BROWN CENTER/HOLLOW HEART OF POTATOES ---WHAT DO WE KNOW?[1]

by
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The internal tuber disorders, brown center and hollow heart, have been problems to potato growers for a long time. However, these disorders have become more serious and widespread in the last few years, and have resulted in large losses to growers as well as processors. We have been working on this problem for the last 4 to 5 years supported by you, the potato grower, through the Washington State Potato Commission. We wish to acknowledge and thank you for this support and interest in our research programs. We need to remind ourselves that these problems are physiological disorders (not caused by disease, insects, etc.) and consequently, are very difficult to easily find positive answers and solutions. However, we have taken some different and new approaches with new techniques for this old problem and feel that we have discovered some new insights into the initial causes or initiation of these internal defects.

Symptoms of this disorder appear as a group of dead, brown cells in the pith area of the tuber. This is the brown center (BC) stage. It can range from a light brown discoloration to a very dark brown which can even develop into hollow heart in the center. This type of hollow heart we call stem-end hollow heart (SEHH), in contrast to the bud-end hollow heart, which we find later in the season and which is probably caused by a different set of circumstances than is the stem-end hollow heart.

Our presentation today will be in the form of a "brown center quiz." Those of you who read the January 7th issue of Spud Topics will have a big advantage, as all of these questions were answered in that article.

Question 1. What is the principal cause of brown center (BC) and stem-end hollow heart (SEHH) in Russet Burbank potatoes?

a. potatoes following wheat in the rotation
b. cool (50° - 60°F) soil and air temperatures
c. heat stress and lack of moisture
d. the potato eelworm

The answer is (b), cool soil and air temperatures. Growth room work, where soil and air temperatures were carefully controlled, has shown that cooler temperatures resulted in more BC formation (Fig. 1), with 50° and 60°F generally exhibiting the most disorders. The lowest amount of BC was found at 70°F. Since 1976 we have recorded soil temperatures in the field and have constructed graphs such as this one for 1977 (Fig. 2). The temperatures barely got below 60° during this entire period. As a result there was very little BC. TI's 1, 2 and 3 correspond to the tuber initiation date of the three plantings; the first planting date was on April 1 with two week intervals. As the temperature decreased during each tuber initiation period, the amount of BC increased. The only time we had much BC was where the average temperature fell below 60 degrees at TI3. This is in contrast to 1980 (Fig. 3) where we had

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1 Paper presented to the 20th Annual Washington State Potato Conference and Trade Fair, February 3-5, 1981, Moses Lake, Wa. 98837

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3 The research reported herein was supported in part by the Washington State Potato Commission.

quite a bit of BC with very low temperatures. Soil temperatures rarely got above 55°F and were down even into the 40's. We had 4 planting dates starting April 1 and continuing every 2 weeks. As the temperature increased with each planting date at tuber initiation the amount of BC decreased. Also, we can see that because the temperatures were low during the first planting dates we had high amounts of BC, over 20%.

Question 2. When is the tuber most susceptible to BC and SEHH initiation?

a. before tuber initiation
b. tuber initiation to two ounces
c. when tubers are mature
d. Monday or Friday nights

Tubers are most susceptible to BC and SEHH initiation at tuber initiation to 2 ounces. In 1978 we did some greenhouse work (Fig. 4) that showed that the closer the tubers were to tuber initiation when given a period of cool temperatures, or if they were constantly cool, the more apt they were to develop BC. To illustrate how small the tubers can be when they first show BC symptoms, hold your hand in front of you and imagine putting five tubers on your two middle fingers and the front of your palm. If small, rapidly growing tubers experience cool temperatures at this early stage of growth, SEHH can also develop.

Question 3. Faster growing tubers are (more, less) susceptible to BC and SEHH.

Faster growing tubers are more apt to get BC and SEHH. We have developed a technique where we wash the soil from the tubers and identify them with plastic tags. Tuber weights are taken every two weeks and then plotted on a graph (Fig. 5). The numbers on the right represent each tuber under one plant. Tubers 5, 3, and 1 grew more slowly and developed normally, whereas tubers number 4 and 2 grew quite rapidly in these cool temperatures and developed BC. We should point out also that these results have shown that 64% of the largest or fastest growing tubers exhibited BC whereas only 18% of the smaller tubers developed the disorder.

