

# **EXPERT SYSTEM FOR MANAGING CHEMIGATION SYSTEMS**

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للحصول على

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قسم الهندسة الزراعية  
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## ABSTRACT

**Ahmed Zahir El Sayed Marzouk Doukhan: Expert System for Managing Chemigation System. Unpublished Ph.D. Thesis, Department of Agriculture Engineering, Faculty of Agriculture, Ain Shams University, 2011.**

Although, chemigation is usually used to ensure stable productivity of crop-unit area and improve yield-quality, but on the other hands, it becomes undesirable due to its potential hazardous to the agri-environmental resources and humans. Moreover, deficiency of irrigation systems due to cloggy problems and enhancement of energy-head losses due to chemical participation in different equipment represent a serious problem for applying such technology and attributed techniques, as well as, its impact an either yield production and attributed quality parameters or agri-physical resources. The abovementioned, corresponded problems could be avoided, even and even so, good management practices had been considered for all parts of chemigation technology, i.e irrigation systems; water and agro-chemical injecting equipment their self.

Management of a chemigation system requires a highly-qualitative database of the available resources and corresponding field status and conditions. Therefore, for solving the abovementioned problems, management information systems (MIS) plays a curcial role and can be an effective tool which can be used efficiently. One of these tools is that Expert Systems (ES) that presents an approach of complex problem solving behavior of a domain expert in narrow discipline.

Hereby, the aim of this investigation was to build, verify and validate a proto type-rule based expert system for managing chemigation technology and attributed techniques under arid and semi-arid ecosystem conditions of Egyptian agriculture.

The effect of different technical parameters of the injector types on the fertigation solution concentration and fertilizer distribution uniformity. However, the restrictions of this case study are: the applied irrigation system was surface drip irrigation system for evaluating the distribution uniformity; the applied materials were nitrogen fertilizers compositions (Nitrate Sulphate and Ammonium Nitrate), and the position of the chemical injectors were located at the control head.

The effected of the chemical injector placement position on the chemigation management. In general, from data analysis of the hydraulic performances of the injectors it can be concluded that the most suitable placement of the venture injector is that near the target area to can eliminate the concentration losses of applied materials and here by improve the chemigation efficiency.

Results indicated that there was a highly significant correlation degrees ranging from 86.39 up to 95% of the dominant-test method work response to the variants in chemigation equipments and its technical parameters therefore CHEMIGAT-ES has an integrity to observe a good chemigation practices in such extreme cases ad anticipated variables and qualifiers.

**Key Words:**

Irrigation systems , Chemigation, Fertigation, Vegetable crops, Soils, Management criteria.



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## 1- INTRODUCTION

Chemigation technology and corresponding techniques were used to ensure stability of crop productivity and improve attributed quality parameters. On the other hand its use is being discontinued due to its potential hazardous to environment and humans. This may be attributed to the leakage of phasing out the appropriate management of the applied chemigation techniques under diverse field status and conditions. However water and nutrients acquisition by plants, and the formation of depleted zone in the immediate vicinity of the roots are the driving forces for solute movement towards the roots.

Moreover, agricultural system communities are overwhelmed by potentially useful but disorganized information. To realize the maximization of the productivity and quality per unit area or per unit irrigation water, fertilizer use efficiencies and minimization of potential costs, existing knowledge and data have to be better utilized to more intelligently managing on-farm irrigation operations. For solving the above mentioned problems information plays a crucial role, therefore, some new techniques and tools as Management Information Systems (MIS); Decision Support System (DSS) and Expert Systems (ES) can be used efficiently. ES programs are a branch of Artificial Intelligence systems (AI) that present an approach of complex problems which up to the present time have defied attempts to produce real time optimization solutions in simultaneous problem solving behavior of a human expert in a narrow domain or discipline. Moreover, ES is designed to solve problems where conventional decision-making approaches proved to be ineffective or excessively time consuming as a problem characterized by fuzzy data and information and where even the rules to be applied are not well defined.

Therefore, effective chemigation management require a highly qualitative database to realize the maximization profits of either yield production and attributed quality parameter or conserving agric–physical resources for sustainable agriculture; and minimization of potential negative impacts on either irrigation system efficiency or environmental and humans hazardous, Existing knowledge and data have to be better handled to more intelligently managing of chemigation systems.

The aim of this investigation was to build, verify and validate a proto type-rule based expert system for managing chemigation technology and it's attributed techniques under arid and semi-arid ecosystem conditions of Egypt.

## 2. REVIEW OF LITERATURE

There is no doubt that the average crop yield is a function of the irrigation water application factors (application uniformity; depth of application and the amount of daily evapotranspiration supplied by rainfall), the hydraulic variation of distributors as well as the crop sensitivity to the moisture stress. Application uniformity depends on the manufacturer's uniformity of the selected distributors, the hydraulic design and the systems maintenance program. Depth of the daily water application is a management decision that depends on the water availability and costs. Irrigation application should increase until the marginal value of water equals the marginal value of the yield or until no yield reduction occurs in any part of the field. On the other hand, the effect of increased hydraulic variation on yield is a small compared to changes in manufacturing variation, wherever, the increase in the coefficient of variation of the flow rate of 10% cause 4% decrease in relative deficit evapotranspiration and 3.4% reduction in the yield. This may be lead to a loss of net return of the farmer income (**Sammis and Wu, 1985; Bralts and Kesner, 1983; Hanks and Rasmussen, 1982; Garrity *et al.*, 1982 and Sammis, 1981**)

### 2-1- Chemigation management therapy:

Chemigation can be defined as the application of agricultural chemicals (fertilizers, herbicides, insecticides, fungicides, nematicides, etc.) via irrigation water. Fertigation (ferti-irrigation) could be defined as the frequent application of appropriate amounts of fertilizers in irrigation water or through irrigation systems at a time when the crop needs it (**Steduts,1984**). This definition includes surface irrigation methods, pressurized systems and soilless type crop production systems using nutrient solutions (**Steduts,1984**). Fertigation is an agronomic technique which supplies fertilizers to crops through the irrigation water (**Boswell,**