The vegetable processing industry had become well established in the upper Midwest by the 1950s, using some 500,000 acres and emphasizing the large-seeded crops such as peas, snap beans, lima beans, and sweet corn. Harvested at a point of rapid change in the plant growth and development process, a field of any of these crops could provide an excellent product on one day and 2 or 3 days later an over-age product that might demand a much lower price, if it could be sold at all.

Not surprisingly, skilled management and careful attention to organization of the growing and processing operation were mandatory in a successful company. The industry consisted of a number of processing firms and their independent contract growers. Some of the firms were national or international in the scope of their production and packing operations and had many factory locations. Others were regional or local, consisting of one to several factory sites. At each site responsibility tended to be structured along two lines; i.e., factory operations and agricultural operations. The responsibility for liaison between the factory and the harvest of raw product from field sites resided with the agricultural manager. Company success during the packing season was contingent on the continuous flow of high-quality raw product from the field to the factory.

In Aug. 1989 John Blume, agricultural manager, St. Croix Valley Foods, Inc., found himself in a difficult situation—more sweet corn fields were nearing optimum maturity than could be processed. A decision had to be made on the harvest sequence for these fields and on whether or not some would be abandoned and, if so, which ones. Preharvest sampling data and planting date were important factors in determining harvest timing, but many other factors would enter into the decision when several fields appeared to be maturing at the same time.

St. Croix Valley Foods, Inc.

St. Croix Valley Foods, Inc., with headquarters at Preston, Minn., was fairly typical of most midwestern vegetable processing firms in its structure, historical development, and operating protocols. Considerable expansion and modernization had taken place in recent years, and several plant locations in the upper Midwest were owned in 1989. The company was not limited to sweet corn and green peas, but these two vegetables were canned at all locations. The total area of sweet corn and green peas under contract to the company averaged more than 15,000 acres annually.

The plants were favorably located in several respects. First, they were sufficiently close to one another to permit some economy in both field and factory management. Second, they were located within hauling distance from irrigated lands. Third, the plants were sufficiently close to one another to permit some exchange (internal sale) of raw product and sufficiently close to other vegetable-processing companies to permit an occasional external sale or purchase of raw product as supply and demand dictated. Occasionally, sweet corn had been hauled up to 200 miles for processing. Finally, the plants were located close to good-quality farmland operated by skilled farmers and to a labor pool for summer help.

About 20% of the company's sweet corn was grown under irrigation, providing some opportunity to reduce the risk of drought effects on dryland production. Furthermore, the sandy, irrigatable soils provided an earlier planting date and permitted planting and harvesting sooner following rains. Thus, the higher cost per acre of production under irrigation was offset by reduced overall risk and, frequently, by the higher yields and more-uniform raw product quality from the irrigated land.

The summer vegetable pack normally began with a 6-week green pea pack starting in mid-June. Following a 4- to 8-day down period after peas, a 7- to 5-week sweet corn pack began. It was in the company's best interest to begin the season as early as possible to process an even flow of raw product on a day-to-day, two-shift basis; and to complete as much of the season as possible by Labor Day. After that day, the temporary summer help was less available due to school conflicts, and peak production at the factory was progressively more difficult to maintain.

Responsibilities of the agricultural manager

Blume had the ultimate responsibility for providing a uniform flow of high-quality raw product during the harvest season for each crop and for all agricultural phases at the various locations, including contracting, selection of production locations, designing planting and harvesting schedules, pest control, crop management and consultation for contract growers, equipment acquisition and maintenance, and harvesting and delivery of product. He shared responsibility with the factory manager and top management in forming the annual plan and the sweet corn acreage contract.

Blume had been with the company for several years. Following graduation from college he had worked first for another company for nearly 10 years before joining the firm as agricultural manager. In this capacity he supervised several field representatives, each responsible for a number of contract growers within a "territory." These representatives provided most of the direct liaison between the company and the contract growers and were the first line of supervision above the temporary (summer) crew-chief level.

In addition to the field representatives, Blume was assisted by Mark Gravely. Gravely monitored and interpreted the pregrade data and spent much of each day scouting the maturing fields. He worked across the various territories assigned to the field representatives and was in frequent contact with Blume by radio. He had been with the company since 1985, following completion of his M.S.
Crop establishment

Each spring, sweet corn planting began as early as was commensurate with good emergence, but generally not before the last week of April. With the rapid day-to-day change in raw product maturity near harvest, uniformity of emergence following planting was important for optimizing yields. Thus, plants that would emerge 2 or 3 days earlier or later than the majority in the stand would become a detriment to yield and quality. Such plants acquired a status similar to weeds, using production resources without providing economic return. Seedbed preparation, soil uniformity, seed vigor and uniformity, and planting care could have important influences on stand and uniformity of plant development.

