSTEM

V. KUMAR, A.GURUSAMY, P.P. MAHENDRAN & S.MAHENDRAN[1]

ABSTRACT

Field experiments were conducted at central farm, Agricultural College and Research Institute, Madurai, during *Kharif* and *Rabi* 2008 - 2009 to study the effect of drip fertigation on growth and yield of hybrid rice. The experiments were laid out in factorial randomized block design with four replications. The treatments consisted of two irrigation regimes (drip irrigation at 100 % and 150 % PE) and five nutrient levels viz., soil application of 100 % RDF, drip fertigation of 100 % RDF (P as basal, N and K as urea and Kcl), drip fertigation of 50, 75 and 100 % RD of P and K (50 % P and K as basal remaining N, P and K as WSF + LBF). Drip irrigation was scheduled once in two days and fertigation was given once in six days as per the treatment schedule.

Drip irrigation at 150 % PE exhibited better plant height, number of tillers, leaf area index, root characters and dry matter production in hybrid rice. Similarly, it accounted for higher number of productive tillers per hill, panicle length, number of filled grains per panicle, grain and straw yields. The sterility percentage was also lesser in this treatment.

Among the nutrient levels, drip fertigation of 100 per cent RD of P and K (50 % P and K as basal remaining, N, P and K as WSF + LBF) registered better plant height, number of tillers, leaf area index, root characteristics and dry matter production. Yield attributes *viz.,* higher values of number of productive tillers per hill, panicle length, number of filled grains per panicle, grain and straw yields of hybrid rice found

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to be comparable with drip fertigation of 75 per cent of P and K (50 % P and K as basal remaining, N, P and K as WSF + LBF).

The above treatment also recorded higher N,P and K uptake and lower post harvest soil available N, where as the post harvest soil available P and K were lesser under drip fertigation of 50 per cent of P and K (50 % P and K as basal remaining, N, P and K as WSF + LBF).

Drip irrigation at 100 % PE was found to be better than other irrigation regime (150 % PE) as for as water use is concerned. It has registered an optimum consumptive water use and higher water use efficiency.

Net return and benefit cost ratio were higher with drip irrigation at 150 % PE with drip fertigation of 75 per cent of P and K (50 % P and K as basal remaining, N, P and K as WSF + LBF). It was followed by drip irrigation at 150 % PE with drip fertigation of 100 per cent of P and K (50 % P and K as basal remaining, N, P and K as WSF + LBF)

From the above study, it can be concluded that the rice hybrid Co(R) H3 responded well to the combination of drip irrigation at 150 % PE with drip fertigation of 100 per cent of P and K (50 % P and K as basal remaining, N, P and K as WSF + LBF) maximizing the yield and gross income. However, drip irrigation at 150 % PE with drip fertigation of 75 per cent of P and K (50 % P and K as basal remaining, N, P and K as WSF + LBF) recorded higher net income compared to other treatments. Hence, drip irrigation at 150 % PE with drip fertigation of 75 per cent of P and K (50 % P and K as basal, remaining N, P and K as WSF + LBF) was found to be the best treatment combination for hybrid rice.

STOCHASTIC DEFICIT MICRO IRRIGATION OPTIMIZATION

Hosein Alizadeh[1], S. Jamshid Mousavi[2]

ABSTRACT

A short term stochastic optimization-simulation model of deficit micro-irrigation, which distributes crops water stress over whole growing season, has been developed and tested in this study. The model, which is a nonlinear program with an economic objective function, considers interaction of stochastic rainfall and irrigation. It includes an eco-hydrologic-based simulation model that integrates an explicit stochastic analytical soil moisture model with the FAO crop yield model. Under some simplistic assumptions, analytical expressions have been derived for estimating expected value of crop yield and irrigation requirement volume along with assessing credibility of the assumptions made. While the developed explicit stochastic optimization model is of NLP form and showing convexity properties, it is computationally efficient comparing a similar implicit model which is time-consuming due to necessity of simulating the system for many realizations of rainfall events. Therefore, the model was effectively used in multi-crop situations and is extendable to be utilized in long-term irrigation planning models. The model was used in Dasht-e Abbas irrigation district of Karkheh basin in southwest of Iran, multi-crop realistic case. Results show that the proposed modeling approach with fast converging property is computationally efficient. It was also observed that for a multi-crop case with the same soil and climate conditions for all crops, three key factors, including potential crop yield, crop price and irrigation demand; chiefly participate in denoting the best deficit irrigation strategy under water shortage condition.