Question 4. Wet areas of the field generally contain (more, less) BC and SEHH than drier areas.

We have found that BC occurs more in wetter areas of the fields. In 1979 we sampled 14 commercial fields and in 1980, 13 fields (Fig. 6). The wet areas of the field, which correspond to the draws and the low spots where moisture accumulates or soil moisture is naturally higher, had nearly twice as much BC as the dry spots of the fields that were sampled. The dry spots correspond to the knolls or the edges of the circles. Also, experimental plot work (Fig. 7) has shown that high water applications or water replacement throughout the growing season also resulted in a much higher percentage or severity of BC.

Question 5. Planting late in spring will always prevent the formation of BC and SEHH. True/False

From what we have said so far, with soils generally warming as the summer approaches, the logical answer to this question would be true, but when we look at the individual years we see something quite different (Fig. 8). Those years in which the cool spell occurred early in the spring, corresponding to the early or medium planting dates which would be in April or early May, and then gradually warm, throughout the rest of the spring, we do in fact find a decrease or drop in the severity of the BC as indicated in 1978 and 1980. Looking at 1977 and 1979, we then see that even the cool spells in those particular years were later in the spring, corresponding to the time of tuber initiation on the later planting; and there was an increase in BC. Simply saying that the time of planting, in this case, corresponded to the time of the cool spell. Also, 1979 (Fig. 9) is a good example of a year when this late planting had the coolest temperatures at the time of tuber initiation. Here we notice the cool spell, 52°F, corresponded exactly to the time of tuber initiation for the third planting. Also TI2 was below the 60°

threshold, compared to TI1 and, as the temperature decreased, BC increased dramatically in these later plantings. So, we can not generally associate the time of planting with an increase or decrease in BC; it depends on when the cool spell occurs in relation to the time of tuber initiation.

Question 6. Although nature controls the initiation of BC, you can, to some extent, control the development of it. True/False

This is true. Although we realize we cannot control temperature, which is the cause of BC, we can have some influence on the development of this disorder through two means. One, we should survey our fields and know the stage of growth of the plants and the tubers in that field. Secondly, we need to consider the weather. We have to keep watch. If we have a cool spell and a large percentage of the tubers are at the susceptible stage, which we have seen to be tuber initiation up to 2 ounces, then we need to reduce our water applications in attempting to slow the plant growth for this short period of time.

Question 7. Which of the following practices will help reduce the possibility of severe BC and SEHH problems developing.

a. watering only if necessary during a cool spell
b. reduce planter skips
c. be sure sprinkler nozzles are sized and working properly
d. use dam pitters

We hope that all of these will help control BC and SEHH. First of all, you should water only if necessary during a cool spell but be sure not to dry them out. Your plants at that time in late May and June are using very little water compared to later on in July and August. Avoid planter skips. These skips give the plant an opportunity to grow too rapidly thus developing BC or SEHH. Also, be sure your nozzles and sprinkler system are sized and working properly to avoid areas of the field which will be either over-watered or under-watered. You can also use dam pitters which will create gouges in the furrow, collecting water and thus preventing runoff into the lower parts of the field creating waterlogged areas.

Question 8. Preventing BC and SEHH development results in significantly reduced yields. True/False

We feel the answer to this question would be false. Because the period we are talking about is early in the season, slowing the growth at this time will have little effect on the ultimate total yield. The largest amount of growth, the tuber bulking stage, occurs later during the months of July and August. Other advantages which might be gained through not over-watering are fewer losses due to tuber rot or disease and plant diseases, reduction of soil erosion and nutrient loss either caused by the runoff of the water or leaching. The largest advantage, of course, would be the reduced amount and severity of BC and SEHH at harvest time.

In summary, the major points we have highlighted include:

1. Be aware of cool temperatures (below 60°).
2. The most susceptible stage for BC initiation appears to be during tuber initiation to two ounces in size.
3. Excercise proper soil moisture and irrigation management during this period particularly if temperatures are cool.
4. Attempt to slow plant and tuber growth during this cool period.
5. Use proper cultural and planting practices.

