Executive summary

Introduction

Drip irrigation is considered as the most efficient irrigation system, but there is proof from literature that this system can also be in-efficient, as a result of water quality, mismanagement and maintenance problems. Clogging of the emitters is one of the most serious problems associated with drip irrigation and various approaches in preventing the clogging of emitters include filtration, flushing and chemical treatment of the irrigation water. Through this project, guidelines were developed to enable irrigators with drip irrigation systems to apply good management and maintenance schedules to enable them to adhere to the conditions of the National Water Act regarding the efficient and beneficial use of water in the public interest.

Objectives

The National Water Act (Act 36 of 1998) makes provision for water to be protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner to the benefit of all people in South Africa. Currently, drip systems account for 140 000 hectares under irrigation in South Africa. To assist the users to utilise their systems effectively, the research was carried out with the following objectives:

- to determine the performance of various types and ages of drippers under different water quality and typical farming conditions;
- to develop operational guidelines to make the correct dripper choice;
- to enable irrigators to maintain their drip systems effectively and ensure that available water resources are utilized efficiently.

Methodology

An extensive literature study on all facets that can influence the different types of drippers under field conditions was undertaken. Aspects that are addressed in this study include water quality, water treatment methods, inherent factors that effect emitter performance, filtering, system maintenance and design.

Agriplas's Drip-In Regular, Agridrip PC and Netafim's Ram PC drippers were selected, as they were the most commonly used drippers for surface drip in South Africa. The performance of these new drippers, ten models in total, was evaluated under controlled conditions in the hydraulic laboratory of the ARC-Institute for Agricultural Engineering.

In the empirical study, professionals in various disciplines, e.g. design, scheduling, maintenance and supply of equipment were contacted in order to obtain information regarding clogging problems experienced in the various drainage regions in South Africa. Drippers prone to physical, chemical and biological clogging problems occurring in South Africa and used on a large scale in different regions right across the country, were included in the investigation.

With regard to the field evaluation, six catchment areas in South Africa were identified, namely the Berg, Breede, Orange, Kouga and Crocodile rivers, together with the Vivo region where farmers experience problems with drippers that clog. In these areas, a total of 42 systems were identified and selected on a basis of dripper type and dripper age. Dripper systems younger than five years and those older than five years were identified. These systems' performance was evaluated in the field twice a year for two consecutive years, according to ASAE EP 458. Apart from the performance evaluations, data was also collected of the maintenance schedules and water samples were taken for water quality analysis.

After the field evaluation, one dripper line was sampled out of the relevant block and replaced with the same dripper type. Evaluations were then carried out in the ARC-ILI Hydrolab to determine possible causes of clogging. This was repeated the following year.

Results

The new drippers' coefficient of variation (CV_q) varied from an excellent 2,1% to a good 4,2% with an average of 3,12%. The pressure compensated drippers' average CV_q was 3,45% and that of the regular drippers a better 2,63%.

There was a tendency that the Emission Uniformity (EU') as measured in the field of all the dripper types deteriorated over time from a EU' of 87,1% in the first evaluation to 82,4% in the fourth and last evaluation one year later. This is an indication that the performance is affected by clogging due to the water quality and lack of proper maintenance schedules.

Dripper lines from each of the 42 identified blocks were also recovered from the field for two consecutive years and tested in the laboratory. Dripper lines with regular type emitters showed a general tendency of reduced average discharge due to partial or total clogging of emitters while drip lines with pressure compensated emitters showed a general tendency of increased discharge, due to foreign objects that got stuck between the compensating membrane and the labyrinth, or the compensating membrane loosing its elasticity over time due to chemicals and the water quality. If the outlier values of CV_q are disregarded due to severely damaged drippers and heavily soiled dripper lines, the average discharge variation CV_q in the first year was a fair 6,5% for all the drip lines with a variation of 3,0% up to 21,3% for the individual drip lines. In the second year, the average discharge variation CV_q was a poor 8,2% with a variation of 2,7% up to 22,2% for the individual drip lines. This confirms the deterioration of the drippers over time and the importance of proper preventative maintenance.

With regard to the statistical uniformity discharge coefficient (U_s), the Ram PC met the requirements in 84% of the cases, the Drip-In Regular in 58% of the cases and the Agridrip PC in only 50% of the cases. For all three dripper types, no significant conclusion could be reached that the age of the pipe played a role in the degree of clogging. However, it was evident that incorrect or no maintenance of the drip systems contributed in most cases to the decreased performance.

In the laboratory a relative clogging test on new emitters was also conducted. The regular drippers were also significant more resistant to clogging compared to the pressure compensated drippers. The average percentage clogging of the regular drippers is 42,7% in comparison to the 66,6% of the pressure compensated drippers.

Conclusions and recommendations

Proper maintenance schedule and its execution is of utmost importance for the successful long-term operation of any drip irrigation system.

It is recommended that water quality analysis be carried out to identify the potential clogging problems due to water quality. This will assist in dripper type selection and to develop proper preventative measures.

Full details are given in terms of solutions for specific clogging problems, choice and management of equipment to ensure effective water utilization, design principles, operation and maintenance information for best management practices and the importance of a complete design report with details of the system's specifications, maintenance requirements and installation guidelines.

No formal capacity building in terms of postgraduate students took place, but through the study the research team's knowledge was enhanced tremendously and a vast amount of capacity building within the industry and that of producers took place through interaction.

The following aspects need further attention:

- Technology transfer and training of irrigators with practical demonstrations.
- The compilation of a user-friendly manual regarding the maintenance of drip irrigation systems.
- The compilation of a user's guide, which describes the complete development process of an *irrigation system at farm level and norms for minimum acceptable standards for irrigation* equipment and services.
- A further investigation is recommended where the water treatment methods for water sources with a high clogging hazard are practically and experimentally tested.