Foliar Absorption of Urea by Sandblasted Wheat Seedlings[1]

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ABSTRACT

One-month-old wheat (*Triticum aestivum* L. sp.) seedlings were exposed to 13.6 m/sec wind velocity and sand at 1 kg/min for different lengths of time in a wind tunnel. Urea solution was foliar applied at different time intervals of up to 4 days after exposure. Total nitrogen content of the tissues decreased as follows: wind plus sand greater than wind alone equal unexposed. There was a strong indication that foliar uptake of urea was greater when the urea solution was applied soon after exposure to wind and sand.

Additional index words: Sandblasting.

FOLIAR uptake of urea nitrogen has been well demonstrated in several crops. Urea, when applied to leaves, is utilized through hydrolysis by the enzyme urease, which gives ammonia and carbon dioxide (3). The main absorption site is believed to be the stomata (4), although uptake has been shown to occur in several other plant parts (9). Absorption was most rapid during the first hours after spraying but continued for 2 days (1).

Stomatal closure has been associated with wind (6) and sandblasting (8). Pauli and Laude (7) pointed out that photosynthesis is interrelated with reduction of nitrates. A lower rate of photosynthesis in lodged wheat plants resulted in lower amino acid synthesis.

Based on this literature review, any factor that causes stomatal closure or impedes photosynthetic processes may alter nitrogen utilization by the plant. However, as far as is known, no work has been done on the effect of mechanical injury on foliar uptake of a nutrient.

MATERIALS AND METHODS

Eighty 'Scout' wheat (*Triticum aestivum* L.) plants were grown in 18-cm-diameter plastic pots containing 3 kg of sieved Cass fine sandy loam soil having 0.6% organic matter and pH of 8.1. Nutrients were supplied in solution to give 80 ppm P as $NaH_2PO_4 \cdot H_2O$; 100 ppm K as KCl; 10 ppm S as Na_2SO_4; 2.5 ppm Fe, 2.5 ppm Mn, 6 ppm Zn, and 1 ppm Cu as chelates; 1 ppm B as H_3BO_3; and 0.5 ppm Mo as $(NH_4)_6Mo_7O_{24} \cdot 4H_2O$. As starter, 20 ppm N as NH_4NO_3 in solution was also added.

After 4 weeks of growth, the plants were exposed to a 13.6-m/sec wind velocity and sand at 1 kg/min in a wind tunnel. The length of exposure was 15 and 30 min and 15, 30, and 40 min to wind and wind plus sand, respectively. Plants not exposed served as controls. The plants were sprayed with a 26.4% urea solution at different time intervals after exposure as follows: immediately after exposure (IAE), within 15 min for both wind and wind plus sand, and 2 and 4 days after exposure for wind plus sand. The spray was provided by a constantly pressurized garden sprayer calibrated to give 2 cc

[1] Contribution from the Soil and Water Conservation Research Division, Agricultural Research Service, USDA, in cooperation with the Kansas Agricultural Experiment Station. Department of Agronomy Contribution No. 1064. Received Dec. 19, 1968.

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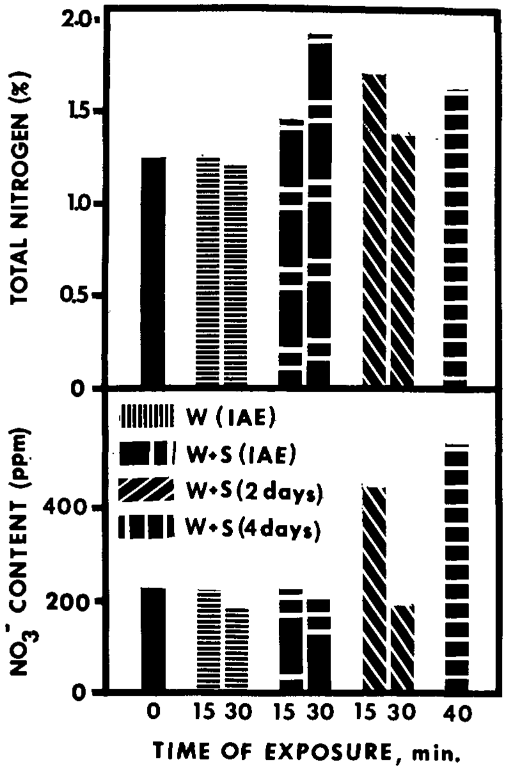

Fig. 1. Total nitrogen ($LSD_{.05}$ = .31%) and nitrate ($LSD_{.05}$ = 94 ppm) contents of aerial portions of wheat plants exposed to varying degrees of mechanical injury and times of urea application.

of solution per pot. The pots were treated inside a cylindrical container to eliminate air currents. The plants were sprayed periodically with distilled water to ensure urea-salt dissolution, and pots were watered as needed. Each treatment was replicated three times.

The above-ground portions of the plants were harvested 3 weeks after exposure, briefly washed, and dried at 70C. Total N was determined by the Kjeldahl method described by Jackson (5) and nitrate by the alphanaphthylamine method described by Hanway et al. (2).

RESULTS AND DISCUSSION

Results of chemical analyses for total nitrogen and nitrate contents are shown in Fig. 1. There was a significant increase in the total nitrogen content of the sandblasted seedlings, but wind alone did not increase foliar uptake of urea-nitrogen. Evidently no serious tissue damage was inflicted by the abrasive action of the sand as indicated by the dry weight (Fig. 2) and nitrogen uptake. The increase in dry weight in certain cases may have been caused by increased absorption of urea-nitrogen.

An early chlorotic condition in all of the plants due to the low nitrogen content of the soil was corrected by the urea spray suggesting that foliar absorption of urea occurred. Visual observation showed little desiccation of the leaf and stem tissues several hours after exposure to wind and wind plus sand, and plants generally did not lodge. Desiccation due to the me-

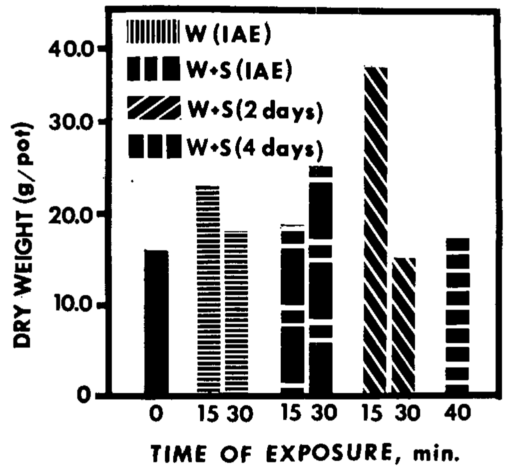

Fig. 2. Dry weight ($LSD_{.05}$ = 3.0 g) of aerial portions of wheat plants exposed to varying degrees of mechanical injury and times of urea application.

chanical treatments become more pronounced in the margins of the leaves a few days after the treatments. This leaf damage apparently was not sufficient to be detrimental to photosynthetic processes and subsequent nitrogen absorption and translocation. No adequate explanation of the increase in nitrate content of certain sandblasted seedlings can be given. It should be considered, however, that mechanically injured tissues may exhibit a decrease in amino acid synthesis, as pointed out by Pauli and Laude (7). Such a decrease in amino acid synthesis might be produced by a lower rate of nitrate reduction and subsequent accumulation of this form of nitrogen in the plants. It is conceivable that the seemingly mild tissue damage mentioned above was sufficient to affect the plants' ability to metabolize nitrogen.

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