So, this coming season be especially aware of cool or cool, rainy weather. If it occurs, get out in your fields and dig up some plants to determine if they are in the critical stage we have talked about (TI to two ounces). If the tubers are this size, then practice careful water management to reduce growth as long as the cool period persists. And if all goes well, instead of being behind the eight ball, you will have a prize winning crop this fall.

Figure 1.

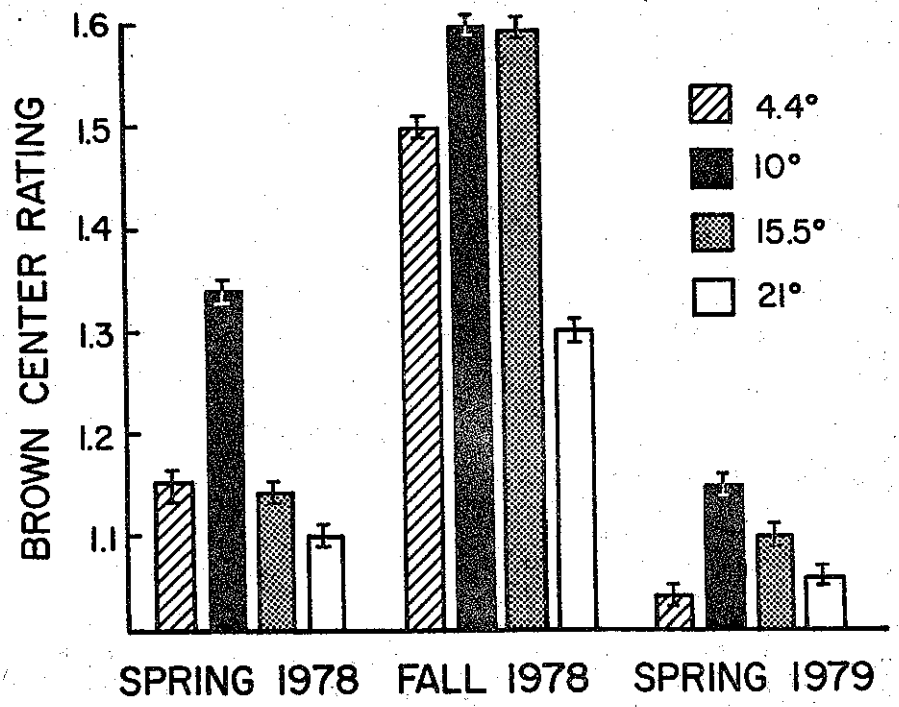


Figure 2.