Planting sequence was based on the heat unit system, using a 50F base temperature. Thus, sufficient acreage was planted the first day of the planting season to keep the factory busy for 1 day at harvest. The company normally planned to operate two 10-h shifts and to pack ~80 tons of raw product per hour. Hence, the factory would need ~1600 tons per day, which translated to 270 acres, if yield were projected to be 5.9 tons/acre, the state average. In reality, the average daily acreage that could be packed sometimes increased slightly near the end of the season if shortage of subsoil moisture and cool, cloudy weather impeded development and, therefore, reduced yield. At planting time, heat units accumulated slowly, whereas at harvest in midsummer they accumulated rapidly. Thus, based on average heat unit accumulation per day at harvest, a similar accumulation had to occur after the first planting, before the second planting could be made. Hence, even though the fields for the next unit of 270 acres might be ready to plant, one had to wait, if temperatures were cool, until the required heat units had accumulated to ensure that the first planting had a sufficient lead before the second planting was made.

Thus, the total packing season (tonnage) could be divided into a series of acreage (actually tonnage) units, with each unit defined as the daily capacity of the factory. Because of 1) the use of several different varieties, each with a different maturity; 2) local differences in temperatures; 3) “fast” and “slow” soils; and 4) rainy days that prevented planting or harvesting, the system became fairly complicated, and evenness of product flow, although generally good, sometimes was not quite as exact as one would have liked.

Therefore, in the vegetable processing industry, there were some inherent risks and inefficiencies as compared to a manufacturing industry based on a nonperishable, nonweather-related product.

Product maturity and grade

In the processing industry optimum maturity of sweet corn for processing was determined by several ways as listed below. Some were subjective, while others, such as kernel moisture and probable factory recovery, could be measured or calculated. In practice, a combination of the measured and subjective methods was used.

The preharvest monitoring of a field of maturing sweet corn progressively increased as the field approached optimum maturity. Beginning at ~10 days before projected harvest, 25-ear samples were harvested every 2 days from a predetermined point in the field. If the field (or crop) was perceived to be variable, perhaps more than one sample and sample location would be used. Generally, the samples were taken between 4:00 and 9:00 AM. Although decisions as to which fields to harvest next were made throughout the day, the plan for each harvest day ideally was crystallized by 5:00 PM the preceding day, unless rain, storms, or equipment breakdown occurred after that time.

Pregrade data taken from these samples were a major factor in final determination of harvest date. The samples were taken to the factory location. The ears were husked and lined-out, from apparently most mature to apparently least mature, on an inspection table. The following data were recorded.

Subjective: 1) kernel color and its variability from butt to tip; 2) kernel fill and depth from butt to tip; 3) degree of seed set; 4) insect damage and other problems; 5) number of ears judged as ready for harvest; 6) kernel appearance from a cut sample composed across the ears.

Objective: 1) kernel moisture from the cut composited sample; 2) probable factory recovery (degree of cut-corn yield from snapped, unhusked yield).

The samples from the various fields were compared with one another and also against a mental standard. The samples receiving greatest attention were from those fields that were nearest to optimum maturity. The differential appearance of each hybrid at maturity and its characteristic pattern of change with time as it approached maturity had to be recognized and understood.

Percent kernel moisture was the most important single factor on which harvest decisions were based during the final 10 days. The highest-quality cut corn from most of the standard (su) sweet corn hybrids was obtained at a kernel moisture level of 72% to 73%. [For supersweet (high-sugar) hybrids, such as sh-2 and se types, the optimum moisture level was higher, approaching 78% to 79%.] At 74% to 75% moisture, the flavor and taste were good, but kernel size and uniformity, color, and cut-corn yield of su hybrids were below par. At 70% to 71%, a critical dividing point, yield was higher, but the cut corn appeared older (large, darker yellow kernels) and might have been tougher. The company’s experience was that the pregrade sample moisture level taken one day was what you would get if you harvested the field the next day.

In the simplest sense, the industry used three grade designations to identify its sweet corn packed product for pricing and inventory purposes. These were, in declining order of quality, fancy, extra-standard, and standard. Although these were determined subjectively from company to company and without the use of regulatory standards, they were sufficiently meaningful and stable across companies and years to provide a basis for buying and selling. However, it was to be expected that there were vintage years and down years, as well as reputation differences from one company to another.

St. Croix Valley Foods recognized two additional quality grades of packed, cut sweet corn. First, they recognized a high-fancy grade, a notch above fancy. Second, they would, on occasion, pack a low-standard grade, if they anticipated a market outlet. In practice, the quality grade was assigned in the quality assurance laboratory after canning. Thus, other factors could and did enter into the decision.

Cut-corn kernel moisture level

HortTechnology Jan./Mar. 1992 2(1)