The hidden implications of this word quality that are not exposed by a definition of grade, leaves plenty of room for error between fresh produce at farm level and what the consumer sees in the retail store. Especially is this true when many marketing people cannot define quality. Another thing that I would like to mention is that this concept of profit as determined by retailers, is entirely different from what most of us would consider as profit. For instance, the historical accepted retail margin for produce departments is 25%, but the average of 7% losses that I spoke of earlier does not come out of this 25%. Also, this 25% margin as used by retailers involves adding one-third the cost of the merchandise to what they pay for it. Retailers figure their profit on a basis of cash received from sales. Whereas most of us generally consider profit as what is received over and above what we pay for it. I think it is important to mention why retail price levels seem quite reluctant to change. This is brought about by the fact that retailers are not interested particularly in sales or profits from one particular commodity. They place all of their produce commodities, literally, into one pile and sell them as a department. It is the average profits from this department that they are concerned with. Most retailers feel that once consumers have been conditioned to a certain price level it is better for them to maintain that price for a commodity even though their margin of profit may vary considerably on a commodity basis. The last thing that I would like to mention in regards to important things that we should know, is that a tremendous lack of skills, training, and technical information help to hold down the farmer's share of the consumer's produce dollar. It is a wellknown fact that the producer, in general, is a residual claimant on what's left from the consumer's dollar after marketing charges have been paid. Therefore, any reduction in marketing waste and spoilage and any saving through handling efficiency will be eventually passed on to the farmer.

To give an idea of what I think can be done to improve the best marketing system in the world, I will start with a broad statement and become more specific. Marketing starts at the farm and continues through to the consumer. All levels and phases of marketing activities should be well informed and trained for the jobs which they are to perform. For instance, maximum production per acre is not enough when quality is such that the consumers will not buy. Grading for size, maturity, and damage should be much more closely and thoroughly done. An effort should be made to either label as such or to prevent inferior products from being placed on the market in competition with quality merchandise. It is my feeling that in many cases one man's gain by the sale of inferior merchandise results in a loss to the entire industry. It is important to do a much more thorough job of seeing that proper quality insuring conditions are maintained throughout the marketing period. In order to reach maximum sales, an effort should be made to see that fresh quality merchandise is properly displayed in all neighborhoods where it is profitable to sell fresh produce.

Some of my thoughts on how these things may be accomplished are that this problem is not one of marketing alone but is also one for the horticulturist. I could go on to mention each level of produce handling and cite specific examples of improvements needed, but we have time for only a few. Harvesting crews could use much more care in handling. Precoolers, in many instances, should be informed that their job is more than just a cool refreshing bath. Shippers should be shown that precooling is wasted effort if perishable merchandise is to be shipped in hot cars or trucks. There is room for improvement in transportation. Wholesalers are way behind in handling efficiency and facilities for maintaining quality. Retailers are receiving attention in only a few states. Consumers on the average are not eating enough fresh produce from a nutritive standpoint according to the health authority. Any improvements that can be made regarding any of the problems from farm to consumer will result in material savings to the nation, the farmer and the consumer.

FIELD CONTROL OF BLACKHEART OF CELERY

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Blackheart has been a serious problem of celery growers for more than 50 years. In Florida, individual growers have at times lost all or large portions of a given crop depending on the prevalence and severity of the conditions associated with blackheart. It is estimated that losses in Florida due to blackheart have often averaged about a million dollars annually.

Most investigators agree that blackheart is a physiological disorder characterized by the break-down of the young leaf tissue in the heart of the plant (Fig. 1). It may eventually

Fig. 1. A blackhearted celery plant before treatment.

spread throughout the entire heart and the affected tissue usually turns black, hence the common name "blackheart." A summary of the literature (1, 2, 5, 11, 16) indicates that blackheart is often associated with unbalanced moisture, over-fertilization, high soluble salts, and certain practices or conditions that promote rapid growth. Control of blackheart as suggested by various workers has been approached by the use of measures alleviating such conditions as far as possible. These measures have sometimes been helpful, but generally inadequate.

In 1952 (7) it was reported that blackheart could be completely controlled in greenhouse celery by application of a calcium solution directly to the heart of the plant. A number of field trials were completed during the past season in the Sarasota celery-growing area. A summary of these results is presented in Table 1.

It is evident that blackheart was prevented or cured by the calcium treatments (table 1 and Fig. 2). A number of growers located in several different celery growing areas in Florida successfully utilized this method of blackheart control during the past spring crop season. The common spray machines were easily adapted for delivery of the calcium solution directly into the heart of the plant. It should be emphasized that if the calcium does not reach the heart area, it is useless as a control for blackheart. The older foliage already contains relatively large amounts of calcium which is not translocated to the younger tissue.

