Split nitrogen applications best for cauliflower

Norman C. Welch ❑ Kent B. Tyler ❑ David Ririe

Cauliflower is a cool-season crop that is exacting in its climatic and cultural requirements. For highest quality curd (edible portion), this crop needs an average monthly temperature of 60° to 70°F. Extreme heat, poor cultural practices, or both can interrupt growth and result in poor quality curd, rendering the product worthless to the processor and fresh vegetable market.

A thorough knowledge of cauliflower growth patterns and nutrient uptake is essential for a better understanding of the fertility requirements as well as insect and disease control in this crop. Unfortunately, only limited information is available on these subjects. We conducted a study to learn more about the nutrient amounts and application timing necessary to produce a high-quality curd. The information should help reduce the amounts of nitrogen applied and improve fertilizer timing to achieve optimum results.

In this study, the cauliflower cultivar 123 was direct-seeded in a single row on 40-inch side beds, and thinned after emergence to 16 inches between plants. Each treatment was replicated five times using a randomized complete block design.

The soil was a Watsonville loam containing 59 parts per million (ppm) phosphorus (bicarbonate-soluble), 263 ppm potassium, and 3.2 ppm zinc (DTPA-extractable). The samples were taken from the upper 12 inches of soil, which would indicate that these nutrients were in sufficient amounts for normal growth and development of the plants. Residual nitrogen was below 4 ppm. The nitrogen in the soil had been reduced by previously growing several lettuce crops without nitrogen fertilizer.

All experimental plots received the same treatment of 200 pounds per acre of 0-20-20 fertilizer banded into the soil at bed formation. One-half of the crop's nitrogen fertilizer, in the form of ammonium sulfate, was sidedressed into beds two days before planting at rates of 0, 30, 60, and 120 pounds per acre. The remaining half was banded into beds 35 days after planting, or after about one-third of the growing period had passed. The plots were irrigated five times (twice by sprinklers), with a total of 1.4 acre-feet of water per acre. Watering was timed to minimize the leaching of nitrogen from the soil.

We obtained data on above-ground cauliflower growth and nutrient uptake by cutting the plants at ground level at 18-day intervals, starting 30 days from seeding. Plants were weighed, dried in a forced-air dryer at 160°F, weighed again for dry weight, and then analyzed for total nitrogen, phosphorus, potassium, calcium, and magnesium.

Curd yields were obtained by harvesting plants from 60 feet of bed. Yield significantly increased with each additional increment of nitrogen to the 90 + 90 N rate per acre. At this rate and above, yields leveled off, indicating that maximum production had been obtained (table 1).

TABLE 1. Cauliflower curd yield at various nitrogen fertilization rates

Nitrogen*	Yield†
lb/acre	*tons/acre*
0	1.3 a
30 + 30	3.5 b
60 + 60	5.0 c
90 + 90	8.0 d
120 + 120	8.0 d

* Applied as ammonium sulfate at planting and after thinning.
† Means followed by different letters in columns are significantly different by Duncan's multiple range test at 1% level.

TABLE 2. Dry matter production of cauliflower plants* at various nitrogen fertilization rates

Fertilizer nitrogen	Dry matter at following days after planting†: 30	48	66	82	97	113
lb/acre	*lb/acre*					
0	0.9	3.3 a	73.0 a	447.6 a	874.1 a	1064.5 a
30 + 30	1.1	6.5 b	151.0 b	931.4 b	1638.5 b	2160.0 b
60 + 60	1.5	7.1 b	318.3 c	1842.1 c	3073.5 c	4881.9 c
90 + 90	1.5	7.4 b	330.2 c	2003.9 c	3124.8 c	4870.7 c
120 + 120	1.5	7.2 b	337.9 c	2059.3 c	3013.0 c	4808.6 c

* Cauliflower at 10,070 plants per acre.
† See dagger (†) footnote, table 1.

TABLE 3. Amounts of nutrients in cauliflower tops at various nitrogen fertilization rates

