November 21, 1992

RESEARCH REPORT: PINELANDIA BIOPHYSICAL LAB.

LABORATORY Code: KS-01-64

PLANT MATERIAL: Sweet corn (*Zea mays*), var. Illinois Chief

FORMATION: Formation in Ashtabula, Ohio, USA - a few days before Sept. 2, 1992, -- 8 x 25 ft. rectangle in a field owned by Donald Wheeler. Stalks had been leveled but not broken.

SAMPLES COLLECTED BY: Mrs. Connie Sistek, Ashtabula, Ohio, USA

COMMENTS ON SAMPLES: This study is based on two sample collections made at different stages of development. Thanks to the diligence of Mrs. Sistek, the findings provided an excellent example of the importance of obtaining samples through plant development stages following the initial formation.

SAMPLE SET #1-TAKEN SEPT. 5, 1992

EXTERNAL APPEARANCE: The corn (received at lab. 9-8-92) was at a very early stage of development - ears just beginning to form. A quite obvious development difference was observed in the tassels. On the control plant the spikes and florets had not formed or opened outward. On the formation plants the anthers had been extruded from the primary, male florets, whereas on the controls the pedicellate spikelets were still tightly grouped along the tassel as shown in Fig.1-A.

These differences in tassel form suggest that the formation plants are developing at a more rapid rate than the controls. Generally anthesis (tassel opening, pollen shedding etc.) is very closely timed in a field of corn and under normal conditions, one does not observe the differences in tassel formation, as seen here. These tassel differences were also seen in several on-site photographs submitted by Mrs. Sistek.

EMBRYO DEVELOPMENT: The small developing ears were removed from the lower, node-2 and the upper node-3 positions on each plant (no ears found on sample #1). All the ears from the formation plants appeared a darker

brown color and the pericarp on the tiny kernels had a roughened appearance and were smaller in size compared with the controls.

CELL WALL PIT EXAMINATION: The thin tissue covering the anthers on the tassel glumes was used in this analysis - still in green stage.

SAMPLE	PIT DIA. (microns)	N-PITS	DIA. CHANGE
Control	1.98 s.d. 0.46	30	---------
Circle	1.96 s.d. 0.32	30	-1.0% (N.S.)

The high degree of elasticity in this early, green tissue would allow it to rapidly recover from an expansion force. As found in wheat, the size of the cell wall pits within tissue at this early growth stage cannot be used as an indication of crop formation energies.

SAMPLE SET *2, TAKEN OCTOBER 2, 1992

The second sampling was planned to take place after the ears had matured (no green tissue on the plants) and the seeds dented. Mrs. Sistek had to take the samples on this earlier date due to pressure from the farmer - he wanted to plant some other crop on this land.

SEED DEVELOPMENT: Four ears were taken from the formation and four ears outside the downed region. The corn was still in the milk stage with white endosperm. The outer husks were starting to loose some of their green color. The ears ranged from 10-18 cm in length and externally there was no apparent difference between the two sample groups. The silk formation also appeared normal in both sets.

GERMINATION TESTING: Several attempts were made to germinate these immature seeds. These attempts are listed in sequential order of testing.

1) Seeds were immediately removed from the cob by inserting a scalpel and lifting out. A total of 30 seeds from each sample set were imbedded in MS media (Murashige-Skoog, Sigma Chem.) within a "Phytocon" (media depth about 2.5 cm) which was then placed in a growth chamber at 25° C. Examination at 5-days gave no evidence of germination in either sample group.

2) Seeds excised from cob on 10-8-92 then dried in air for 16 days. Paper roll germination test on 10-24-92, with negative results.

3) Seeds dried on cob for 19 days, then air dried for 6 days after excision from the cob. From a paper roll germination test, 30% of the controls seeds had germinated at six days development whereas 0% of the formation seeds had germinated.

Not only were the seeds non-viable from the formation ears, but they were also of much reduced size relative to the controls-as shown in the following table.

SAMPLE	WT./50 SEEDS (gm)	WT./SEED (gm)
Control	3.23	0.065
Formation	0.55	0.011

This pronounced kernel size difference is particularly interesting when it is considered that the cob sizes were essentially the same in both the control and formation samples.

