fully fertile while heterozygous individuals had some normal progeny and some progeny which were fertile but had partially dehiscent anthers. These results, combined with the earlier observation that the F_1 was somewhat less than completely normal in anther dehiscence, indicated that the mechanism controlling anther dehiscence expressed incomplete dominance in this cross.

Results of the diallel cross among the homozygous *ia* segregates indicated that a single gene conditions *ia*. All progeny from all crosses were *ia*. If more than one allele were involved, the probability is high that some progeny would have had normal, dehiscent anthers.

The *ia* character is relatively easy to maintain and manipulate (9) and has been stable in all environments in which it has been grown. In the field, *ia* plants crossed readily with normal bean breeding lines and cultivars in the vicinity, making the character valuable as a breeding tool for recurrent selection in *P. vulgaris*. The results of this study indicate that *ia* segregates should be progeny tested for one generation to assure homozygosity of the character. The gene symbol *ia* is proposed to denote the recessive gene conditioning indehiscent anther.

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Chemical Defoliation of Cucumber Vines for Simulation of Once-over Harvest in Small-plot Yield Trials

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Abstract. **Chemical defoliation of cucumber (*Cucumis sativus* L.) vines was evaluated as a method for rapid screening of breeding lines. Six chemicals (dinoseb, diquat, ethephon, glufosinate, glyphosate, and paraquat) were used at one or 2 rates on one pickling and one fresh-market cucumber cultivar ('Calypso' and 'Poinsett 76', respectively) in 1983 to determine speed of vine defoliation and amount of fruit damage. Of the chemicals tested, paraquat at 0.6 kg/ha provided the most rapid defoliation (85% to 91% defoliation one day after treatment) but caused some bleaching and chlorosis of the fruit. If the fruit were rolled 180° during evaluation, the damage was not noticeable. Chemical defoliation of vines for simulated once-over harvest provided a rapid, labor-saving method, requiring only 42% of the time to evaluate each plot compared to the conventional method. The chemical defoliation method is especially useful for initial evaluation of populations and breeding lines for fruit yield and other horticultural characteristics.**

Yield of cucumbers (*Cucumis sativus* L.) for pickling or fresh-market can be measured using either once-over harvest or multiple-harvest trials. Once-over harvest involves a destructive machine operation, whereas multiple harvest is nondestructive and usually is done by hand. Measurement of fruit number from small plots harvested once-over was found to be an efficient estimate of yield for plant breeders to use for both once-over and multiple-harvest production systems (2). Once-over harvest of small plots is especially useful in the initial stages of selection where many families or lines must be evaluated. Normally, the plants are pulled from plots by hand and the fruit laid out for evaluation. The once-over harvest trial provides a rapid method for measuring yield without the labor required in a multiple-harvest trial, and it provides sufficiently reliable data to make selections (2).

For pickling cucumbers, the optimum time for once-over harvest is when 10% of the fruit are oversized (1). Oversized fruits for pickling have a diameter greater than 51 mm and greater than 60 mm in fresh-market cucumbers. Unfortunately, since fresh-market cucumbers are not harvested once-over in commercial production, the optimum harvest stage for this method has not been determined. If fresh-market cucumbers were harvested once-over when 10% of the fruit were oversized, however, the counts of fruit number provided a good prediction of yield in multiple-harvest trials (2).

A rapid and less labor-intensive method of once-over harvest for collection of data on fruit yield in small-plot trials could involve chemical defoliation of the vines, instead of hand-pulling the plants, removing the fruit, and lining them up in the row. In order to be useful, a chemical should defoliate the vines rapidly and cause little damage to the fruit, so that fruit quality (shape, color and seedcell ratings) could be scored accurately. It would be convenient if the plots could be evaluated the day following chemical application.

The objective of this study was to evaluate 6 chemicals for rapid defoliation of vines of pickling and fresh-market cucumbers without causing serious damage to the fruit.

