$(NH_4)_2SO_4$ added to dry rooting medium and by the latter in wet rooting medium in 'Spring Green' while in 'Honey Gold' the effect was similar but less striking.

Extrapolation from a peat-vermiculite rooting medium in pots to the field situation may not normally be justified, but, in the present experiments, the visible injury noted on beans in the field as a result of NH_4NO_2 sidedressing was demonstrated in the controlled-environment experiments. The controlled-environment experiments also indicated that plant growth may be retarded without visible injury. The generally more injurious effect of $(NH_4)_2SO_4$ than NH_4NO_3 was due either to the greater ammonium content of the former or the presence of nitrate in the latter. The presence of nitrate may improve the assimilation of ammonium relative to an all ammonium regime. There was some evidence for enhancement of ammonium toxicity by cool night temperatures and a strong indication that ammonium toxicity is enhanced by simultaneous application of ammonium fertilizer solutions and water to dry rooting media. Thus the interactions of ammonium toxicity with environmental variables may be quite substantial, but the reason for these interactions is not clear. Acidity of the rooting medium may be an important variable, responding to N salt applications, but pH was not monitored in the present experiments. Apparent deleterious effects of $Ca(NO_3)_2$ (Fig. 1) deserve further study that should include the separation of calcium effects from nitrate effects.

Bean growers should avoid the use of supplementary ammonium fertilizer at times of cool night temperatures and particularly when plants are drought-stressed. Water-stressed plants may absorb water more rapidly, and absorb larger amounts of ammonium ions. Supplementary ammonium fertilizer applications used to offset leaching losses should take place after irrigation or periods of substantial rainfall.

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Response of Pepper to Transplant Clipping and Daminozide[1]

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Abstract. **Clipped pepper (*Capsicum annuum* L.) transplants produced as well as control plants, but out-yielded plants sprayed with butanedioic acid mono-(2,2-dimethylhydrazide) (daminozide). Clipping increased branching and fruiting sites. Solution-culture studies showed fresh weight of clipped plants to be similar to that of daminozide-treated plants, but root and shoot growth of treated plants was less than that of control plants. The different growth responses affected N and Ca absorption.**

Occasionally, the harvesting and shipping of southern-grown transplants of tomato and pepper is ahead of conditions for setting out in the northern areas because of adverse weather. However, plants left in the field become old which do not perform as well as plants transplanted at the proper stage of development. Clipping transplants has been practiced on tomato (8, 10) and pepper (9) with no adverse affect on yield, but may promote the spread of leaf diseases. Since daminozide has been used to restrict growth of tomato plants with no adverse affect on yields (2, 11, 13, 14), these studies were initiated to determine if daminozide could be used in place of clipping pepper transplants and to evaluate their response.

Treatments of clipping out the terminal bud with 1 to 2 youngest leaves, daminozide sprayed at the rate of 2500 ppm, and control were observed by growing the plants in the field and by solution culture in the greenhouse. Treatments were applied to transplants when 5 to 6 true leaves were visible. For the field experiment, transplants of 'Yolo Wonder L.' were grown in the greenhouse at a minimum temperature of 21°C in 5.6 × 4.4 cm cell-paks containing peat-vermiculite (1:1) fortified with 0.24, 0.5, 0.3, and 5.9 kg/m^3 of N, P, K, and dolomitic limestone, respectively, prior to transplanting to the field on May 13, 1977. The Maury silt-loam field soil tested 127, 337, 2352, and 187 kg/ha of P, K, Ca, and Mg, respectively. P and N were broadcasted prior to planting at 112 and 90 kg/ha, respectively, with an additional sidedressing of N (45 kg/ha) on July 21. Treatments were replicated 6 times with 12 plants per replication in a randomized block design. Yield data were recorded on turning and red fruits for the first 3 harvests, while green fruits larger than 2.5 cm in diameter were also recorded at the last harvest. The solution culture study was conducted from November 10 to January 16 in a glass greenhouse with 'Keystone Resistant Giant' seedlings which were transferred at the 2 to 3 true leaf stage from an unfertilized peat-vermiculite medium to glazed crocks containing 11 liters of a complete Hoagland and Arnon (6), aerated solution. The solution was renewed every 10 days. The treatments were the same as those for the field study and were replicated 6 times on a raised, wire mesh bed and grown at a minimum temperature of 21°C. Samples of the most recently-matured leaves were washed in deionized water prior to drying for tissue analysis. Roots of solution-cultured plants were washed in deionized water, blotted and air-dried prior to weighing. All tissues were oven-dried at 60°C prior to analysis for total N by Kjeldahl and Ca by atomic absorption spectrophotometry methods.