ABNORMAL EAR DEVELOPMENT:

One ear was found in the formation group which turned out to be very interesting. The outside of the ear was the same in appearance and size as all the others. Inside, the "double ear" formation, shown in the bottom photograph (Fig.1-B), suggested two growth stages of development. The small, tapered ear on the lower part was of the same size and stage of development as those taken from the formation on Sept. 5, one of which is shown at the right. The bulbous ear growth at the upper section contained much larger, more completely formed kernels indicative of normal development. It should be pointed out that this type of abnormal ear growth can occur as a result of insect damage within the ear; however, there was no indication of insect damage or abnormal silk formation within this or any of the other samples submitted.

COMMENTS:

Several aspects of the findings from this sample set indicate that at the time of the crop formation a suppression of the embryo growth occurred, a developmental perturbation which did not appear to be carried over into the somatic tissue. To summarize, each factor in the sequence of events are discussed below in relation to the control plants and the observed developmental differences.

1)-the apparent out of phase opening of the tassels might be explained by lodging trauma; however, photographs from Mrs. Sistek and one in the Ashtabula, "Star-Beacon" of Sept. 2, 1992 show standing plants at the immediate edge of the formation, with the open tassels, whereas the plants in the background (out of the formation) display closed tassels. These factors indicate a slight increase in the rate of development in the formation plants but due to the small sample populations is merely suggestive.

2)-the subtle differences observed in the color and kernel sizes on the ears within the Sept. 5 sampling are again only suggestive of alterations within the formation. At this point in development a much larger sample population would be needed to confirm this.

3)-the sample harvest of Oct. 2, tended to confirm the seed and ear development variations indicated in the earlier samples. After several attempts, the controls were found to have a 30% germ. and the formation a 0% germination. The seed weight within the formation ears was only 1/6 the seed weight in the controls. This seed weight difference was surprising in view of the fact that the ear sizes were the same as those in the controls.

4)-the abnormal ear is again indicative of embryo development suppression at the time of the formation (lower ear section in Fig.1-B). The somatic tissue continued to develop, and due to a hormonal situation known as apical dominance a new ear with normally developing seeds was formed at the apex.

What we have seen in this sample group is quite in line with what has been observed in other samples obtained during the 1992 crop season. In every case where embryo growth has been suppressed, the formation occurred very early in the plant development cycle (for example see Code: KS-01-5 in report-#5). Under the circumstances Mrs. Sistek did an excellent job of sample collection - what we have learned here makes it apparent that in future formations more extensive field sampling will provide a larger data base with which statistical analyses can be made.