Fig. 2. Left: An untreated plant showing the destruction caused by blackheart and a secondary soft rot infection.
Right: Recovery of a blackhearted celery plant after the calcium treatment.

It has been noted that the larger more vigorous plants have the greatest tendency to be affected by blackheart. The fact that calcium is taken up and moved rather slowly by the plant may be important when considering that blackheart is often most prevalent in rapidly growing celery. Celery is a notoriously gross feeder, requiring more fertilizer than most other truck crops. Yields of 1200 field crates per acre are not uncommon. In the Sarasota area the growing season is 100 to 110 days from the time of setting to harvest. The part of the celery plant produced during the final 6 weeks of growth is considered the marketable product. During this period, growth is normally very vigorous; and the nearer the rapidly growing plant approaches maturity the more likely blackheart is to appear. Considering the limited root area of a celery plant and the relatively slow absorption and translocation of calcium by the plant, it is possible that calcium availability within the plant cannot keep pace with calcium demand, especially when other factors favoring blackheart development are also operating.

High soluble salt is a factor often associated with blackheart in Florida celery growing areas. This high salt in the Sarasota area seems to be the result of a residual effect of heavy fertilization over a number of years

Table 1. Effect of Field Treatments on the Incidence of Blackheart of Celery

Treatment*		Marketable Celery** Yield per acre	Marketable Celery** lbs. per stalk non-blackhearted	% Blackheart
Fall				
Calcium nitrate	10 lbs/100 gal.	1006	1.31	0
Calcium chloride	5	1110	1.45	0
Check		364	0.84	43.3
Sodium Oxalate	5 lbs/100 gal.	--	--	91.5
Spring				
Calcium nitrate	10 lbs/100 gal.	1000	1.30	0
	20	1005	1.31	0
	50	1010	1.32	0
Calcium chloride	5 lbs/100 gal.	1080	1.40	0
	10	1080	1.41	0
	25	910	1.19	0
Check		590	1.22	40.0
Sodium Oxalate	5 lbs/100 gal.	0	--	100.0
Sodium Citrate	10	0	--	100.0

*Approximately 5 lbs of calcium chloride contains as much calcium as 10 lbs. of calcium nitrate (commercial basis). Application was directly to the heart area at a rate of about 150 gal. per acre. Treatments were applied once weekly, beginning about 5 weeks before harvest when some blackhearting was apparent.

**The yield is given as number of 52 lb. field crates per acre. Blackhearted celery is not considered marketable.

plus heavy fertilization during the current crop season. Indications are that the calcium content of the celery plant varies inversely as the salt concentration in the soil (7). Results of a recent survey (15) indicate that celery from the Belle Glade area, where blackheart is of little consequence, contained an average of 1.66% calcium while that from the Sarasota area contained 0.77%. The soils of the two areas where these samples were grown are of a similar type, containing similar amounts of base exchange calcium, but cultural practices differ widely. The Belle Glade celery grows more slowly, being supplied with lesser amounts of fertilizer, especially nitrogen. Many celery and soil samples from the Sarasota fields have been analyzed during the current investigation. High soluble salts in the soil are almost invariably associated with a correspondingly low calcium content in the heart tissue of the plant, other factors being equal.

Some typical soils analysis results are presented in Table 2. The results recorded in Table 2 are from samples taken at the time of harvest and are representative of relative differences occurring during the growing season.

A study of the results in Table 2 suggests that several factors are interrelated. No blackheart developed in Field 1 and the data from this field is therefore used as bases for comparison. The soluble salt content was relatively low, an average amount of fertilizer was used, and the crop was harvested during a time when the weather was relatively cool. Field 2 was heavily fertilized and this can be directly associated with the prevalence of blackheart. Comparison of the figures for the A and B sections of Field 2 makes it apparent that blackheart was much more prevalent in the section (A) which already contained excessive amounts of soluble salts than in the section (B) which was comparable to Field 1 in amount of soluble salts. Field 2 was harvested in early March when the temperature was still cool. The effect of a warmer growing season is emphasized by the results obtained from field 3. In comparing fields 3B and 1, it appears that the warmer weather is a factor associated with blackheart. However the comparison of 3A with 2A suggests that development of blackheart was re-

Table 2. The Association of Soluble Salts, Quantity of Fertilizer and Time of Harvest with the Prevalence of Blackheart

*Soil Sample	Harvest Date	PPM in the Soil Sol at Field Capacity**				Fertilizer lbs/A of 5-8-8	% Blackheart
		Sol Salt	Ca	Na	K		
1	1/20	5200	1268	405	815	4000	0
2A	3/3	10800	1900	2532	504	7000	90
2B	3/3	5600	1420	884	430	7000	5
3A	4/6	9600	1560	2300	320	2000	40
3B	4/6	4260	688	346	56	4000	20

*Soils 2A and 3A are areas in fields 2 and 3 which annually are expected to be troublesome because of blackheart.