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EFFECTs OF DRIPIRRIGATION AND FERTIGATION LEVELS ON THE YIELD AND QUALITY OF MUSCAT GRAPES (*VITIS VINIFERA*)

N. Asokaraja[1]

ABSTRACT

The present investigation was taken up with an aim to optimize the dripirrigation requirement and to to determine correct fertigation schedule so as to maximize water and fertilizer use efficiencies along with fruit quality improvement in Muscat grapes. Three levels of dripirrigation were scheduled at 100%, 75% and 50% of computed Irrigation Requirement (IRc) and 3 levels of fertigation were carried out at 125%, 100% and 75% of recommended NPK with imported grades of Water Soluble Fertilizers (WSF) as well as Normal fertilizers (NF) like Urea, Phosphoric acid and Potash. Results from this project showed that optimum dripirrigation scheduling is once in 3 days and at 100% IRc (about 20-25 liters/vine/day) with a total water requirement of 370 to 450 mm in the growing season including effective rainfall. Fertigation with NF was found to be equally superior and cost effective to that of fertigation with WSF. Drip fertigation at 125% of recommended NPK dose was superior to 100% dose both in WSF and NF revealing that there is greater response for enhanced fertilizer dose with Muscat grapes for maximum production. Dripirrigation at 100% IRc was superior to lower levels of 75 and 50%. No. of bunches per vine, number of berries per bunch, berry weight and yield per vine were favourably improved by dripfertigation with WSF. Maximum fruit yield (27.5 tonnes/ha) in Muscat grapes was possible with WSF at 125% dose under higher dripirrigation level of 100% IRc followed by NF (25.86 tonnes/ha).

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Fertigation at 75% dose with NF was economical as compared to WSF. Fruit quality of Muscat grapes was greatly improved with higher TSS and total sugar with less acidity by drip fertigation with WSF followed by NF. Maximum gross income was obtained with dripfertigation with WSF at 125% dose, INR 4, 12,500 (US $ 8417) per ha and INR 3, 87,900 (US $ 7914) in case of NF. However, NF has registered higher benefit cost ratio ranging from 1.92 to 2.36 per rupee invested as compared to WSF. Thus drip fertigation with NF was economically superior to WSF in Muscat grapes chiefly grown in Tamil Nadu State in India.

DRIP AND FILTRATION EQUIPMENT'S PERFORMANCE

Felix B Reinders[1]

ABSTRACT

Drip irrigation together with the heart of the system, its filtration, is considered as one of the most efficient irrigation systems. However, it is of utmost importance to correctly select, plan, design, install and to properly maintain it for the successful long-term operation.

About 40 years of progress and development have taken place in the drip irrigation industry and many types of drippers and filters are available today.

Research was carried out by the Agricultural Research Council's-Institute for Agricultural Engineering (ARC-IAE) on three drip irrigation companies' drip irrigation equipment and eight different irrigation filters (sand, disc and screen) to determine the performance of the drippers and the filters. Evaluations were also carried out in the laboratory and on field as well under farming conditions.

The results of the project showed that the good performance of the different drippers and filters can be maintained when a proven maintenance schedule is followed.

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EVALUATION ON THE IRRIGATION WATER TEMPERATURE CHANGES INFLUENCING THE COMPENSATING AND NON- COMPENSATING EMITTERS HYDRAULIC PROPERTIES

Ali Heidar Nasrolahi[1], Majid Behzad[2], Saeed Boroomand Nasab[3], Faramarz Judy[4]