Fertilizer nitrogen	Dry matter at following days after planting†: 30	48	66	82	97	113
lb/acre	*lb/acre*					
	Nitrogen					
0	0.03	0.1 a	2.1 a	7.7 a	11.9 a	13.7 a
30 + 30	0.04	0.2 b	6.2 b	19.6 b	30.2 b	36.3 b
60 + 60	0.06	0.3 c	14.2 c	49.0 c	81.8 c	116.6 c
90 + 90	0.06	0.3 c	15.5 d	75.7 d	102.5 d	163.2 d
120 + 120	0.06	0.3 c	16.4 d	81.5 d	116.3 d	160.6 d
	Phosphorus					
0	0.004	0.01	0.24 a	2.3 a	4.5 a	5.4 a
30 + 30	0.005	0.02	0.51 b	4.3 b	8.8 b	11.2 b
60 + 60	0.007	0.02	0.95 c	9.8 c	16.3 c	29.3 c
90 + 90	0.007	0.02	1.05 c	10.8 c	15.9 c	35.6 d
120 + 120	0.007	0.02	1.04 c	10.5 c	15.4 c	38.4 d
	Potassium					
0	0.02	0.1 a	2.6 a	12.2 a	23.8 a	24.6 a
30 + 30	0.03	0.2 b	5.5 b	30.6 b	54.1 b	62.4 b
60 + 60	0.04	0.2 b	10.8 c	60.2 c	100.8 c	159.2 c
90 + 90	0.05	0.2 b	12.1 d	71.5 d	111.6 d	202.6 d
120 + 120	0.04	0.2 b	11.1 cd	73.9 d	108.3 d	223.1 d
	Calcium					
0	0.02	0.6	1.5 a	7.6 a	14.9 a	21.5 a
30 + 30	0.02	0.1	2.6 b	12.8 b	27.5 b	34.3 b
60 + 60	0.03	0.1	6.1 c	34.5 c	53.8 c	85.4 c
90 + 90	0.03	0.1	6.3 c	37.3 c	56.2 c	85.7 c
120 + 120	0.03	0.2	6.6 c	38.5 c	56.4 c	86.1 c
	Magnesium					
0	0.005	0.02 a	0.4 a	1.6 a	3.0 a	3.4 a
30 + 30	0.006	0.03 a	0.8 a	3.1 b	5.4 b	5.8 b
60 + 60	0.009	0.05 b	1.9 b	7.6 c	12.3 c	13.7 c
90 + 90	0.009	0.05 b	2.2 b	9.6 c	15.0 d	12.2 c
120 + 120	0.009	0.05 b	2.0 b	10.0 c	16.6 d	12.2 c

† See dagger (†) footnote, table 1.

Dry matter production leveled off at the 60 + 60 N rate. The most rapid development of dry matter occurred during the last 31 days of growth (table 2). The maximum uptake of nitrogen, phosphorus, and potassium occurred in the 90 + 90 N plots (table 3). The most rapid absorption of these nutrients was closely associated with rapid dry weight development during the last 30 percent of the crop growth. Similar results were obtained with calcium and magnesium, except at the 60 + 60 N rate. Notes on hollow stem and curd discoloration showed no association with any of the nitrogen treatments.

Conclusions

Split nitrogen applications at the rates of 180 and 240 pounds per acre resulted in maximum plant growth, development, and curd yield of cauliflower. At less than 180 pounds per acre, yields were significantly reduced and curd quality was poorer.

Maximum dry matter production occurred with 120 pounds nitrogen per acre in split applications. As the nitrogen rates increased to 180 pounds per acre, the quantity of nitrogen, phosphate, and potassium absorbed by cauliflower plants also increased. Plant absorption of calcium and magnesium followed a similar pattern up to the rate of 120 pounds of nitrogen per acre. Based on our results, there appears to be little justification for applying large amounts of nitrogen at seeding time, as is commonly done by vegetable growers in the central coast area of California.

Because nitrogen in nitrate form is readily leached out of the soil by water, at least one-half of the total nitrogen should be applied after the first 30 percent of the growing period has passed. Phosphate, potassium, calcium, and magnesium are not readily leached out, so these nutrients can be applied before or at planting time.

Above-ground parts of cauliflower plants at harvest maturity for fresh market absorbed 160 pounds nitrogen, 38 pounds phosphorus, 223 pounds potassium, 80 pounds calcium, and 12 pounds magnesium per acre. Phosphorus is absorbed at only one-fourth the rate of nitrogen, potassium even less. The common practice of using triple-combined fertilizer should be modified so that less phosphorus is used with each crop or the phosphorus is skipped for several plantings.

Norman C. Welch is Farm Advisor, Cooperative Extension, Santa Cruz County; Kent B. Tyler is Extension Vegetable Specialist, Kearney Agricultural Center Parlier; and David Ririe is County Director/Farm Advisor, Cooperative Extension, Monterey County.

Pitch canker threatens California pines

Arthur H. McCain ❑ Carlton S. Koehler ❑ Steven A. Tjosvold

Although it primarily affects Monterey pines, pitch canker is also a potential threat to other pines in the urban landscape as well as to commercial pine forests and recreation areas.

In the summer of 1986, hundreds of Monterey pines in Santa Cruz County were found with serious branch dieback symptoms that did not fit the pattern of any disorder known in the state. Subsequent investigation confirmed that these symptoms were the result of a disease known as pitch canker, caused by the fungus *Fusarium subglutinans*.

Pitch canker is native to the southeastern United States, from Virginia at the north and westward to Texas. A wide range of pines is affected there, including slash, Virginia, shortleaf, and pitch pines. How or when the fungus reached California is not clear, nor is it certain that the disease occurring here is caused by the same strain of the fungus that affects pines in the Southeast.

The most obvious symptom on Monterey pine is dead branch tips, but entire branches and even tree tops may be dead. A great deal of pitch often oozes from diseased plant parts. The canker is at the junction of dead and living tissue; it is sometimes sunken, yet the bark remains intact. The wood beneath the canker is resin-soaked and honey-colored. Symptoms of new dieback may be seen at any time of year, suggesting that inoculation occurs over a long period. Affected trees become progressively worse in appearance, probably as a result of bark beetles exploiting declining tissue.

Surveys

The California Department of Forestry and Fire Protection has confirmed the principal center of infection to be Santa Cruz County, where several thousand trees are diseased. Smaller diseased areas been identified in the counties of Monterey, Santa Clara, San Mateo, and Alameda.