NITROGEN UPTAKE IN MIDWINTER LETTUCE

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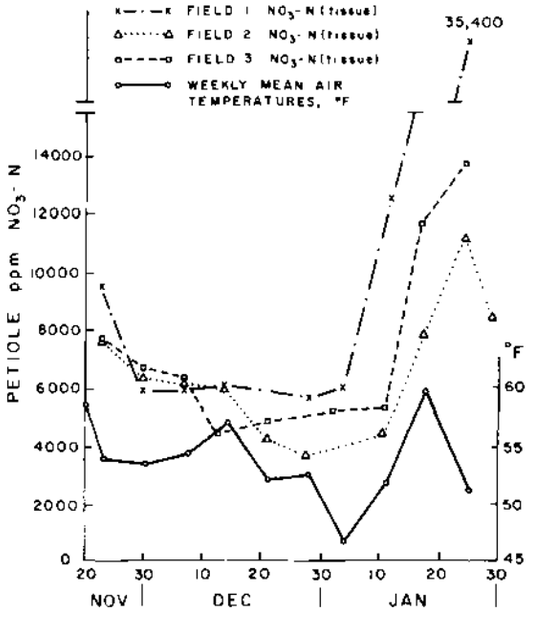
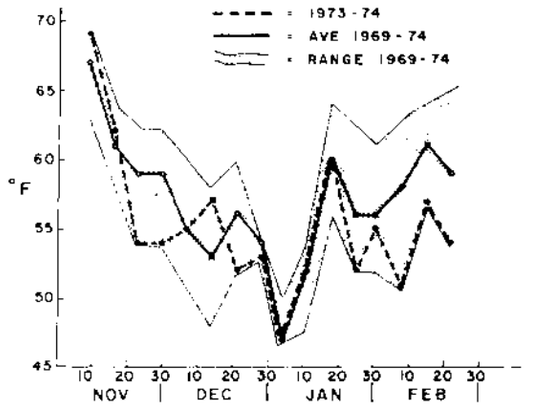


Graph 1 NO_3–N Uptake by Lettuce Petioles as Affected by Mean Weekly Temperature.



Graph 2. Maximum and Minimum Mean Weekly Temperatures, 1969–1974.

IN THE IMPERIAL VALLEY it has been a common practice for growers to apply high rates of nitrogen in the form of calcium nitrate, in an attempt to increase the growth rate of head lettuce during cold weather and to improve external head color.

Investigations in Arizona have shown a correlation between the mean weekly temperature (MWT) of the ambient air and the uptake of nitrogen by lettuce. When the MWT drops below 55°F, a marked drop in the NO_3 N level in the lettuce tissue has been observed.

A survey of nine commercial lettuce fields was made during the 1973–74 midwinter growing season to ascertain if the popular Climax variety of lettuce was affected in the same manner by low temperature.

Procedure

In cooperation with commercial growers, fields for the survey were selected from the Holtville, El Centro, Calexico, Westmorland, Brawley, and Calipatria areas. The fields were sampled at one-week intervals, beginning at thinning and continuing through harvest, except when irrigation or pesticide applications prevented entry into the fields. Approximately 15 wrapper leaves were collected in each quadrant of the field, for a total sample of sixty. The mid-ribs were removed for analysis and dried in a forced air oven at 160°F for 48 hours. Analysis for NO_3–N was conducted by the University of California Cooperative Extension Laboratory on the Riverside campus.

Daily maximum and minimum temperature readings were obtained from the Imperial Valley Field Station. The MWT was calculated by adding the daily maximum and minimum temperatures for the week and dividing by 14.

Results

Information regarding the source, timing and rate of nitrogen applications was obtained from the grower.

The MWT for the 1973–74 growing season is shown in graph 1. On November 23, the MWT fell below 55°F and, except for the weekly reading on December 14, 1973, remained below 55°F until the weekly reading on January 18, 1974. For almost 60 days, the MWT was below the designated critical value for nitrogen uptake by lettuce. Maximum and minimum MWT for 1969–74 is shown in graph 2. These data indicate that one could reasonably expect a period of at least two weeks and possibly longer when the MWT would be below 55°F. The extended cold period during the 1973–74 season started earlier than normal. Nevertheless, it does serve to show the dramatic effect of temperature on the nitrogen status of winter lettuce.

Data from three of the nine fields surveyed were selected for this report. The three fields are representative of the results observed for the survey. The fields were approximately four miles apart and were farmed by three different companies. Seven out of the nine fields surveyed responded similarly to the extended period of cold temperatures. The two remaining fields exhibited a temporary recovery of NO_3–N levels in the mid-rib during the brief period in mid-December, when the MWT rose above 55°F. The NO_3–N levels decreased with the drop in MWT and remained low until the MWT again rose above 55°F in mid-January.

For the three representative fields reported here, a sharp drop in the lettuce mid-rib NO_3–N levels occurred from November 20 to 30. This decrease corresponded to a drop in the MWT from 68°F during the second week in November to 54 and 53.5°F in the third and fourth week. The 14-degree drop in MWT resulted in a 3500, 1300, and 1000 parts per million NO_3–N reduction in fields 1, 2, and 3, respectively.