ABSTRACT

Discharge of emitters changes by various factors such as pressure, manufacturing coefficient of variation, obstruction and temperature of irrigation water. In order to review the effects of temperature on discharge of emitters, 10 types of emitters were tested in irrigation laboratory in Water Sciences Engineering Faculty of Ahwaz, "Shahid Chamran University", In this research, the effects of 4 different temperatures i.e. 10, 20, 30, 40 °c under 4 pressures i.e. 5. 10, 15, 20 m were reviewed. For experiments in temperature of 10° , the ice was used and in temperatures of 30° and 40° , a tank equipped with an element and controlling unit for temperatures respectively was used. Then by calculation of manufacturing coefficient in temperature of laboratory (20°c) and based on American Society of Agricultural Engineers Standard of variation in qualitative classification of emitters was done which, in result , four types were excellent, two ones, unusable and the rest were between both conditions. With regard to obtained results by raising temperature of irrigation water, the discharge of non-compensating emitters was increased. In compensating emitters, the temperature didn't have meaningful effect on discharge of emitters in 3 cases of temperature, but in two types caused up to 7decreased discharge. In final, result

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showed that Temperature doesn't have a meaningfull effect on manufacturing coefficient of variation.

Keywords: emitter, manufacturing coefficient of variation, water temperature, pressure

EFFECTS OF FERTIGATION UNIFORMITY ON COTTON YIELD AND QUALITY UNDER ARID CONDITIONS

Hongjie Guan[1], Jiusheng Li[2], Yanfeng Li[3]

ABSTRACT

Drip irrigation under plastic mulch can be the most efficient in-season water application method for cotton production in the arid area of Xinjiang Uygur Autonomous Region, China. One of the biggest obstacles to the widespread adoption of this method is the high cost of initial installations. The costs of drip irrigation installations may be reduced if the systems are designed using a uniformity that is lower than the costs recommended by the current standards. However, it is left unclear that whether lower fustigation uniformity results in a decreased lint yield and quality in the arid regions or not. Field experiments were conducted in the arid environments to evaluate the effects of fertigation uniformities on growth, nitrogen uptake, lint yield, and quality of cotton. In the experiments, three fertigation uniformities of 0.60, 0.80, and 0.99 (referred to as C1, C2, and C3, respectively) and three irrigation levels of 50%, 75%, 100% of irrigation requirements (referred to as I1, I2, and I3) were used. The results demonstrated that plant height and leaf area index (LAI) were sensitive to nonuniformity of water and fertilizer applied. During the growing season of cotton, a great decrease of *CU* for plant height and LAI was observed for the low and medium uniformity treatments of C1 and C2, while a slight increase in the *CU* was observed for the high uniformity treatment of C3. Only at the full

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irrigation level of I3 did fertigation uniformity have a positive effect on lint yield, although the lint yields among different *CU* treatments were not significantly different. Fertigation uniformity imposed an insignificant influence on the mean values of plant height, LAI, nitrogen uptake, lint yield, and quality parameters; but significantly reduced the uniformity for plant height, LAI, and nitrogen uptake. In the arid regions, the possibility of using a drip irrigation uniformity that is lower than the values recommended by the current standards should balance the installation and operation costs, crop production, and products quality.

NITROGEN AND POTASSIUM CITRUS TREE UPTAKE, FRUIT REMOVAL AND SEASONAL DISTRIBUTION IN THE ROOT ZONE UNDER IMPROVED FERTIGATION MANAGEMENT PROGRAM

Abdelkader Hammami[1], Hafedh Jamil Mellouli[2]
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ABSTRACT

Optimum application of nitrogen and potassium fertilizers to citrus grove requires information's regarding existing soil N and K residues, dynamics in soil, and tree N and K requirements. However, more understanding of the fate of nutrients in the tree root zone soil matrix provides useful information to develop fertilization management practices with an adequate balanced N and K citrus needs that maximize tree uptake efficiency by minimizing losses of water soluble nutrients. The objectives of this work, was to assess the effects of nitrogen and potassium rates applied through drip irrigation system, on the citrus trees nutrient uptake, fruit nutrient removal and seasonal dynamics of fertilizer-N and K in the root zone. A field trials were conducted from 2005 to 2007 in the citrus production area located in the North East of Tunisia (El Gobba, Cap Bon); on sandy soil with 25 years old 'Clementine mandarin' trees (C.*reticulata*) on 'Sour orange'(C.*aurantium)* rootstock. Nitrogen and potassium rates from 160 to 232 kg $ha^{-1}yr^{-1}$ and 200 to 290 kg $ha^{-1}yr^{-1}$, respectively, were applied as fertigation through a drip irrigation system. Irrigation was scheduled based on soil water content monitoring by daily tensiometer readings at the root zone. Fruit yield was positively associated with N (r^2=0.91**) and K (r^2=0.84**) rates, indicating that application of 192 and 200 kg $ha^{-1}yr^{-1}$ of N and K_2O (N:K=0.9), respectively, are required for Clementine mandarin trees to support optimal fruit yield of 43 T $ha^{-1}yr^{-1}$. These responses suggest that N and K tree use efficiency varied from