Dr. W.C. Levengood

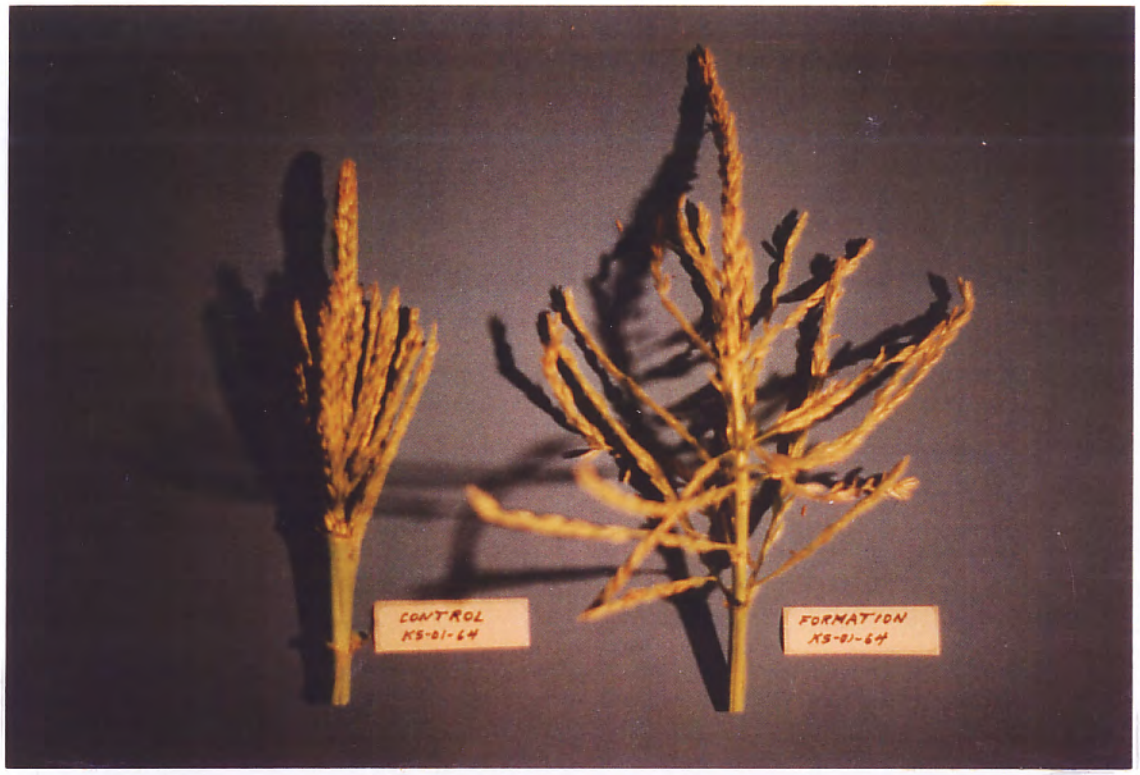

Fig.1-A Indication of accelerated tassel development in formation plants.

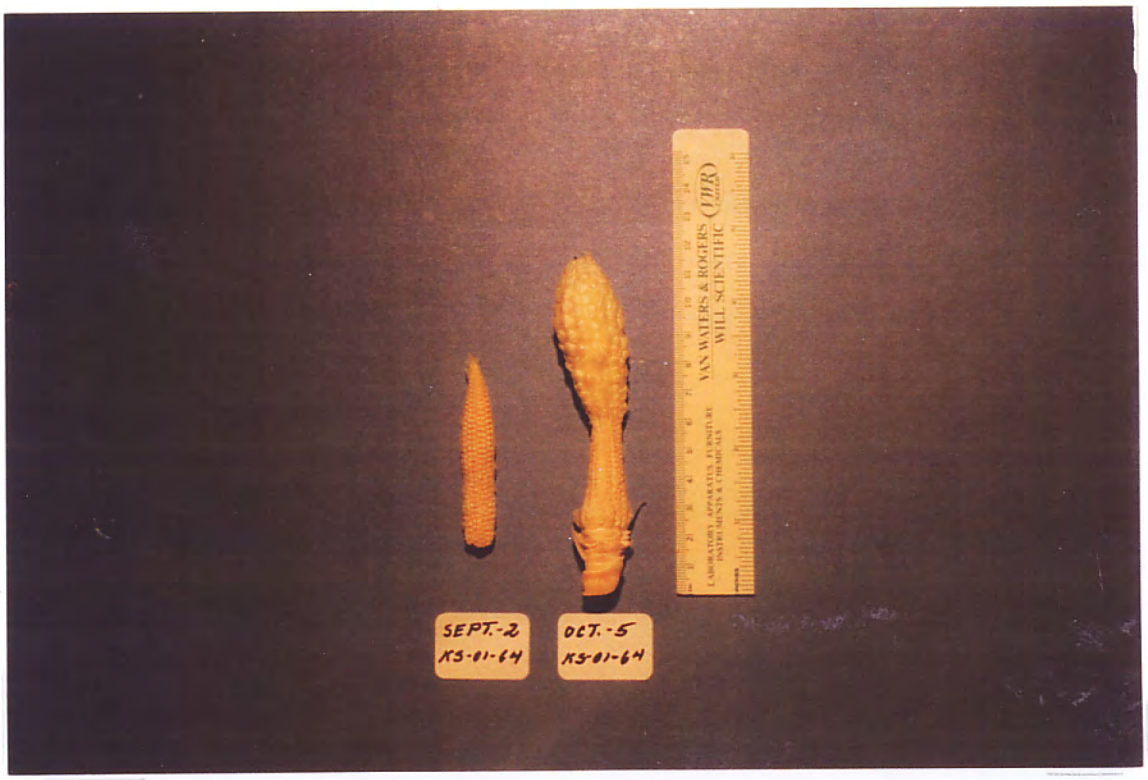

Fig.1-B Ear re-growth at the apex of a formation sample showing an earlier suppression of embryo growth.