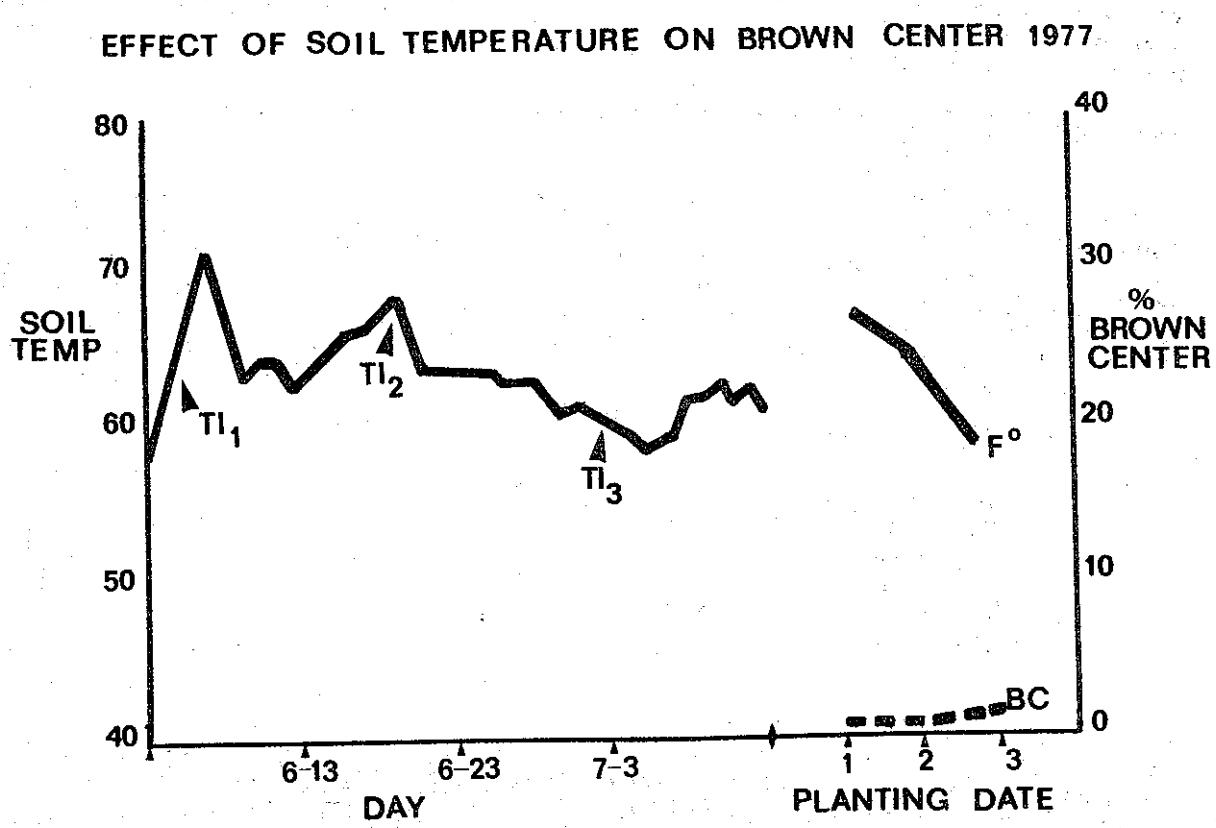


Figure 3.