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4.5 to 3.9 kg T^{-1} of Clementine mandarin fresh fruit, respectively. On the other hand, tree nutrient removal indicated that both total N (r^2=0.97**) and K (r^2=0.98**) in fruit were positively linear correlated with fruit load, and there was also, a strong linear relation (r^2=0.97**) between N and K in fruits, which supports the needs to maintain 1:1 ratio between the rates of N and K_2O applications. Further more, nutrient uptake efficiency (mineral fruit removal: fertilizer applied ratio) were 32.5% and 27.5% for N and K, respectively. However, the selected fertigation management program, has contributed not only to optimize fruit yield but also to enhance tree nutrient uptake and water use efficiency by minimizing losses below tree root zone. Consequently, it should be an essential component of best management practices for Clementine mandarin under semi arid Mediterranean conditions.
Keywords: Tree nutritional requirements, nutrient use efficiency, Mediterranean conditions.

PRESSURE RESISTANT EMITTER DESIGN FOR THE TRICKLE IRRIGATION SYSTEM

Momon Sodik Imanudin, Robiyanto Hendro Suanto[1], Bistok Simanjuntak[2]

ABSTRACT

The research objectives were to develop block emitter having S, Y, and Phi types suitable for high pressure conditions in drip irrigations system and to test and compare the discharge for each type of emitter in the laboratory. Stages in this research were as follows: 1) designing block type of emitter; 2) developing of block structure media; 3) developing structure block; 4) installing and testing the emitter in the laboratory; and 5) Analyzing data. Results of laboratory test showed that the average discharge for each emitter Phi, S, and Y were 0.2; 0.08; and 0.1 ml/sec, respectively. The highest discharge was found on the Phi structure, while the discharge for S and Y structures were similar. The variability of discharge due to structure design in each emitter had different effect in reducing pressure. Technical evaluations showed that type of Y structure was simpler to develop than the other two structures. Phi style was the most difficult one to be developed. The main reason was related to the complexity in making structure pattern in the block of emitter. Recommendation for applying emitter was strongly influenced by crop and soil type. Crop which needs high water and planted in the high porosity soil may use emitter with small discharge for long time application. On the other hand, the soil with heavy soil texture may use the high discharge emitter for short time application.

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Theme 4

- Socio-economic consequences of the conversion of traditional systems to micro irrigation systems
- Analysis of long term sustainability of micro irrigation systems
- Technical Performance and quality assessment of micro-irrigation systems.
- LCA (Life Cycle Analysis) applied to micro irrigation

SOCIO-ECONOMIC AND POLICY-INSTITUTION ISSUES AND CHALLENGES IN SUSTAINABLE DEVELOPMENT OF PRESSURIZED IRRIGATION SYSTEMS IN IRAN

Nader Heydari[1], Hossein Dehghanisanij[2]

ABSTRACT

Sustainable development of pressurized irrigation systems is a key to mitigate the crises of water scarcity, mainly because of more demand for food, in Iran. However, despite the importance of the issue, little areas of lands are equipped with the pressurized irrigation systems. Moreover to the different technical, technological and infrastructural problems and challenges associated with the sustainable development of pressurized irrigation systems in Iran, socio-economic and policy-institution issues and problems are among the important cases. Therefore, the objective of this research project was to systematically identify the socio-economic and policy-institution problems, issues, and challenges associated with the sustainable development of pressurized irrigation systems in Iran. The methodology of the program was fully participatory, with the participation of representatives of different stakeholders in the water and the agriculture in general, and the experts, and resource persons in pressurized irrigation enterprise of the country in specific. Based on the results, the main socio-economic and policy-institution problems hindering sustainable development of pressurized irrigation systems in Iran could be categorized in the following categories: Economic and finance problems (including national economy, costs to the beneficiaries, banking and finance and credit issues), socio-cultural problems (including socio-cultural basis and capacity building, inefficiencies in adaptation of the systems, and weaknesses in agricultural

