Efficient Lettuce Production

Demands Critical Fertilizer Management

*by B. R. Gardner & W. D. Pew**

Efficient production of quality head lettuce results from the proper management of many cultural practices. Some of these practices are readily controlled by the grower while others are controlled with difficulty. Nitrogen fertilization is not only a practice that may have a remarkable effect on the growth of lettuce, but one over which the grower has a great deal of control. Nevertheless, this control is not often exercised by the grower. It is probable that more fertilizer is applied to lettuce in Arizona than any other vegetable crop. However, lettuce removes smaller amounts of nutrients from the soil than many of the other vegetable crops. Under the conditions found in Arizona, growers use more nitrogen fertilizer than any other single element or combination of fertilizer elements in the production of lettuce. Its use, however, is more of a habit than an understood procedure. An understanding of the growth pattern of the lettuce plant and the ways in which nitrogen fertilizer affects this growth pattern has been evaluated through a plant tissue analysis program.

The University of Arizona, in cooperation with Bruce Church Co., Yuma, has just completed a five-year research project in which the effects of nitrogen fertilizer sources, rates, and timing of applications on the yield, quality, shipping and storing qualities of head lettuce were studied. Attempts were made to keep all cultural practices, except fertilizer applications, on a commercial basis. Tissue and soil analyses were used to evaluate the influence of the various nitrogen treatments on the lettuce plants. Both fall and spring lettuce crops were studied.

Temperature has a marked effect on the growth rate of the lettuce plant. This is particularly evident in areas where lettuce is grown from early fall until late spring. For example, in the Yuma area, lettuce which is planted in late September requires about 90 days from planting time to harvest, while lettuce planted in mid-November takes about 125 days to reach harvest maturity. For ease of discussion we have designated the growth period from germination until the cap leaves begin to fold and form a small head as the vegetative stage; and the growth period from folding until harvest as the heading stage. The duration of the vegetative stage was found to average 56 days for the September planted lettuce compared to 95 days for the November planted crop. The difference was attributed primarily to the differences in soil and in temperatures during the cooler mid-winter months. The heading period for fall lettuce occurs during a transition from warm temperatures and growth rate to colder temperatures and a slower growth rate and has taken an average of 34 days.

On the other hand the heading period from spring lettuce, which occurs during the warming trend of late spring resulting in a very rapid growth rate, takes an average of only 28 days.

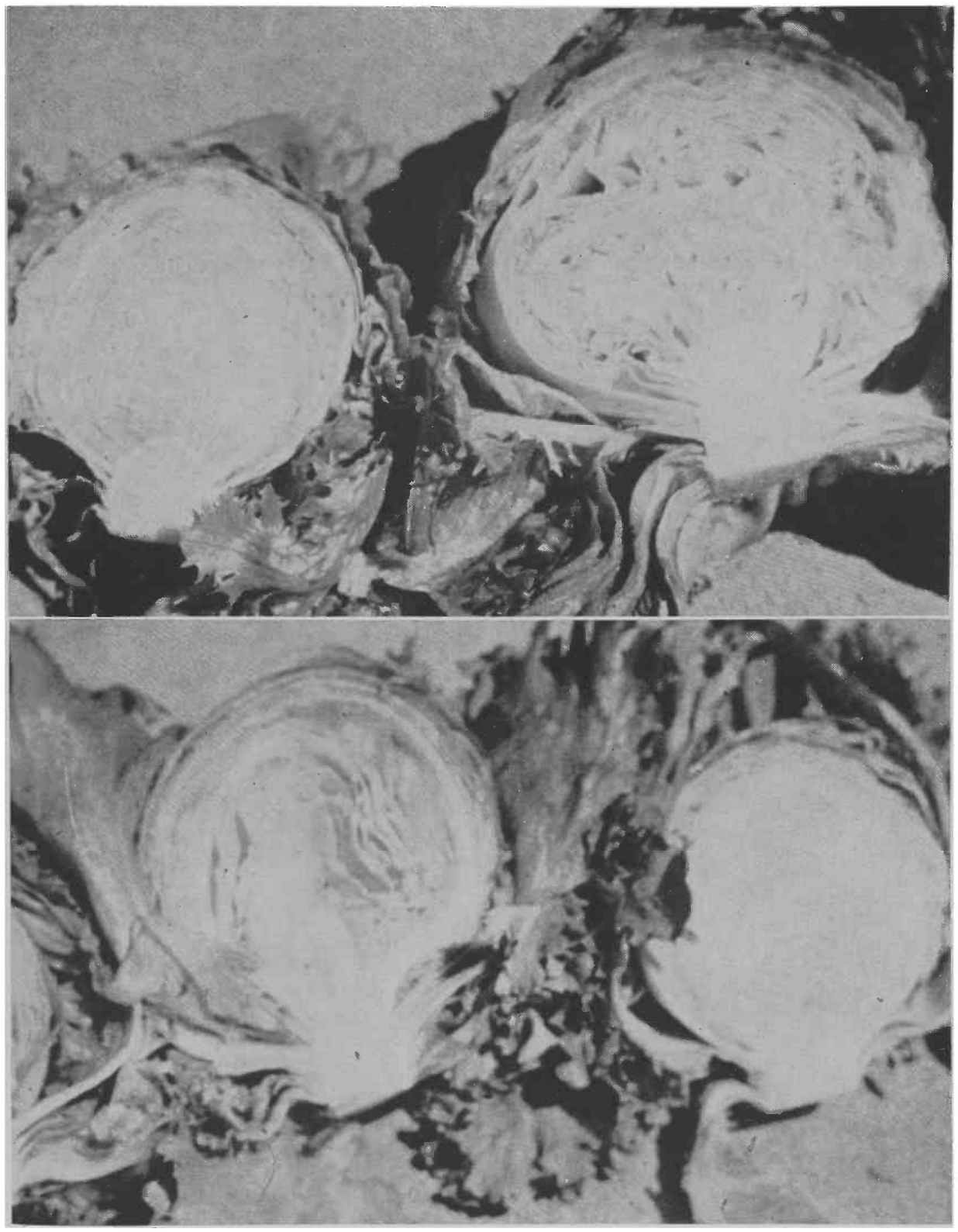
It was determined that about 80 percent of the total dry weight of the lettuce plant is produced during the heading period and hence about 80 percent of the nitrogen is absorbed during the same period. Thus, nitrogen fertilizer applied in the nitrate form at planting time is extremely susceptible to loss by leaching. If other forms of nitrogen are used, they too may be converted to the nitrate form and lost before they can be used by the plants. Consequently, large applications of nitrogen fertilizer at, or near, planting may be lost prior to the time the demand for nutrients becomes greatest. This suggests that the most efficient program would include smaller applications of fertilizer during the vegetative growth with large enough side dressing applications just prior to the heading period to insure adequate nitrogen supplies for the rapid plant growth during head formation.