Both clipping and daminozide reduced growth, but sprayed and control plants had not yielded as well as clipped plants in the field (Table 1). The greater number and total weight of fruits from clipped plants was due to increased branching and fruiting sites which sustained fruiting, as indicated by the larger number of green fruits at the last harvest (Table 1). The reduced growth and higher percent dry matter

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Table 1. Effect of clipping and daminozide on height, N, and yield of 'Yolo Wonder L.' pepper plants.

Treatment	Transplant height (cm)	N (% dry wt) Transplant	Fruits per plant: Matured by Sept. 12 (No.)	Matured by Sept. 12 (g)	No. green fruit > 2.5 cm at last harvest
Control	20.8 c[z]	4.12 b	4.5 ab	684 ab	6.2 a
Clipped	11.5 a	3.78 ab	5.3 b	795 b	10.4 b
Daminozide	14.8 b	3.52 a	3.8 a	587 a	6.4 a

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

Table 2. Effect of clipping and daminozide on growth of 'Keystone Resistant Giant' pepper plants grown in solution culture.

Variable	Control	Clipped	Daminozide
Fresh wt (g/plant)			
Leaves and stem	241 b[z]	149 a	114 a
Root	77.6 b	56.3 a	48.9 a
Dry wt (%)			
Shoot	10.4 a	13.0 b	15.7 c
Root	12.0 a	16.5 b	18.0 c
N (% dry wt)			
Leaves	6.28 a	6.23 a	6.49 b
Roots	5.30 b	4.60 a	4.88 a
Ca (% dry wt)			
Leaves	2.76 a	3.26 c	3.03 b
Roots	1.84 a	4.99 c	4.00 b

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

by plants sprayed with daminozide, an antimetabolite (3), seems to be due to bud inhibition and reduced assimilate utilization, whereas, initially, the reduced growth of clipped plants seems to be associated with the utilization of assimilates for enhanced bud initiation, branching, and new leaf development, resulting in less carbohydrates for root growth (Table 2). The reduced root growth of daminozide-treated plants is consistent with data (4, 12, 15, 16) on the use of other growth inhibitors on other species.

The differential absorption of N seems to be associated with N availability and its utilization for shoot and root development. The reduced N concentration in leaves of daminozide-treated plants at the time of field setting (Table 1) could be due to reduced metabolic activity and limited absorption by the restricted root system as found later in solution culture (Table 2). N and dry matter accumulated in leaves of daminozide-treated plants because of reduced utilization for growth. In contrast, the lower N concentration and percent dry matter in clipped than in daminozide-treated plants was probably due to greater utilization of N and carbohydrates for new shoot growth. Conversely, Humphries (7) found more N in leaves of decapitated than in leaves of intact bean plants. The higher N accumulations in roots of untreated plants (Table 2) could be attributed to the greater absorption area of the larger root system than that for treated plants.

Both treatments had a profound effect on the Ca concentration in roots and shoots with clipped plants accumulating the most Ca (Table 2). It was also reported that apple (5) and grape (1) leaves of daminozide-treated plants contained more Ca than control plants. The low concentration of Ca in untreated pepper plants, particularly in the roots, was attributed to continuous transport and utilization for growth.

If daminozide is used to hold back pepper plant growth, growers can expect delayed setting and lower yields from plants sprayed at 2500 ppm as compared to clipped plants. Cultivar differences, growing conditions, and rates of daminozide other than that used may produce different responses than those reported in this study.

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