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production systems), policy and institutions issues (including organizational and human resource structures weaknesses, and problems associated with the policy and planning, inefficiencies in motivation of beneficiaries willingness toward acceptance and adaptation of the systems). Quantity basis, the identified problems were totally 88 cases, of which the economic-finance, socio-cultural, and policy-institution problems, included 39.8, 29.5, and 30.7 percent of total problems respectively.

Keywords: Pressurized irrigation, Socio-economic, Policy-Institution, Sustainable development, Problem, Challenge

RESEARCHABLE AND PROMOTIONAL ISSUES IN MICROIRRIGATION

H.S.Chauhan[1]

ABSTRACT

Micro irrigation is an efficient method of water application, applicable mostly for fruits vegetables and field crops. It was introduced in India about 3 decades back which has expanded at a very fast rate. Its coverage has been higher than most of the countries. Although its application has progressed in most of the states in India, it has extended maximum in Maharashtra, Gujarat, Karnataka, Taminadu and Andhra. A number of system manufacturers have come up which not only to manufacture but also to design install and maintain the systems. The Government of India is also providing subsidy to encourage its application. However with fast expansion a number of concepts and issues have also evolved relating to Crops, Micro irrigation components, Standardization, and Implementation. The objective of this paper is to describe the concepts and analyze the problems.

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LIFE OF MICROIRRIGATION COMPONENTS

H.S. Chauhan[1]

ABSTRACT

Application of Micro irrigation for different crops has increased globally in the last few decades. Being an expensive system and requiring periodic replacement, there is a need to determine the life of its components. This is also necessary to calculate the comparative economic advantages with other prevailing systems. Although it has several components, the lateral pipes are required in large quantities. Not much literature is available on this subject. However, an attempt has been made to discuss various aspects on laterals and the feasibility of a novel method known as Artificial weathering to estimate the life of LLDPE plastic pipes.

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COMPARED EFFICIENCY, CONSUMPTION AND WASTE OF ENERGY BETWEEN DRIP AND SPRINKLER PUMPING PLANT IRRIGATION

S. Rezvani[1], M. Farzamnai[2], A. Zolfagharan[3], S. Amin[4]

ABSTRACT

For efficiency and consumption of energy measurement in irrigation pumping plant, a project was performed from 2007 to 2009 in some fields in Hamedan, Kerman and Khorasan Razavi provinces. Nebraska Pumping Plant Performance Criteria (NPPPC) was used for comparison of pressurized irrigation pumping plant energy efficiency. Overall energy efficiency and waste energy were measured in electrical and diesel pumping plant. Electromotor and pumping efficiency were measured in electrical pumping plant. Technical measurements were done in 44 fields in Hamedan, Kerman, and Khorasan Razavi, with 22-drip and 22-sprinklers for irrigation in these fields. Results showed average of overall energy efficiency in electrical pumping plants to be 48.5 percent (73.5 present NPPPC) and in diesel pumping plants 12.3 percent (51.3 percent NPPPC). Average of waste fuel consumption in diesel and electrical pumping plants was 3.9 liters diesel per hour and 9.8 kW-h, respectively. Energy consumption in electromotor and diesel pump was 60.5 percent and 115.4 percent as compared to actual energy, respectively. Average electromotor and pump efficiency were 91.3 and 50.6 percent in pressurized irrigation, pumping plant did not connect directly to the well and the average of electromotor efficiency was only higher than NPPPC. Average of overall energy efficiency in motor-powered pumping plants was 48.0 and 49.2% in trickle and sprinkler irrigation, system respectively. Comparison of means with t-test showed overall energy efficiency did not reveal

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significant difference in sprinkler and drip irrigation systems with electric-powered pumping plants. For each percentage increased in overall energy efficiency, the average of excessive energy consumption decreased 0.6 and 0.4 kWh in sprinkler and drip irrigation systems, respectively. Average of excessive energy consumption in sprinkler and drip irrigation systems was 60.6 and 60.5% more than NPPPC, respectively. Average of electric-motors efficiency was 92.7% and 89.5% in sprinkler and drip irrigation systems, respectively. Pump efficiency could be estimated from overall energy efficiency and electric-motors efficiency. Mean of pumps efficiency was 51.2% and 50.0% in drip, and sprinkler irrigation systems, respectively.