* *B. R. Gardner is an agricultural chemist at the University of Arizona's branch Agricultural Experiment Station in Yuma.*
W. D. Pew is superintendent of UA's branch Agricultural Experiment Station near Mesa.

During periods of low temperatures it is common for growers to attempt to increase the rate of growth by nitrogen fertilizer applications. Results have indicated that when the growth rate of lettuce plant is limited due to cold weather — mean temperature of 55° F. or lower — neither the source of nitrogen fertilizer nor the amount applied increases the rate of growth. Since the vegetative growth period is longer because of cold weather for the spring crop, nitrogen that is applied early is subject to losses by leaching for an extended period of time.

Yet, in order to insure a quality product, adequate amounts of nitrogen must be available to the lettuce plant throughout the growing season. To determine this, the amount of nitrate nitrogen found in the midribs of the wrapper leaves has been found to satisfactorily indicate the nitrogen level in the plant and can be used to aid in developing an efficient nitrogen fertilizer program. And, if plant analyses are used properly, nitrogen deficiencies can be averted and unnecessary fertilizer use avoided.

The effects of nitrogen deficiencies on the lettuce plant at different stages of growth were evident. The lettuce receiving adequate nitrogen throughout the season was normal in all visible respects, while the one allowed to become nitrogen deficient during the vegetative stage of growth showed a reduced growth rate and maturity was delayed. Plants in commercial fields responding in this manner could create serious problems in planning the harvest and marketing of the lettuce. In this connection, the minimum nitrate level in the petiole should be 8000 ppm to maintain good growth. However, this may be too low if the plants are in the heading stage and temperatures are 55° F. and below. With this in mind, it would be wise for the grower to maintain a slightly higher level particularly when these conditions are likely to occur. Likewise, a lettuce plant will show a definite deficiency when the nitrate level is at 5000 parts and below. Lettuce allowed to become deficient during the heading period resulted in heads that were small in size, very hard, and considered unmarketable. Subsequent applications of nitrogen had very little effect other than to "green up" these plants. This indicates that the heading stage is critical and that adequate



In the top photo the head of lettuce on the right demonstrates a head which was adequately supplied with nitrogen. The other head of lettuce on the left, however, demonstrates a deficiency of nitrogen during heading.
In the bottom photo the effects of nitrogen during heading is shown in the head at right while the effects of early growth is shown in the head at left.

supplies of nitrogen must be available to the plant prior to this time. Applications must be timed to prevent nitrogen deficiencies from occurring during the heading stage.

There is also an effect of nitrogen on the quality factors in head lettuce. A nitrogen deficiency had a detrimental effect on such other factors as color and ribbiness. But source, rate, or timing did not affect these factors as long as adequate nitrogen was available to the plants throughout the growing season, either the maturity or head size or both were affected. If the plants were dificient in nitrogen during the vegetative stage, subsequent applications of nitrogen would usually overcome the effects on size, solidity, and color, but harvest maturity would be delayed as much as 14 days depending upon the severity of the deficiency and the climate of the season.

Other quality factors such as the incidence of pink rib, rib discoloration, russet spotting, slime mold, and pith condition were not affected by any of the nitrogen treatments studied. This indicates that these factors are not associated with nitrogen supply or source.