**The soluble salts were determined by means of conductivity of the soil saturation extract.

tarded by limiting the amount of fertilizer added to 3A even though the temperature and the soluble salts were both relatively high.

Both high temperature and liberal to excessive amounts of fertilizer tend to produce rapid growth, which has often been associated with blackheart. On the other hand, accumulations of soluble salts tend to retard growth and should be a factor retarding the development of blackheart. However high soluble salts seem also to retard calcium uptake or utilization by the plant. Since blackheart is usually associated with high soluble salts, it would appear that the association as related to the effect on calcium uptake or translocation is of primary importance. It should be noted that sodium salts comprise over half of the total soluble salts in areas where blackheart is most prevalent. Sodium is known to affect adversely the calcium uptake by plants (12, 13).

Unbalanced water relations is a factor often associated with blackheart. Observations pertaining to how this factor may affect calcium availability or assimilation are limited, and therefore will not be discussed at this time. Regardless of how the conditions causing blackheart may be associated with the calcium supply or demand it appears that temperature and light are factors as well as moisture balance, excessive soluble salt and over-fertilization. Freeland (6) has reported that high transpiration associated with high temperatures caused bean and corn plants to take up relatively more potassium and less calcium. Observers have noted that where soluble salts, especially nitrogen, are in excess, celery plants are very susceptible to blackheart in cloudy weather. It was observed by Bennedict (3) that ultra-violet rays between 2900 and 3100 A° caused an increase in the percentage of calcium in all plants that he examined. Light and temperature, as altered by greenhouse conditions, seem to be factors associated with the 100% prevalence of blackheart in greenhouse-grown celery. Relatively higher temperatures are also associated with the increased prevalence and severity of blackheart in field-grown celery during the spring crop season.

Investigations are in progress on the means by which the conditions usually associated with blackheart affect the calcium uptake, translocation, and assimilation. It is logical that in some cases a limited calcium supply or availability could be a direct cause of blackheart. In other cases it appears that adequate calcium enters the plant but excessive amounts of certain organic acids may "tie up" the calcium so that normal assimilation of calcium is retarded. As indicated in Table 1, oxalates and citrates markedly increased the prevalence and severity of blackheart. Some of the conditions often associated with blackheart could cause an abnormal metabolism in the plant producing excessive amounts of certain organic acids. A number of investigators (9, 10) have noted that nitrate reduction and assimilation are associated with increased production of organic acid and increased uptake of cations. Pierce and Appleman (14) state that insoluble oxalates and insoluble calcium in 12 different plant species were highly correlated. Gilbert et al. (3) found that oxalic acid formation in tung leaves was related directly to nitrate concentration and uptake as well as to the supply and uptake of calcium. Evans and Troxler (4) working with blossom-end rot, a physiological disorder of the tomato fruit, have indicated that organic acids may have an influence on calcium assimilation. Blossom-end rot seems to be similar to blackheart of celery in that calcium appears to be a limiting factor as associated with conditions similar to those associated with blackheart of celery.

In considering the nature of the suggested cause and the success of the foliar calcium treatment as well as the pertinent material in the literature, it appears that calcium must be supplied at the proper time and to the proper place for successful control of blackheart.

SUMMARY

Blackheart, a physiological disorder of celery can be completely controlled by applications of a calcium solution directly to the heart of the plant. Temperature and light as well as unbalanced moisture, high soluble salts and over fertilization seem to be factors associated with the prevalence and severity of blackheart. These factors may directly or indirectly affect the uptake, translocation or assimilation of calcium by the plant. It appears that when two or more of the many possible influencing factors are involved, the incidence of blackheart increases accordingly. Rapid growth makes the plant more sensitive to the effects of contributing factors because per unit of time, the requirement for calcium is further extended. It may be concluded that, regardless of the cause or causes, blackheart can be controlled by supplying sufficient calcium at the proper time and to the proper part of the plant.

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SOME MANGANESE-IRON RELATIONSHIPS IN TOMATO FRUITS GROWN ON MARL, PEAT AND SAND SOILS

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Manganese and iron are known to be active agents in the formation of chlorophyll in plants. Many workers have noted an inverse relationship between the availability of manganese and of iron in the soil with respect to the health and yield of crops. A comprehensive review of manganese-iron relationships in soils and plants is given by Mulder and Gerretson (5), from which the concensus is that iron and manganese have a close inverse relationship within the cells of the plant, in addition to soil relationships.

The present study was undertaken for two reasons, first to determine the relative availability of manganous sulfate, manganous oxide, manganese dioxide and the manganous salt of ethylene diamine tetra-acetic acid (Mn EDTA). The second reason was to find out

Florida Agricultural Experiment Station Journal Series, No. 205.