EFFECT OF ONION BED SHAPE ON ACCUMULATION OF SOLUBLE SALTS AND SODIUM

Tim C. Knowles and Charles Poole

Abstract

An experiment was conducted to examine the effectiveness of knifing a v-shaped notch into the center of raised onion beds for reducing soluble salt accumulation in the seed rows. Sodium salts accumulated within an 18 inch wide band in the top six inches of the knifed raised bed profile. Sodium salts accumulated primarily within a narrow six inch wide band, and to a somewhat lesser extent, within an 18 inch wide band in the top six inches of the conventional raised bed profile. Total soluble salts accumulated primarily within a six inch wide band in the top six inches of the knifed and conventional onion raised bed profiles.

Introduction

Onions are often planted in four to six rows on 40 inch wide raised beds and furrow irrigated. When raised beds are irrigated in every furrow, water and soluble salt movement is from the furrow into the upper center of the bed. Thus, soluble salts present with the irrigation water tend to accumulate in the upper center of the bed. Planting a row of seeds in the center of a raised bed places them in the area where soluble salts become concentrated. Onion seedlings often fail to germinate when seeds are planted into this zone of salt accumulation.

Several methods have been developed to reduce soluble salt accumulation in the tops of furrow irrigated raised beds. Alternate furrow irrigation is a common practice when irrigation water is saline. Seeds can be planted in two or more rows, closer to the shoulder of the raised bed, and away from the zone of salt accumulation. Seeds can also be planted in row(s) on the shoulder of sloped beds oriented toward the south for both temperature and salinity control. Lettuce growers often use raised beds with a narrow cap shaped along the top and center of the bed. Soluble salts are allowed to accumulate in this soil cap, away from germinating seedlings.

Colorado River water used to irrigate Parker Valley crops has a pH ranging from 7.9-8.3, an electrical conductivity (EC) that ranges from 0.9-1.4 dS/m (576-896 ppm soluble salts), and a sodium adsorption ratio (SAR) ranging from 3-5. A leaching fraction is normally required for vegetable production to leach soluble salts below the root zone of these salt sensitive crops. Sulfur containing soil amendments are often used in conjunction with leaching to manage sodium. Local onion growers have utilized raised beds with a v-shaped notch knifed approximately 2 inches deep into the top center of the bed. Two rows of onions are planted on each side of the v-shaped notch. It is thought that this bed shape allows soluble salts contained in the irrigation water to accumulate deeper within the center of the bed, below germinating onion seed.

This is a part of the University of Arizona College of Agriculture 1999 Vegetable Report, index at http://ag.arizona.edu/pubs/crops/az1143/

An experiment was conducted to determine the effectiveness of knifing a v-shaped notch into the center of raised onion beds for reducing soluble salt accumulation in the seed rows.

Materials and Methods

A field experiment was conducted during summer, 1996 in Parker Valley located in western La Paz County to determine if a two inch deep v-shaped notch in the top center of raised onion beds reduced accumulation of soluble salts in the seed rows, compared to conventional flat-top raised furrow irrigated onion beds. Two rows of onions were seeded on each side (4 rows total) of the v-shaped notch cut in knifed beds and six rows of onions were seeded (two rows in the center of the bed) on the flat-topped (conventional) onion beds. The onion beds were 40 inches wide. Resulting onion plant populations were approximately 230,000 plants/acre on knifed beds and 285,000 plants/acre on conventional beds. Half of the 40 acre field consisted of knifed onion beds and the other half consisted of conventional raised beds.

On May 23, 1997, adjacent (with a separation of one row) knifed and conventional raised onion beds were grid sampled to profile salt distribution. A two foot wide trench approximately 30 inches deep was hand dug from furrow to furrow across each 40 inch raised bed. The face of each vertical profile was smoothed off with a shovel. Pieces of string were hung in place with nails to create a six inch wide square grid for soil profile sampling. Two to three four inch deep one inch diameter soil cores were taken from within each six by six inch grid across the raised bed profile to a depth of 18 inches. This sampling procedure was replicated two times for the knifed and conventional beds. Soil profile samples were sent to the soils laboratory at Maricopa Agricultural Center where they were analyzed for pH, electrical conductivity (EC), and sodium adsorption ratio (SAR).

Results and Discussion

Soil pH values of the six inch wide grid samples within each raised bed profile ranged from 7.6 to 8.2 and were not significantly different for soil samples taken from knifed and conventional beds, for samples within the raised bed profile, or for the interaction of bed shape by position within the profile (data not shown). Soil pH was fairly consistent within each raised bed profile and among knifed and conventional beds.

Soil sodium adsorption ratio (SAR) values were significantly higher in conventional raised beds, compared to knifed onion beds ($p<0.05$). Soil SAR values were also significantly different within each profile ($p<0.01$), with the highest values in the top six inches of each type of raised bed (Figure 1). However, with only two replicates, the interaction of SAR values of bed shape by position within the profile was not significant at the 0.05 level ($p>0.47$). Sodium salts accumulated within an 18 inch wide band in the top six inches of the knifed raised bed profile. Sodium salts had a tendency to accumulate primarily within a six inch wide band, and to a somewhat lesser extent, within an 18 inch wide band in the top six inches of the conventional raised bed profile.

Soil electrical conductivity (EC, which is a relative measure of total soluble salts) values were not significantly different between the conventional raised beds and knifed raised beds ($p>0.95$). Soil EC values were significantly different within each profile ($p<0.001$), with the highest values in the top six inches of each type of raised bed (Figure 2). However, with only two replicates, the interaction of EC values of bed shape by position within the profile was not significant at the 0.05 level ($p>0.18$). Total soluble salts accumulated primarily within a narrow six inch wide band, and to a lesser extent, within an 18 inch wide band in the top six inches of the knifed and conventional onion raised bed profiles. Although EC values within this zone of accumulation were slightly higher for the conventional vs. knifed onion bed profiles, this difference was not significant with only two replicates.

There seems to be some benefit to knifing a v-shaped notch into the top center of raised vegetable beds from a salt management perspective. Sodium salt concentration was 70% less in the top center six inches of knifed onion beds, compared to conventional raised, flat onion beds. Total soluble salt concentration within this zone of salt accumulation was 13% less for knifed raised beds, compared to conventional raised beds, however this difference was not significant at the 0.05 level with only two replicates.