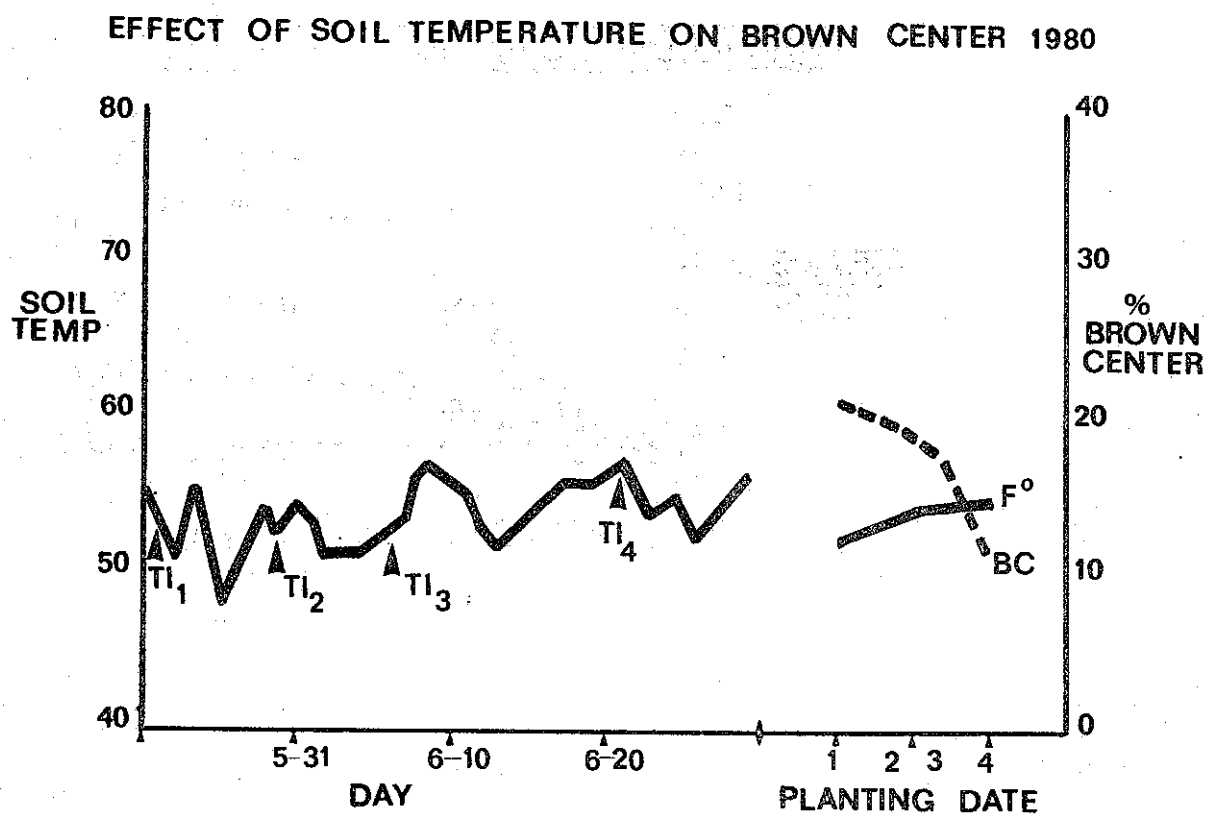


Figure 4.

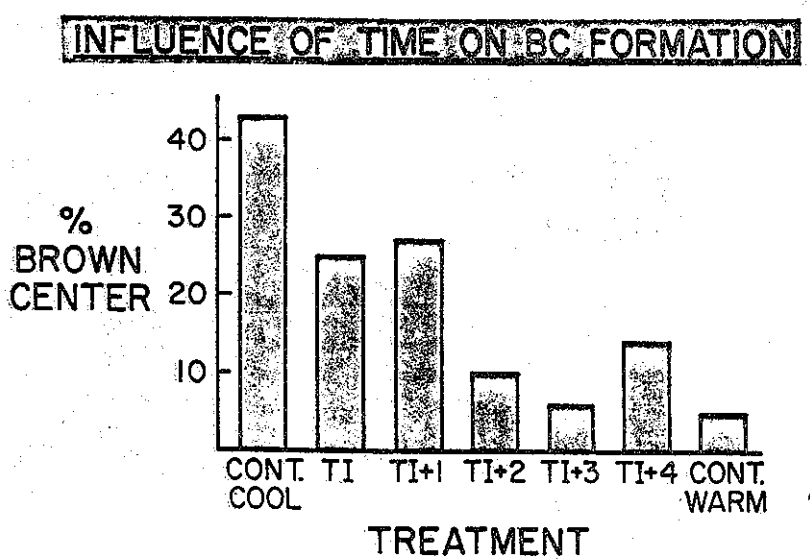


Figure 5.

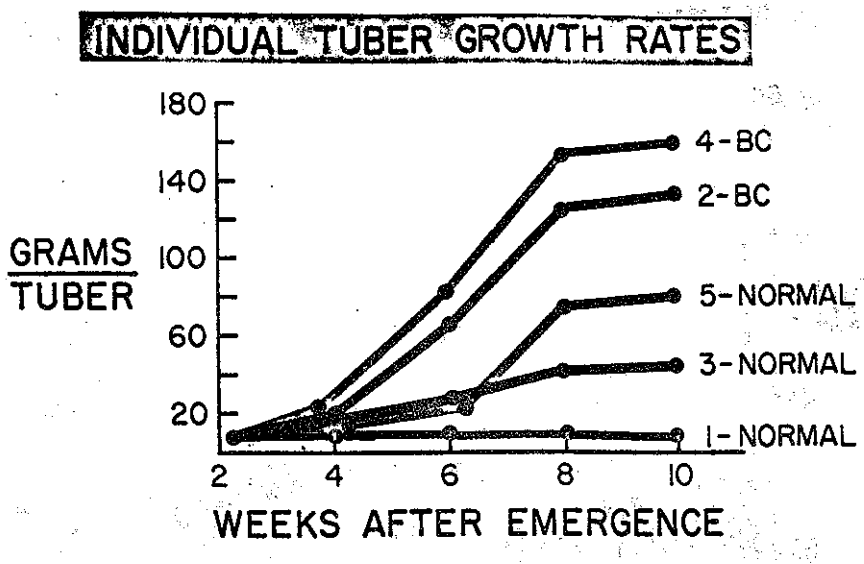


Figure 6.

