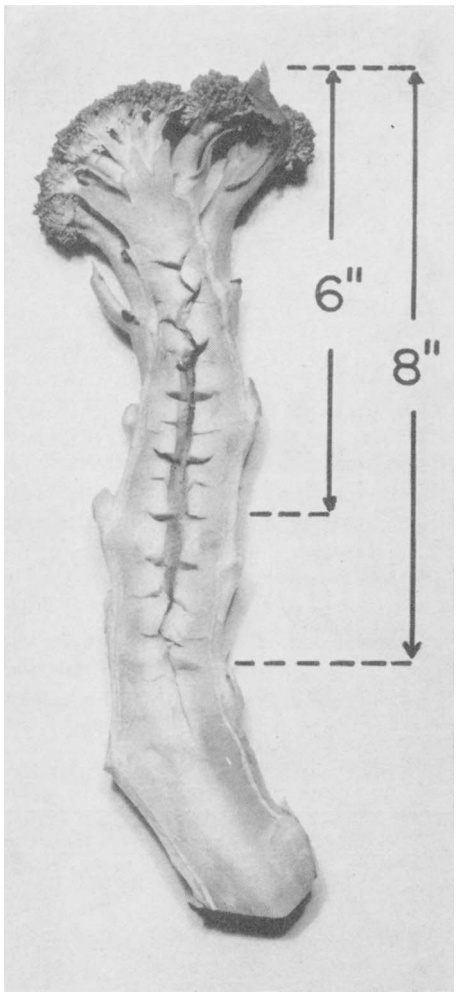

Stem and center bud cut to show hollow stem in broccoli.

HOLLOW IN BROCCOLI

Growers of sprouting broccoli, Brassica oleracea var. italica, find that plants developing during the summer and fall months have a high percentage of hollow stem. These experiments were conducted in the central coastal broccoli districts of California to study hollow stem and pith discoloration in relation to growth and environmental factors. Foliar applications of the trace nutrients boron, magnesium, manganese, copper, zinc, and iron during the growth of the crop had no effect on the incidence of hollow stem and pith discoloration. Close plant spacing reduced the percentage of hollow stem. Higher rates of application of nitrogen fertilizer increased the incidence of hollow stem. The hollow stem condition begins following the initiation of the central inflorescence, the "center bud." At first these are elliptical transverse gaps in the tissues which gradually enlarge so much that the stem is hollow as shown in the photo. There is ordinarily no discoloration of the surfaces of these openings at harvest. However, pith breakdown and discoloration may develop during shipping and marketing.

F. W. ZINK

BROCCOLI VARIETIES differ widely in rate of maturity according to the season of planting. In the central coastal district of California broccoli may be planted and harvested every month of the year. Crops direct-seeded in May, June, and July (to reach market maturity in August, September, and October) have a higher percentage of hollow stem than crops maturing under cooler temperatures of the winter and spring months. Furthermore, the summer and early fall crops have a shorter growth period (approximately 75 to 90 days) compared with 105 to 160 days for the winter and spring crops. The seasonal effect on the development of hollow stem was found to correspond fairly well with the rate of increase in stem diameter and shoot weight as the plant approached market maturity.

Trace nutrients

Hollow stem has been reported as a symptom of boron deficiency in cabbage and cauliflower. A preplant soil application of borax at 10 lbs per acre did not reduce the incidence of hollow stem in broccoli. No reduction in pith discoloration or in percentage of hollow stem was obtained from repeated foliar applications of the trace nutrients boron, magnesium, manganese, copper, iron, and zinc, when used either alone or in combination.

Plant spacing—nitrogen

A spring, summer, and fall crop in the Salinas Valley were selected for this study on the relationship of plant spacing and nitrogen fertilization to the incidence of hollow stem. Because hollow stem was not sufficiently extensive in the spring and fall crops to provide valid data, only the results of the summer crop are presented here. The summer crop was direct-seeded July 3, in two rows 14 inches apart, on the tops of beds on 40-inch centers. The plants were thinned to 8-, 12-, 16-, and 20-inch spacings in the rows. Nitrogen fertilizer, as ammonium nitrate, was applied at the rates of 50, 100, and 200 lbs of nitrogen (N) per acre. Half the nitrogen

STEM

was applied at planting and the remainder at thinning. All plots received a preplant application of 60 lbs P_2O_5 and 50 lbs K_2O per acre. Fertilizer materials were placed in the shoulders of the beds. Furrow irrigation was supplied as needed. There were four replications of each treatment, arranged in a randomized-block design. Each individual plot comprised four beds 65 ft long. Data were recorded from the center two beds in each plot.

Treatments

A significant difference in percentage of hollow stem occurred as the result of the several nitrogen and plant-spacing treatments (graph 1). At any given nitrogen treatment, as plant spacing increased so did the percentage of plants with hollow stem. At a given plant spacing, as nitrogen was increased so did the percentage of hollow stem.

Both plant spacing and nitrogen fertilizer changed the general conformation of the plants. At 50 lbs N per acre, the plants were small at market maturity and had nitrogen deficiency symptoms, especially those at 8- and 12-inch spacings. Plants grown with 100 or 200 lbs N per acre at the 16- and 20-inch spacings were stocky and about 16 inches high, while at the 8- and 12-inch spacings the plants were approximately 30 inches in height and had smaller stem diameters than the 16- or 20-inch spaced plants. A comparison in any given treatment of the average stem diameter of plants having a hollow condition with the average stem diameter of plants free of this condition indicated that internal stem cracking was associated with plants having the larger stem diameter—at the 6-inch cut.