One or 2 rates of 6 chemicals were evaluated for use in simulating once-over harvest on one pickling and one fresh-market cucumber cultivar. The pickling cucumber tested was 'Calypso' (a gynoecious hybrid) and the fresh-market cucumber tested was 'Poinsett 76' (a monoecious inbred), both grown extensively in the southeastern United States. Plots were planted at the Horticultural Crops Research Station at Castle Hayne, N.C., on 14 Apr. 1983. The plots consisted of 3 rows 6 m long and 1.5 m apart (center to center). Plots were overplanted and thinned to 65 plants per row for 'Poinsett 76' and 59 plants per row for 'Calypso', giving population densities of 70,000 and 64,000 plants/ha, respectively. In order to minimize contamination from spray drift, alleys 1.5 wide were left at each end of the plot, and only the

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Table 1. Defoliation and fruit damage in chemical-treated plots of the fresh-market cucumber, 'Poinsett 76'.[z]

Herbicide	Rate (kg/ha)	Rank	Defoliation[y] (%) Day 1	Day 3	Day 7	Damaged fruit (%)	Fruit damage index[x]	No. days to defoliation[w]
Paraquat	0.3	1	70	100	100	82	3.8	1.0
Paraquat	0.6	2	91	100	100	95	3.2	1.0
Diquat	0.6	3	85	100	100	87	3.7	1.0
Glyphosate	1.1	4	2	18	99	82	6.1	7.0
Dinoseb	2.8	5	52	83	83	92	3.4	3.0
Glyphosate	2.2	6	2	22	79	58	5.2	5.7
Ethephon	2.2	7	1	3	78	29	6.4	7.0
Glufosinate	2.2	8	3	76	76	7	7.1	3.0
Control	---	9	0	1	2	5	7.8	7.0
LSD (5%)			9	11	20	23	3.6	1.3
$\bar{x}$			34	56	80	60	5.2	4.0
CV (%)			15	12	15	22	40	19

[z]Data are means over 3 replications.
[y]Plots were sprayed with chemical on day 0.
[x]Fruit damage rating was assigned as follows:
1–3 = extensive, 4–6 = moderate, 7–8 = slight, 9 = none.
[w]Estimated for each plot as that time when fruit could be easily evaluated through the foliage. Plots not sufficiently defoliated after 6 days were assigned a value of 7.

Table 2. Defoliation and fruit damage in chemical-treated plots of the pickling cucumber, 'Calypso'.[z]

Herbicide	Rate (kg/ha)	Rank	Defoliation[y] (%) Day 1	Day 3	Day 7	Damaged fruit (%)	Fruit damage index[x]	No. days to defoliation[w]
Paraquat	0.3	1	90	100	100	87	5.8	1.8
Paraquat	0.6	2	85	100	100	92	5.0	1.8
Diquat	0.6	3	80	100	100	79	6.1	1.8
Glyphosate	1.1	4	4	33	99	10	7.0	6.0
Ethephon	2.2	5	6	35	97	82	4.6	7.0
Glyphosate	2.2	6	10	90	90	28	6.7	4.5
Dinoseb	2.8	7	5	85	85	79	5.4	6.0
Glufosinate	2.2	8	1	70	70	8	6.9	4.5
Control	---	9	2	4	20	0	7.2	7.0
LSD (5%)			10	12	24	31	1.6	1.2
$\bar{x}$			31	68	85	52	6.1	4.5
CV (%)			16	14	15	41	18	18

[z]Data are means over 4 replications.
[y]Plots were sprayed with chemical on day 0.
[x]Fruit damage rating was assigned as follows:
1–3 = extensive, 4–6 = moderate, 7–8 = slight, 9 = more.
[w]Estimated for each plot as that time when fruit could be easily evaluated through the foliage. Plots not sufficiently defoliated after 6 days were assigned a value of 7.

center row of each 3-row plot was evaluated.

Plants were grown using standard horticultural practices. Fertilizer (90N–39P–75K kg/ha) was incorporated before planting, and sodium nitrate (112 kg/ha) was sidedressed at vine tip-over stage. Bensulide [*O,O*-diisopropyl-phosphorodithiate *S*-ester with *N*-(2-mercaptoethyl) benzenesulfonamide] at 4.4 kg/ha plus naptalam (*N*-l-naphthylphthalamic acid) at 3.3 kg/ha were preplant soil-incorporated to control weeds. Plots were seeded on raised, shaped beds with 0.5 m tops and irrigated as needed to prevent moisture stress.

Chemicals were applied when 10% of the fruit were oversized (>51 mm for 'Calypso' and >60 mm for 'Poinsett 76'). The chemical treatments were: diquat [6,7-dihydrodipyrido(1,2,-α:2′,l′-c)pyrazinediium ion] at 0.6 kg/ha; glyphosate [*N*-(phosphono=methyl)glycine] at 1.1 or 2.2 kg/ha; dinoseb (2-*sec*-butyl-4,6-dinitrophenol) at 2.8 kg/ha; paraquat (1,1′-dimethyl-4,4′-bipyridinium ion) at 0.3 or 0.6 kg/ha; glufosinate [ammonium (3-amino-3-carboxypropyl)-methylophosphinate] at 2.2 kg/ha; and ethephon [(2-chloroethyl) phosphonic acid] at 2.2 kg/ha. Field plots of 'Poinsett 76' and 'Calypso' were handled as separate experiments. The experimental design was a randomized complete block (one for each cultivar), with 9 treatments (the 8 chemical treatments listed above plus a control) and 3 or 4 replications (3 for the 'Poinsett 76' plots and 4 for the 'Calypso' plots).