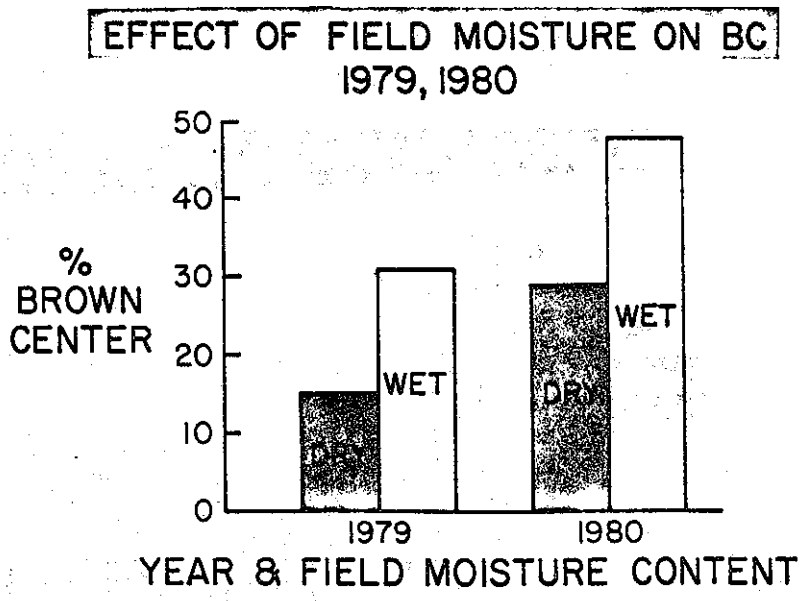


Figure 7.

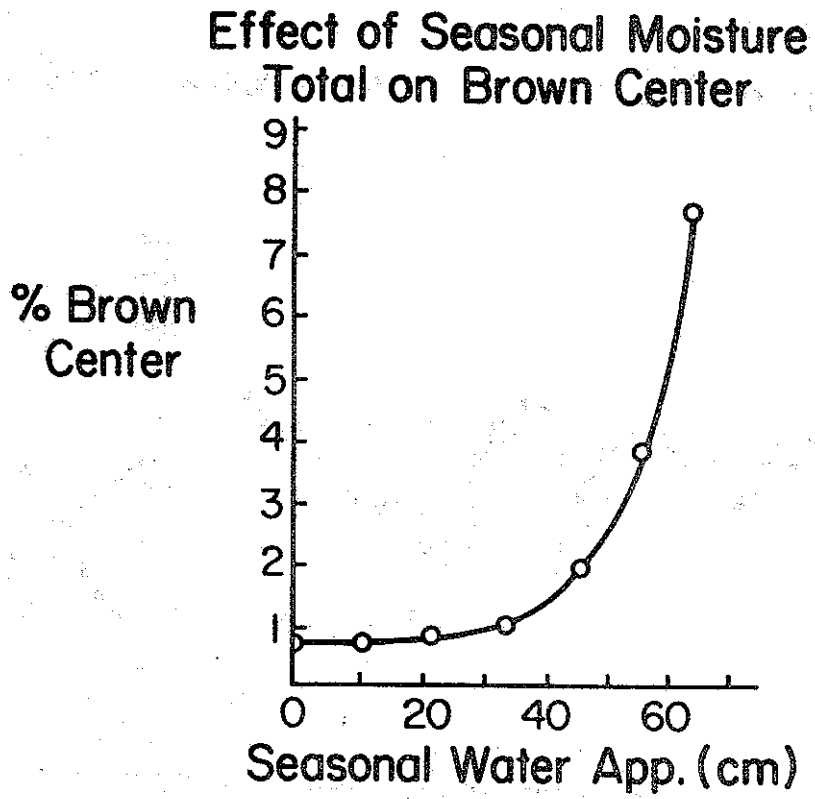


Figure 8.