Fields 1, 2, and 3 were not under-fertilized. Field 1 received 221 lbs of nitrogen between September 28 and December 14; field 2 received 384 lbs between Aug-

ust 13 and January 6; and field 3 received 288 lbs between November 5 and December 19.

Comparison (see table) of the application dates during December and early January with subsequent lettuce mid-rib NO_3–N levels shows that nitrogen fertilization during the period when the MWT is below 55°F does not result in an increased NO_3–N level in the mid-rib tissue.

From January 14 to 21, the MWT rose to 60°F. Corresponding with the higher temperature was an increase in the lettuce mid-rib NO_3–N levels, from 6000 to 35,400 in field 1, from 4300 to 7900 in field 2, and from 5000 to 11,400 in field 3. These latter two fields also showed increased NO_3–N levels at the next sampling time.

Observable nitrogen deficiency symptoms appear as the mid-rib NO_3–N level drops below 5000 ppm. If NO_3–N level falls below 10,000 in the early vegetative stage, the plant may become deficient before harvest. Low NO_3–N can be corrected by applying nitrogen fertilizer, but a three- to ten-day delay in maturity will occur. Late applications of nitrogen during head formation will not increase head size or yield.

Conclusions

Based on the research reported here, the following conclusions may be drawn.

1) Lettuce grown during the mid-winter season should receive sufficient nitrogen during the first few weeks of vegetative growth to raise the mid-rib NO_3–N level high enough to maintain an adequate nitrogen status during the relatively cold period of the growing season.

2) Nitrogen should not be applied immediately before or during the time when the MWT is below 55°F. On the basis of five-year weather records in the Imperial Valley, this period is from December 30 to mid-January.

3) Applying nitrogen to lettuce during periods when the MWT is below 55°F does not result in increased uptake and consquently cannot force the plant to grow or correct a nitrogen deficiency.

4) Applications of nitrogen, however, could be made toward the end of the growing season's cold periods, to insure that adequate usable nitrogen is present in the root zone. Such cultural practices would result in more efficient use of a scarce and expensive resource.

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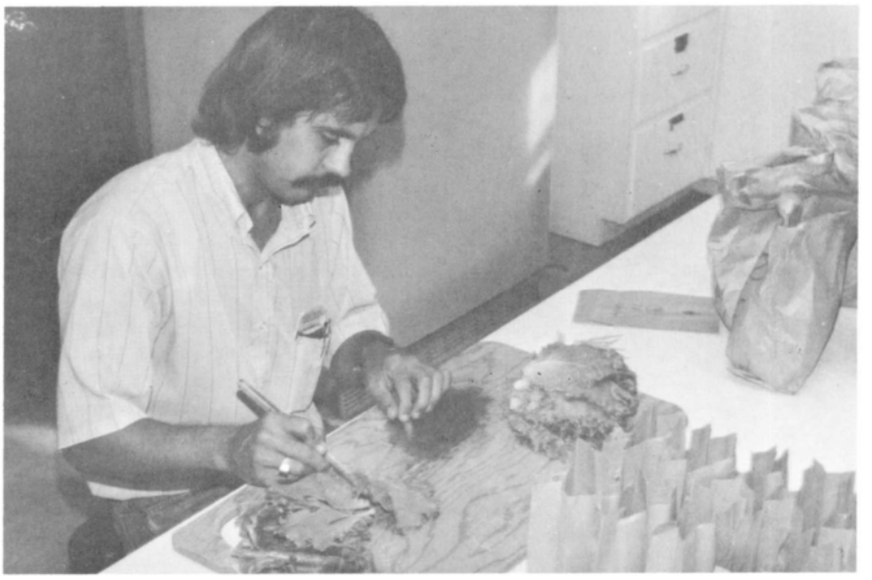
NITROGEN FERTILIZER APPLICATIONS ON REPRESENTATIVE LETTUCE FIELDS IN THE IMPERIAL VALLEY, 1973–74.

Date of application	Method of application	Analysis of fertilizer material	Amount of nitrogen
			lbs/a
Field 1			
Sept. 28	Preplant	11–48–0	55
Dec. 12	Sidedress	8–24–0	16
Dec. 12	Sidedress	33.5–0–0	100
Dec. 14	Water-run	20–0–0	50
			221
Field 2			
Aug. 13	Preplant	13–39–0	78
Oct. 12	Planting	10–34–0	17
Oct. 22	Sidedress	20–0–0	21
Oct. 22	Sidedress	33.5–0–0	134
Dec. 6	Sidedress	18–0–0	26
Jan. 6	Sidedress	18–0–0	108
			384
Field 3			
	Preplant	11–48–0	50
Nov. 5	Water-run	20–0–0	40
Dec. 16	Sidedress	33.5–0–0	158
Dec. 19	Water-run	20–0–0	40
			288



Midribs Being Removed From Lettuce Leaves in Laboratory.

Lettuce Midribs Ready for NO_3–N Content Analysis.