Vegetable Crop Response to Subsurface Drip Irrigation

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Summary

Drip irrigation lines placed 15 cm (deep) and 5 cm (shallow) below soil surface were compared to furrow irrigation with zucchini squash as a summer crop and cabbage as a winter crop. Both crops were grown on the same drip lines in each treatment. Urea phosphate was injected in drip lines during growing season while the furrow-irrigated plots received preplant application of phosphorus.

In squash, deep lines produced higher yields than did shallow. Deep-drip yields were comparable to those with furrow but used half the water and half the fertilizer. In cabbage, deep-drip yielded slightly higher than shallow-drip and furrow. In these studies, deep-drip was superior in applying water and fertilizer.

Introduction

Subsurface placement of drip irrigation is a fairly recent concept aimed at further improving water use efficiency over surface-placed drip lines. Also, below ground lines reduce water losses from evaporation and deliver P fertilizers close to plant roots. By using the same lines for a succession of crops, the cost of materials and labor can be reduced. The objectives of this study were to evaluate subsurface drip and to measure crop response under this system in comparison to furrow irrigation.

Materials and Methods

Deep drip irrigation lines, drip hose by Chapin, placed 15 cm (6 in) below the soil surface were compared to shallow lines at 5 cm (2 in) and to furrow irrigation. Water was applied each week 3 times by drip and one time by furrow.

Cabbage cv. 'Headstart' was grown in the fall-winter of 1982, followed by zucchini squash cv. 'Ambassador' in the spring-summer of 1983. The same lines were used for each crop.

Ammonium phosphate was injected below the row in half of the furrow treatments and urea phosphate was used with the drip. (For more information see the following report). Periodically, plant issue was analyzed for NO_3-N and P. Yields were recorded during the harvest season.

These experiments were conducted at the Marana Agricultural Center.

Results

With cabbage, both drip treatments and the fertilized furrow gave comparable yields that were significantly higher than the unfertilized furrow (Table 1). The deep drip yielded 19% higher than the shallow drip, using equal amounts of water and fertilizer.

Squash plants with deep drip and fertilized furrow out-yielded plants grown with shallow drip and unfertilized furrow (Table 2). Deep-drip yielded 34% more than shallow-drip and was comparable to the fertilized furrow while using about half as much water and fertilizer.

Leaf P and NO_3-N concentrations with deep drip lines were at least comparable or higher than leaf tissue with furrow and shallow drip.

During 1985 two crops - squash in summer and lettuce in fall-were successfully grown on the same deep drip lines at the Marana Agricultural Center.

Conclusions

Deep drip irrigation produces as good as or better yields than other methods. Deep lines out-yield shallow lines, especially in summer when surface evaporation is high. Yields from deep drip are comparable to those from proper furrow irrigation but are produced with about half the water and half the fertilizer. Deep drip appears to be an efficient way to apply water and nutrients.

Also, costs are reduced by using the same lines for a succession of crops over several years. The deep lines are more compatible with planting and cultivation in these situations.

Table 1. Yield of Cabbage as Affected by Irrigation and Fertilizer Treatments

Treatment	Yield kg/15.2 m row
Unfertilized furrow	3.9a[z]
Fertilized furrow	13.9b
Shallow drip	15.0b
Deep drip	17.9b

[z] Mean separation by Duncan's multiple range test, 5% level.

Table 2. Fruit Yield of Squash, During 21 Days, as Affected by Irrigation and Fertilizer Treatments

Treatment	Yield kg/15.2m row
Unfertilized furrow	8.0a[z]
Fertilized furrow	12.4b
Shallow drip	9.0a
Deep drip	12.1b

[z] Mean separation by Duncan's multiple range test, 5% level.