An Assessment of Simulated Cooling Tower Drift on Cantaloupe and Cotton

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Summary

The impact of foliar salt deposition, similar to that which is predicted to occur in the vicinity of the Palo Verde Nuclear Generating Station, was investigated on cantaloupe and cotton. Simulated salt drift was applied throughout the growing season. There was an increase in the amount of lead found in the fruit harvested from the highest treatment level as compared to the untreated plants. No other observable salt-induced responses were observed in the cantaloupe. A trend toward reduced yields was observed in the cotton plots receiving the salt treatments.

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When in full operation, the cooling towers at the Palo Verde Nuclear Generating Station will consume approximately 63,000 acre feet of water annually. The water source is waste water effluent from Phoenix; it is high in salts and contains some heavy metals. During the cooling process, some of the cooling water and dissolved salts will escape from the towers and be dispersed into the atmosphere in the form of small water droplets. Once in the atmosphere, the droplet will evaporate, leaving behind a small amount of salt that will disperse with ambient winds and eventually settle on the surrounding farm and desert lands.

When all nine cooling towers are in full operation, several tons of salt per day will settle over the surrounding area. In response to grower concerns, the Nuclear Regulatory Commission required that the problem be investigated by the University of Arizona prior to full operation of the nuclear facility. To evaluate the potential impact of foliar applied salts, simulated saline drift was applied to field grown cantaloupe (*Cucumis melo*, L., Topmark) and cotton (*Gossypium hirsutum*, L., DPL-90) grown in Marana in 1983.

Materials and Methods

A modified tobacco sprayer was used to apply small doses of simulated saline solution over the canopies of the two crops. The treatments included an unsprayed control, distilled water, and 7.4, 74.0, and 370.0 lbs/A per year of simulated saline

drift. The treatments were applied 5 days per week, with the actual amount applied per day being approximately equivalent to the quantity deposited daily at these annual deposition rates. At the time of the study, maximum deposition rates of 10.0 lbs/A per year on nearby fields were predicted.

Visual analyses of the plants were performed weekly to detect any salt-induced injury or changes in growth. Physiological functions and morphological changes were monitored throughout the growing season. Detailed flowering and fruiting studies were conducted in the cotton plots.

Results

No statistically significant differences in the visual evaluations were observed in the cantaloupe. There were no detectable differences in yield over the season. Yields averaged 15,499 lbs/A, which compares favorably with the 1983 Central Arizona average of 15,210 lbs/A.

Lead levels in the cantaloupe fruit were higher (at the 6.9% level of statistical significance) in the 370.0 lbs/A per year treatment (1.06 ppm Pb) as compared to the unsprayed control (0.75 ppm Pb). It should be noted that both lead levels were well below EPA guidelines.

The cotton plants were evaluated more intensively and some interesting findings observed. In general, there were no physiological changes observed in the cotton plants at any of the treatment levels. Simulated saline drift may have actually enhanced vegetative growth by acting as a foliar fertilizer. There was no difference in the numbers of flowers produced in any of the treatments; however, boll production was consistently lower in the plots which were treated with simulated saline drift. Only the 370 lbs/A per year plot had significantly fewer bolls as compared to the controls. This indicates that the salts may have affected fruit set after flowering.

Two estimates of yield were made in each experimental plot in the cotton study. Two rows were machine harvested, and in a separate portion of the plot, a seven foot section of row was hand harvested as the bolls opened. Both measurements showed a trend towards reduced yield with increased salt application (Table 1). These differences were statistically different only in the hand harvested plots. No differences in fiber quality were detected.

Table 1. Seed Cotton Yields (lbs/A) from Machine and Hand Harvested Plots Treated with Simulated Saline Drift, Marana, 1983

SALT TREATMENT (lbs/A per yr)	SEED COTTON (LBS/A) HAND HARVESTED PLOTS		SEED COTTON (LBS/A) MACHINE HARVESTED PLOTS
Unsprayed	2527.2	ab	2269.6
0	2734.3	a	2594.4
7.4	2356.5	ab	2316.2
74.0	2237.4	bc	2238.8
370.0	1905.2	c	2124.4
LSD (.05)	381.6		NS
Standard Error	30.4		133.3

Means followed by the same letter within a column are not statistically different at the 5% level using the least significant difference (LSD) test.

Conclusions

A one year study is not adequate to understand fully the impact of a problem such as salt drift. This is especially true for a year like 1983 which had 10.58 inches of rain during the study. Preliminary indications suggest that there may be a salt-induced impact on cotton yields. Increased levels of lead in cantaloupe fruit is another potential problem not fully understood.

The consensus of the University of Arizona Researchers working on this project was that further research was needed to obtain a fuller understanding of the severity of the problem. The Nuclear Regulatory Commission did not require a continuation of this study.