Keywords: pressurized Irrigation, Energy, Nebraska Pumping Plant Performance Criteria, Overall energy efficiency

ENVIRONMENT MONITORING AND ESTIMATION OF WATER REQUIREMENT INSIDE A POLYHOUSE THROUGH INTERNET

Neelam Patel[1], T.B.S. Rajput[2]

ABSTRACT

Polyhouse cultivation gives higher yield, higher productivity, better quality produce and production throughout the year. Capsicum (*Capsicum annum L.)* is a valuable vegetable crop with excellent prospect both for the domestic and export market. To ensure its regular and off-season supply, technology for growing of capsicum under protected conditions needs to be standardized. Irrigation is one of the most important inputs, which affects the yield and quality of agricultural produce from polyhouse. Efficient irrigation in polyhouse can be achieved by accurate estimates of evapotranspiration. The important factors to control the polyhouse evapotranspiration are solar radiation, air temperature, relative humidity and wind speed. Control and monitoring of environmental parameters inside a Polyhouse, so as to ensure continuous maintenance of favorable crop atmosphere is the objective of the work presented in this paper. The objective is achieved through the use of internet based technology. The polyhouse has a direct effect on air temperature, and relative humidity and an indirect effect on soil temperature and soil moisture inside the polyhouse. Climatic parameter inside a polyhouse need to be controlled to ensure timely and abundant yields. The present study has been undertaken to study the effects of climatic variability on the evapotranspiration and to determine the schedule of irrigation of drip irrigated capsicum in a naturally ventilated polyhouse. Web enabled automatic weather station having sensors for real time online measurement of soil temperature, soil moisture, ambient temperature, humidity, leaf wetness, solar insolation, was installed inside the polyhouse.

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Capsicum (*Capsicum annum L.)* was transplanted inside the polyhouse and crop evapotranspiration was estimated. The system also allows transmission of process parameters, including sending a SMS on a mobile phone. The concept encompasses data acquisition through a sensor network, data storage, post processing and online transmission of data to multiple users logged on to web-browsers. Further, control of process parameters of a Polyhouse control of pumps and accessories and ventilators in real time was also possible. From, this study it is concluded that the total crop water requirement of capsicum under inside polyhouse was about 20-40 % less than outside the polyhouse. Farmers do require expert guidance to use this new technology of Polyhouse farming. This methodology of farming reduces dependency on rainfall and makes the optimum use of land and water resources; typical gains may be three times as much as those of traditional farming.

SOLAR POWERED CONSTANT / CONTINUOUS MOVE CENTRAL PIVOT IRRIGATOR

Padmakar Waman Kelkar[1]

ABSTRACT

Water efficiency with respect to yield, is a very crucial factor, in agriculture now. In the case of remote fields, due to lack of electricity, it may not be possible to cultivate the fields, even when sufficient water is available. It is very difficult to have the electricity at that location. Solar Powered Central Pivot Irrigator is an ideal for such applications, not requiring any electricity to drive the machine, which can be programmed to irrigate the fields, for predefined time at predefined time even during nights, reducing water requirements still further. The machine will start at pre-programmed set time. Real Time Clock (RTC) takes care of timing issues. One has to only supply water at Pivot point. Water can be pumped from remote area, where water and electricity are available. The machine will stop, automatically, during low water pressure, not counting time, and will resume, moving when water pressure develops again. Constant or Continuous move concept, distributes water more evenly, increasing the yield still further. Since all the towers move all the time, multiple start / stops are avoided, improving the life of the machine substantially, reducing maintenance. The probability of churning of wheels in muddy field is greatly reduced as well. A Slip timer incorporated in the machine takes care of this problem, avoiding excessive water and crop loss. All other advantages like even distribution of Liquid Fertilizers, Insecticides, and Anti Weeds, associated with central pivot irrigator, increasing the yield are also provided. Lacking calcinations of soil, is one of the major advantages with this system. Remote uncultivated undulated areas without tedious & expensive preparation with predefined slopes are

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brought under cultivation, delivering extra yield to the tune of 150-180% with additional extra 30-40% coverage area, with the same volume of water uses and pumping costs, due to reduced water requirements. The machine is tested with 27 Degree slope. Since no trenches required, we get additional coverage area of 15-20%, adding the yield still further.

