

SPRINKLER GERMINATION OF ALFALFA WITH SALINE WATER¹

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Introduction

Investigation of sprinkler irrigation of crops with Colorado River water began at the University of California, Imperial Valley Field Station in 1964. Most of the sixteen crops studied showed a significantly higher seedling emergence rate when sprinkled at rates of 3.0 to 4.3 mm/hr than when surface irrigated (Robinson 1969). The better emergence has been associated with lower total accumulation of salts in the seed bed (Robinson 1969), a lower total application of water (Robinson 1970b), maintaining seed beds moist without saturating the soil, and cooling the seed beds during hot periods (Robinson 1970a). The use of sprinklers commercially to germinate seeds has seen a steady increase particularly in the vegetable fields where high emergence rates are essential to successful precision planting (Robinson and McCoy 1965, 1967; Robinson 1970b; Robinson, Mayberry and Johnson 1975; Robinson and Mayberry 1976).

The planting of alfalfa in Imperial Valley has conventionally taken place from September to November and in February and March (Hageman 1976). During the past year sprinklers have been used commercially to establish alfalfa stands during the hotter months when land was available for planting, but previous attempts to obtain stands with flood irrigation have had poor results.

This paper will review the results of alfalfa emergency observations comparing: 1) emergence rates under sprinkler and flood irrigation; 2) emergence when sprinkled with the present Colorado River (total dissolved solids 877 mg/l) and with water artificially raised to 1350 mg/l; and 3) sprinkling with 877 mg/l water and 1350 mg/l water in July, three months later than the conventional planting period.

Germinating Alfalfa Under Flood and Sprinkler Irrigation

A field approximately one hectare in area containing Imperial clay soil was plowed, disced and rototilled to prepare a seed bed. Eighteen kg/ha of Sonora alfalfa seed were drilled in the surface and then 16 plots laid out. Eight plots had 30 cm borders pulled up so that they could be flood irrigated. Eight plots were sprinkled at 4 mm/hr. The surface flood irrigation was applied and allowed to stand three hours (Lehman et al. 1968). The surplus was then drawn off through a sparging meter for measurement. The first irrigation was applied on February 27, 1967. Sprinkling was continued for two days to equal the same volume applied by flooding. The emergence counts were taken from a 3600 cm² area. The sprinkling produced approximately three times the stand of the flooding as shown in Table 1. Observations in the flooded soil showed cracking with seedlings clustered

Table 1. Alfalfa (Sonora) emergence (plants per square meter) when irrigated by flood and sprinkler irrigation on Imperial clay with 850 mg/l water

Seeding rate kg/ha	Date Counted	Irrigation Method		Significance of difference Analysis of variance
		Sprinkler	Flood	
18	4/4/77	404	114	1%

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along the edges of the cracks and fewer plants between the cracks. In the sprinkled area emergence was uniform over the surface. After the soil dried bulk densities of the soil area showed 1.47 g/cc in the sprinkled area and 1.61 g/cc in the flooded area (Robinson et al. 1968).

Alfalfa Emergence with 877 and 1350 mg/l Irrigation

The remaining tests were conducted with UC 76 alfalfa variety in an area with a permanent sprinkler system. The sprinklers had 5/64 inch nozzles on 9 x 12 m spacing delivery 3.05 mm/hr irrigation. On the west side of the area the soil was an Imperial clay, on the east side it was a sandy clay loam. Three plots on each soil were sprinkled with 1350 mg/l and three each with 877 mg/l water. The 1350 mg/l water was artificially produced from that available by adding solutions of NaCl, MgSO₄, CaCO₃, and NaHCO₃ to the sump which contained the pump. The initial applications on a fall planting October 26, 1973 were 24 hours with subsequent daily 3 hour applications until emergence. A Stanhay precision planter was used on 107 cm beds to place the seed in uniform bands on the bed shoulders. The emergence was not significantly different from the two water qualities as shown in Table 2 (Robinson et al. 1976).

Table 2. UC 76 alfalfa emergence (plants per square meter) when irrigated with two water qualities on two soil textures in three observations

Seeding rate kg/ha	Date counted	Total dissolved solids irrigation				Significance of difference Analysis of variance
		877 mg/l		1350 mg/l		
		Soil texture		Soil texture		
		clay	sandy clay loam	clay	sandy clay loam	
27.0	11/2/73	402	415	395	400	NS
23.6	4/4/77	922	547	682	720	NS
29.3	7/14/77	422	628	585	792	NS

* Difference not significant at 5% level.

A spring planting was made with the same water concentrations and soils on March 7, 1977. Emergence counts taken on April 5, 1977 showed an average germination rate of 717 plants per m² with no significant difference between the areas where the 877 and 1350 mg/l water were applied, as shown in Table 2. This crop was cut once for yield comparison and then double disced to prepare for a summer planting.

Alfalfa Emergence Trial in July

The two soils in the permanent sprinkler area were prepared for seed bed and 29.3 kg/ha of UC 76 seed were applied by drill. On June 27, 1977 waters at 877 and 1350 mg/l were each applied to three plots on each soil. Counts showed a rate of 606.8 plants per square meter and no significant differences between soils or solution concentrations. Copper constantan thermocouples placed in the soil surface during sprinkling showed a drop from 49.2 C to 38.1 C while the sprinklers were running. The summary of data from the three emergence measurements is shown in Table 2.

Discussion

The first experiment on a clay soil showed a significantly better emergence of alfalfa during a conventional spring planting period. This was associated with the maintenance of a lower bulk density of the soil and with an application of water by the sprinkler over a considerable longer period as the seeds were germinating. The soil under the sprinkler accumulated less salinity also (Robinson 1969).

The three experiments with the 1350 mg/l water demonstrated that even the higher concentration of salt in the irrigation water was not detrimental when sprinkled on. This suggests that we may expect damage-free alfalfa germination even as salinity gradually increases into the 21st century. The demonstration of seedling establishment in July offers the prospect of a wider time range of stand establishment for alfalfa.

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