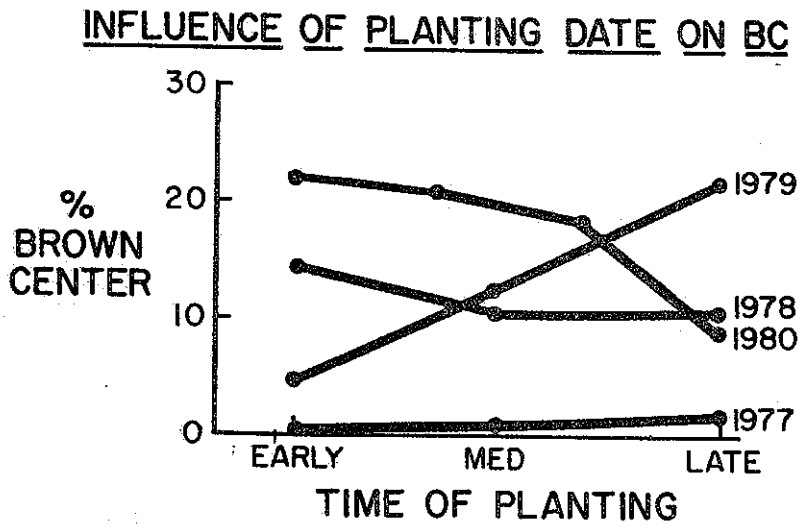
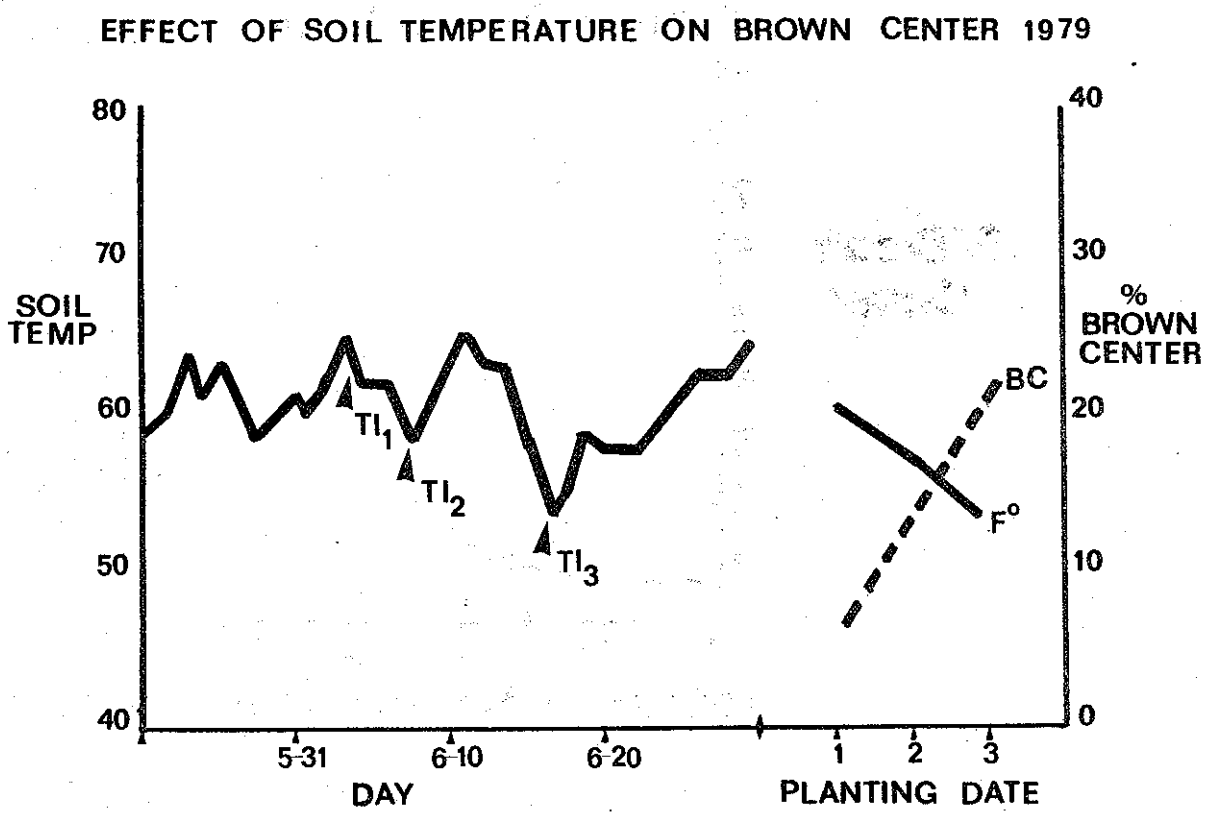


Figure 9.


EFFECT OF SOIL TEMPERATURE ON BROWN CENTER 1979
80
70
60
50
40
SOIL TEMP
TI1
TI2
TI3
5-31
6-10
6-20
DAY
40
30
20
10
0
% BROWN CENTER
BC
F°
1
2
3
PLANTING DATE