Yield

The crop was harvested from September 21 to October 26. Seven cuttings were made during this period. Each center bud was harvested at market maturity and cut to a 6-inch length. The average stem diameter, the average bud cluster diameter, and the average weight per stalk increased as the spacing between plants and as nitrogen fertilizer had been increased. There was a greater effect on the stem diameter and stalk weight than on the diameter of the bud cluster. The percentage of center buds and stems equaling or exceeding the minimum freezing specifications was lower for plants at the 8- and 12-inch spacings with 200 lbs N per acre than for plants at the 16- and 20-inch spacings and 200 lbs N per acre. However, the actual number of center buds of satisfactory size cut from the closer spacings at 200 lbs N per acre was greater than that cut from the 16- and 20-inch spacings because of the larger population. Maximum gross yield was obtained at the 8-inch spacing at 200 lbs N per acre in the summer crop (graph 2). A spacing of 12 inches in the row for the winter and spring crops, when hollow stem is not as extensive, is likely to give the most satisfactory center bud yield.

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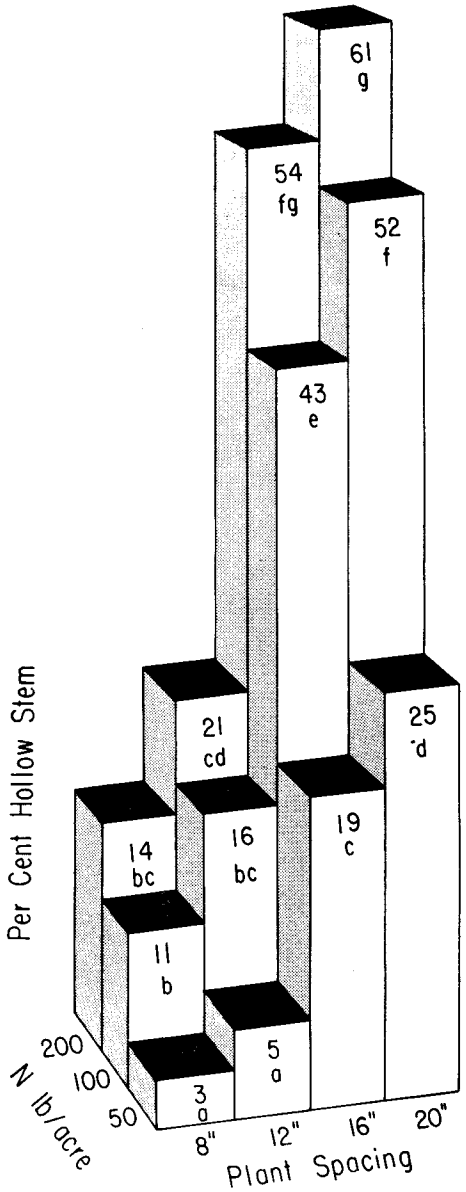
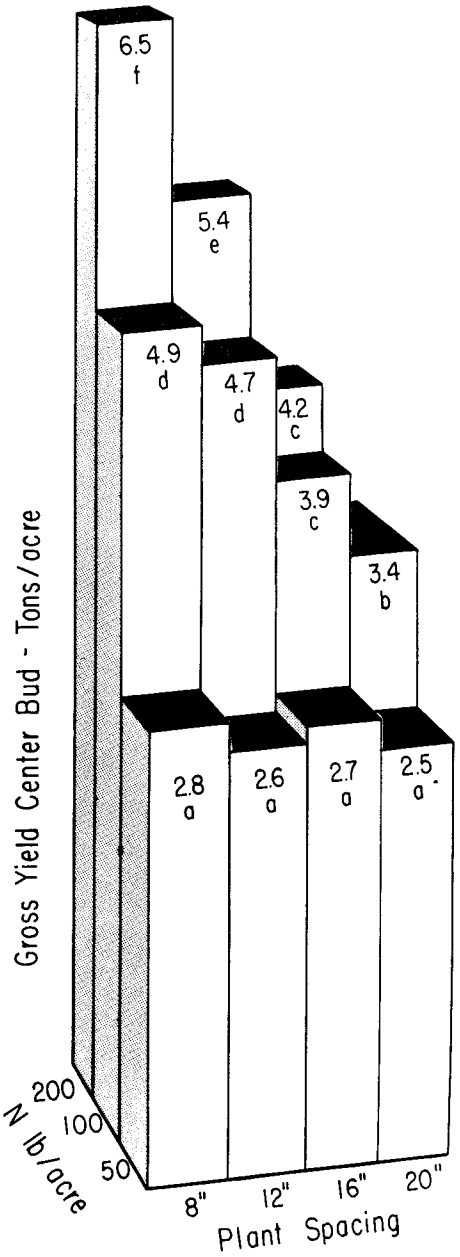
GRAPH 1. INFLUENCE OF PLANT SPACING AND NITROGEN FERTILIZER ON PERCENTAGE OF HOLLOW STEM IN BROCCOLI DIRECT-SEEDED JULY 3



Percentages of hollow stem followed by the same letter or letters are not significantly different at the 1% level, using Duncan's Multiple Range Test.

GRAPH 2. INFLUENCE OF PLANT SPACING AND NITROGEN FERTILIZER ON CENTER BUD YIELD



Tons per acre followed by the same letter or letters are not significantly different at the 1% level, using Duncan's Multiple Range Test.