The plots were rated 1, 3, and 7 days following chemical application (15 June for 'Calypso' and 28 June for 'Poinsett 76'). The percent age of defoliation and the number of days to defoliation were estimated for each plot. Days-to-defoliation was the time required to reach the stage at which plots could be evaluated easily for fruit yield and quality. Plots that were not defoliated sufficiently after 6 days were assigned a value of 7. In addition, the total number of fruit, number of damaged fruit, and an index for the degree of damage were evaluated for each plot on each day. The index for degree of damage to the fruit was an average score for all the fruit in the plot based on a scale of 1 to 9 as follows: 1–3 = extensive, 4–6 = moderate, 7–8 = slight, 9 = none. The percentage of damaged fruit and average fruit damage index were calculated for each plot, and the data were subjected to analysis of variance. Fisher's least significant difference (LSD) was calculated for each variable where the analysis of variance indicated statistical significance.

Chemical treatments that caused sufficient defoliation one day after treatment were paraquat (0.3 and 0.6 kg/ha) and diquat (0.3 kg/ha), which produced at least 69% defoliation in 'Poinsett 76' (Table 1) and at least 80% defoliation in 'Calypso' (Table 2). Other treatments did not defoliate the crop sufficiently one day after treatment to evaluate the fruit easily without moving the vines. However, dinoseb and glufosinate provided the defoliation needed 3 days after treatment.

All treatments that provided sufficient defoliation 1 day after treatment also caused fruit damage (Tables 1 and 2). Most fruit were chlorotic or chlorotic and bleached, as the result of direct contact with the chemicals as the spray penetrated the foliage. Therefore, it would be desirable to have good canopy coverage in the plots when chemicals are applied to prevent excessive damage to the fruit. Chemicals that caused no more fruit damage than the check treatment in 'Calypso' and 'Poinsett 76' were glyphosate and glufosinate. Unfortunately, they caused no more than 10% defoliation one day after treatment. At least 3 days were required to get sufficient defoliation for easy fruit evaluation.

The fruit damage caused by most of the chemicals was sufficient to prevent fruit color from being evaluated accurately. If the fruit were rolled 180° before rating, shape, seedcell, and color could be evaluated without problems. Although color could be rated after rolling the fruit, the ratings may be different than when fruit tops are evaluated, because the bottom (soil side) of the fruit often is lighter colored (yellow-green) than the top side. This light color occurs especially in fresh-market cucumbers.

Paraquat at the high rate of 0.6 kg/ha would be the treatment of choice because paraquat is less expensive and more widely available for field use than diquat, and because when used in once-over trials (data not shown), the low rates of paraquat occasionally did not defoliate the crop as completely as expected.

The chemical defoliation method was used for evaluation of yield and quality in 1.5 × 1.5 m plots in field trials in summer of 1983 (3). It was estimated to be 2.4 times faster than the conventional method, requiring 4.3

worker-min. per plot vs. 10.3 for the conventional method. Thus, using the new method, plots can be evaluated in only 42% of the time required when plants are pulled from the plots by hand.

The best system for simulated once-over harvest of those tested would be treatment of the vines with 0.6 kg/ha paraquat when 10% of the fruit were oversized. The following day, fruit could be lined up in each plot and rolled 180° to facilitate evaluation for yield and quality. Rolling the fruit 180° would be unnecessary if fruit color were not rated.

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Salt Tolerance of Lettuce Introductions

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Abstract. **Salt tolerance differences among 115 plant introductions of lettuce (*Lactuca sativa* L.) were screened in sand cultures under greenhouse conditions. Leaf and root fresh weights of plants grown for 4 to 5 weeks in salinized sand cultures were compared to a benchmark cultivar, 'Buttercrunch'. Plant introductions showed a wider range of salt tolerance than standard cultivars of the United States and therefore have some potential in breeding programs designed to increase the salt tolerance of this crop.**

One approach to managing saline soils and waters is to improve salt tolerance in cultivated species. This tolerance may be achieved by exploiting intraspecific variability (2, 3). Although Ayers et al. (1) reported little variability in salt tolerance among 6 lettuce cultivars, variability was found among 85 U.S. lettuce cultivars and breeding lines that were screened recently for salt tolerance during germination and early seedling growth (5). Results from the greenhouse screening technique used in that study were correlated with field salt tolerance tests. Vegetative fresh weights of 30-day-old seedlings irrigated with salinized nutrient solution were used as the criterion upon which to evaluate salt tolerance.