Sometimes due to uncertainty in rains, and climate change, we may be required to make double sowing, which can be avoided by this machine. It was seen in the year 2008, it rained in the first week of June, as usual, but it skipped for next 4-5 weeks. Since the machine was installed, the field was watered, avoiding any loss. The yield was normal.

As regards to farming community is concerned, one is not required to toil, watering the fields, in hot scorching heat, thus improving the standard of living of both farmer and farm labour.

KeyWords: Solar power, Central Pivot, Constant Move, Slip Timer, Even distribution of water, yield.

ACHIEVING TARGETED GROWTH THROUGH MICRO IRRIGATION

LILY MITRA

ABSTRACT

Micro irrigation in agriculture armed with knowledge and technologies with farmers as beneficiaries is one of the best approaches towards sustainable growth. The technology is enhancing water use efficiency with agriculture production and productivity. The technology is bound to maximize the synergistic interactions of improved seeds, water and fertilizer. Through micro irrigation, an evergreen revolution may be pictured to ensure the congruence of the sustainability, productivity, profitability and equity. Since micro irrigation greatly enhances water, fertilizer and energy use efficiency and promotes precision agriculture, the targeted growth could be achieved without the burden of environmental degradation.

METHOD, SYSTEM, AND APPARATUS OF RADIAL IRRIGATION AND IRRIGATION OF REGULAR AND IRREGULAR LANDS

Seyyed Hadi Abtahi[1]

ABSTRACT

Radial irrigation system and apparatus and irrigation regular and irregular lands, which is known as the first Pressurized irrigation system and apparatus in Iran, and the newest irrigation system and apparatus in the world, not only solves many difficulties of the present irrigation systems in the world, but also has a lot of advantages. This system has the capability of irrigating different lands with various shapes like triangle, square, rectangle, lozenge, parallelogram, regular hexagon, and irregular lands.

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Dr.Iradj Yaghmai has been managing director of company since 1989. He is a Ph.D degree in Mechanical Engineering from university of Minnesota ,USA .

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Dam

Irrigation & Drainage Network

Water & Waste Water

River Engineering

Environmental Engineering

مهندسین مشاور
پویاب
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AB & TOSSEA PAYDAR

Consulting Engineers

- Dams & Hydropower
- Irrigation & Drainage Network
- Water & waste water
- River Engineering
- Environmental Engineering

About Ab & Tossea Paydar at a glance

- Ab & Tossea Paydar is an Iranian private Consulting Engineering was Founded on 1994 with over 16 years experience.
- To keep abreast of the latest technology in water industry, For providing a wide range of consulting and Management services , for all aspects of project development, from inception to implementation and post-commissioning to data.
- Ab & Tossea Paydar, was recognized by the «plan and budget organization of IRAN» (PBO) & also ISO Certificate on the quality control of our studies and supervisory activities.

شرکت مهندسی مشاور طوس آب

TOOSSAB

Consulting Engineers Co.

طوس آب

شرکت مهندسی مشاور

شرکت مهندسی مشاور طوس آب طی بیست و هفت سال فعالیت در راستای ارائه خدمات مهندسی آب توفیق این را داشته تا ضمن نوآوری در انجام پروژه ها، رضایتمندی کارفرمایان داخل و خارج کشور را نیز جلب نماید.

شرکت مهندسی مشاور طوس آب از همان ابتدای تأسیس تاکنون با اعتقاد به رسالتی که بر دوش خویش احساس می کند، تلاش نموده تا کارشناسان متعهد و تراز اول رشته های فنی و مهندسی را به همکاری فرا خواند تا بتواند پروژه های مختلف مطالعاتی، طراحی و نظارتی صنعت آب و فاضلاب را به پایان رسانیده و مهیا جهت بهره برداری نماید.

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