Treenet Proceedings of the 5th National Street Tree Symposium: 2nd and 3rd September 2004
ISBN 0-9775084-4-7

INFLUENCE OF POLYACRYLAMIDES ON THE COMPONENTS OF WATER INFILTRATION IN LIGHT SANDY SOILS OF THE SOUTH AUSTRALIAN MALLEE.

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October 2002

ABSTRACT

Soils from the South Australian mallee were studied to determine the influence that the addition of polyacrylamides (PAM) (x135 and 1011) had when introduced to irrigation water of varying qualities. The addition of PAM to water could be seen to decrease infiltration rates, the effect being influenced by the chemistry of the irrigation water. The use of PAM 1011 at 10 and 1ppm had a greater influence in reducing infiltration rates than x135 at 2.5 and 25 ppm respectively. The influence that both PAM products had on infiltration rates was significantly reduced in the presence of calcium. When sodium was present in the irrigation water the infiltration rates were similar to that in reverse osmosis water. The greatest influence of PAM appears to be in influencing the hydraulic conductivity of the soil.

INTRODUCTION

Soils from three areas of the South Australian mallee, Gurrai, Overland Corner and Blanchtown were collected to determine the effect that adding PAM (1011 and 135) to irrigation water would have in influencing infiltration rates. High infiltration rates in these soils make water loss from the rootzone a critical issue in plant growth and development. Not only does high infiltration rates in sands affect crop water use efficiency, it can also lead to isolated salinity levels as soils go through dry periods as a result of inefficient water retention in soils.

Most published research (refer literature review) indicates that PAM plays a major role in increasing infiltration rates over a wide range of soil types. It is assumed here that most of the research had been conducted on clay soil types, where the impact of PAM on flocculation of clay particles has a role in increasing infiltration rates. However in the sandy soil types of the world a decrease in infiltration rates must be regarded as a key factor in increasing soil water use efficiency and increasing crop production. Retention of water in the rootzone must lead to increased use of this resource, increased nutrient uptake (and or efficiency) as well as major implications on issues facing dryland salinity. In the irrigation industry the use of polyacrylamides could realistically see major changes to current irrigation practices.

Soil water infiltration is a combination of sorptivity and hydraulic conductivity. Sorptivity (S) is the ability of soil to absorb water. Hydraulic conductivity (A) is the ability of the soil to transmit water. S drops as sands become coarser. Water repellant soils also have decrease S values. A can be identified as a measure of texture and conductance. As A increases this equates to a coarser texture or lower viscosity.

It is suggested here that the effect of PAM in soil is influenced by three major factors. These are PAM type and concentration, soil type and chemistry of the irrigation water.

The reality that PAM is a generic term and not a specific one highlights the need for research to identify the PAM product (or configuration used in experimental purposes).

METHOD

Soil samples were packed into acrylic tubes and treated with PAM solutions in reverse osmosis water, 1000ppm and 2000ppm. The salinity levels were made up using sodium and calcium chloride and then combining them to make a solution of SAR 4.6 at 1000 and 2000 ppm. Water was run through a burette and the time taken for each sample to achieve a designated depth recorded. This data was then used to calculate infiltration, sorptivity and hydraulic conductivity.

PAM was applied at 1 and 10 ppm 1011 and 2.5 and 25 ppm x135.

Brief of Results: Blanchetown

Treatment	RO S	 A	Ca 2000 S	 A	Na 2000 S	 A
Control	2.3 3.2	0.5 0.3	4.2 5.8	0.22 0.08	7.5 6.1	-0.2 0.001
1ppm/1011	3.6 2.8	0.04 0.14	5.8 5.4	0.02 0.16	5.1 4.3	0.06 0.1
2.5ppm/135	4.8 5.2	0.02 0.01	3.4 4.1	0.26 0.30	5.7 4.5	0.16 0.22
10ppm/1011	4.3 4.4	-0.09 -0.1	3.2 4.3	0.2 0.09	3.0 3.2	0.18 0.06
25ppm/135	4.1 6.3	0.0016 0.08	5.3 6.3	0.02 0.01	4.7 4.7	0.002 0.001

DISCUSSION

For each soil type significant differences in infiltration rates between the samples was recorded. Gurrai which could be classified as non wetting sand had the slowest infiltration rates and the coarse sand of Blanchetown the fastest. The Overland Corner sample was similar to Blanchetown but had a slightly slower overall infiltration rate.

PAM was seen to influence infiltration rates and in all samples 1011 had a greater effect than x135 at equivalent rates of PAM. (1 v 2.5 ppm).

The addition of calcium to the ‘irrigation water’ was seen to greatly reduce the effectiveness of the PAM in reducing infiltration rates. The influence of sodium was somewhat similar to reverse osmosis water. The presence of calcium in relatively small amounts could be expected to have significant impacts in influencing the effect of the PAM on soil infiltration rates.

A difficulty with undertaking infiltration rate studies in sands is the rapid infiltration rates and the problems in obtaining accurate initial data. This is the single most

influential factor in getting accurate sorptivity data in sandy soil types. Another factor affecting obtaining a realistic figure for sorptivity was the variable wetting front recorded during the initial wetting stage. However there is some indicative values that the use of PAM has had an influence on sorptivity. Again this is influenced by PAM type and water chemistry

The use of calcium rich waters in irrigation can be seen to increase sorptivity and may be an influence in increasing overall infiltration rates as an influence between soil water relationships. It is worth raising here the use of calcium as a facilitator for increasing infiltration rates as a fertigated product, primarily by influencing initial sorptivity. The influence of PAM appears to be most critical in hydraulic conductivity so it is not unreasonable to suggest that the use of PAM and calcium operates on the two different components of water infiltration in soil.
The use of PAM in irrigation waters can be seen to reduce infiltration rates in light sandy soils. This has enormous implications for water use for growing crops under irrigation on these soil types and in high rainfall dryland situation where leaching is a major problem. It is not unfeasible that the use of PAM in these situations may reduce soil acidification by reducing leaching of water through the soil profile.