This previously established screening technique was used in this study to test salt tolerance differences among 115 (*L. sativa*) plant introductions (PIs) and to compare selections from this study to those obtained from the study of the U.S. cultivars (5).

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The *L. sativa* PIs were taken at random from the collection maintained at the U.S. Department of Agriculture, Agricultural Research Service, Western Regional Plant Introduction Station, Pullman, Wash. The PIs were chosen from different countries of origin. The number from each country is about proportional to the total number from each country in the PI collection.

All seeds used in this study were produced in the greenhouse in the spring and summer of 1980. Seeds were planted in screen-lined, wood boxes (0.35 × 0.35 m), and filled to a depth of 0.1 m with washed, medium-textured sand. A plastic mesh bottom allowed free drainage and supported the nylon screen. Within each box, 4 rows (entries) of seed were planted and thinned to 20 plants per row. Irrigation solutions contained 35 mM NaCl, 17.5 mM $CaCl_2$, 6 mM KNO_3, 6 mM $Ca(NO_3)_2$, 3 mM $MgSO_4$, 0.18 mM KH_2PO_4, 0.1 mM Fe as diethylene-triamine pentaacetate, 46 μM H_3BO_3, 9 μM $MnCl_2$, 0.8 μM $ZnSO_4$, 0.3 μM $CuSO_4$, and 0.1 μM H_2MoO_4 and were pumped from 100-liter reservoirs. Sand cultures were irrigated twice daily, and solutions were gravity-drained back into the reservoirs.

Three tests were conducted, each consisting of 4 trials. Each trial consisted of 16 entries and included 'Buttercrunch' as a benchmark cultivar. Three 20-plant rows (replications) were tested for each entry in each trial. The first 2 tests, conducted in Nov. 1980 and Jan. 1981, respectively, compared the salt tolerance responses of 115 PIs. Fresh leaf and root weights were measured. The 3rd test, conducted in Mar. 1981, compared 30 U.S. cultivars, which had been tested previously (5), to 30 introductions which had demonstrated either tolerance or sensitivity to salt in the first 2 tests.

In Test 1 (trials 1 to 4) only two PIs, 169503 and 278108, were significantly more tolerant than the benchmark 'Buttercrunch' as determined by fresh leaf weight (Table 1). Nine PIs were more sensitive than the benchmark. The response of root fresh weight to salinity was similar to leaf weight; plants with the largest leaf fresh weight generally had the largest root weights. 'Climax' and 'Climax 84' were included in Trial 4. These cultivars previously had demonstrated high salt tolerance compared to 'Buttercrunch', and this test reconfirmed that finding. Average electrical conductivities of the irrigation solutions (κ_s) were 7.7, 7.8, 8.1, and 8.0 dSm^{-1}, respectively, for Trials 1 to 4. Test 2 (Trials 5 to 8) was conducted over a 5-week period in contrast to the 4-week period used in Test 1. Consequently, plant size at harvest was

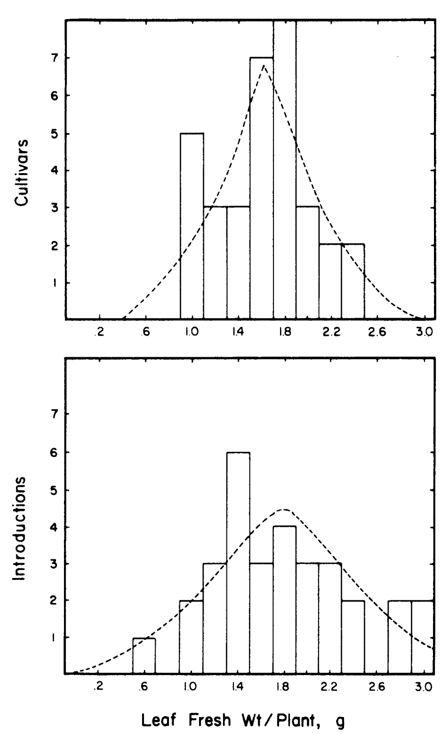

Fig. 1. Distribution of fresh weights in populations of lettuce (*Lactuca sativa*) cultivars and introductions grown under saline conditions.