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Unusual Growth Responses in Crop Circle Seedlings (Research Report #3)

W.C. Levengood

Information sent to: Pat Delgado, Chad Deetken, Tom Nesser, Linda Moulton Howe, Montague Keen and Michael Chorost

INTRODUCTION

The three sample sets discussed here were submitted from widely different locations, and by chance, also represent three different species. They are incorporated into one report since circle sample sets within each location disclosed very similar and unusual growth characteristics. This effect was noted within environmentally controlled germination studies. The unusual aspect stems from the consistent observation that the growth rates of both the roots and shoots in the seedlings from the circle samples, are positive when compared with normal seedlings from the control seeds taken outside the circles.

What makes this growth response a distinct feature of the crop circle formations is that it is diametrically opposite the response one would expect to observe from seeds taken from plants subjected to normal lodging, that is, field crops flattened due to wind and hail. A lodging condition is known to reduce viability and vigor in seeds taken from plants downed by natural causes. By conducting what may be best described as "precision germinating monitoring", it was learned that this growth factor does not dissipate as the plant growth progresses.

In addition to the growth response effect, data are also presented which relate to a new method for examining cell wall pit enhancement in crop circle material. In the original investigation of the cell wall pit enhancement effect (Crop Circle Research Report #2, Sept.4, 1991) the expanded cell walls were located within living parenchyma tissue inside the stem nodes. Recently it was noted that the after effects of the cell wall expansion could also be detected in the epidermal cells in bract layers surrounding the seeds.One primary advantage of using epidermal tissue is the fact that the cell wall pits were clearly seen in the control or normal tissue and this allowed direct statistical comparison between control and circle plants. Furthermore, evaluations of the enhancement could be conducted in mature tissue.

RESULTS

The pit diameter data presented here were obtained with an ocular micrometer at 450X magnification. In each sample set a total of 30 randomly selected cell wall pits made up a test population in which statistical evaluations were conducted. Since in some samples the pits were elongated (as shown in report #2) the maximum diameter of each pit was used for the analyses.

The "precision germination" data were obtained by examining each seed in the test group at regular intervals during the initial germination period. Both shoot and root growth were tabulated and the mean and standard deviations calculated on a daily basis for each test sample group. From these data it was then possible to construct growth curves which provided direct comparison between the responses in the circle samples and their controls. Although the initial radicle growth data were recorded, only the shoot growth will be discussed here since shoot data were available over a longer time interval. It should be pointed out however, that in these sample groups the initial radicle growth was consistently and significantly higher in the circle sample.

Code: G17-12 Species: *Hordeum vulgare* (barley)

Source: Morestead, England

Collector: Pat Delgado, samples taken Aug. 7, 1991

Formation: Complex - estimated to have been formed in mid-June

Comments: "Samples have continued to grow and ripen for at least seven weeks following the formation". Seed heads taken from a circle form.

EXTERNAL APPEARANCE - no difference in the appearance of the heads taken from the formations and those from the control plants.

SEED EXAMINATION - using a low power hand lens (5X) the grossly malformed seeds found in the circle heads are compared with those found in the controls.

Sample	Total Seeds	Abnormal	Percent Abn.
Control	84	3	3.6%
Circle	110	30	27.3%

CELL WALL PIT EXAMINATION - sample means and standard deviations (s.d.) are listed below for N=30 randomly selected cell wall pit populations. The mean values are given in microns.

Sample	ave.	s.d.	Relative Change
Control	1.72	0.40	---------
Circle	*2.02	0.54	+17.4%

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*- P<0.05

SEEDLING GROWTH - The seeds selected for germination were all of normal appearance (malformed seeds not used in germinations). In Fig.1 are the summarized growth data from the 20 seed populations. Although the standard error bars are not shown here the circle seedlings at the 6-day point were at a significantly higher growth (P<0.05).

Code: G17-13 Species: *Triticum aestivum* (wheat)

Source: Vancouver, Canada

Collector: Chad Deetken, All sample groups taken on Sept.5, 1991 in the Vancouver area.

Formations: Both circle and controls submitted with excellent diagrams and photographs.

EXTERNAL APPEARANCE - in all four sample sets no differences were noted in the external appearance of the seed heads taken from the formations and those from the controls.

SEED EXAMINATION - three of the four sample sets contained seed heads - no grossly malformed seeds were found in any of the circle samples or controls.

I. Jenny Skinner Farm - (seed heads and stems)

STEM NODE DIAMETERS - the node size ratios indicated that the node-2 positions in the circle samples were enlarged relative to the controls; however, there were insufficient samples for a statistical analysis, therefore, no definite statement can be made concerning node expansion.

CELL WALL PIT EXAM. - bract tissue, N=30 randomly selected pits per sample (dia. in microns).

Sample	ave.	s.d.	Relative Change
Control	1.73	0.32	----------
Circle	*2.08	0.58	+20.2%

*- P<0.05

SEEDLING GROWTH - the left set of growth curves in Fig.2 are typical of the repressed seedling growth obtained from seeds taken in the majority of the circle formations.

II. Aub Hubbard Farm - (seed heads only)

CELL WALL PIT EXAM.- bract tissue, N=30 per test (dia. in microns)

Sample	ave.	s.d.	Relative Change
Control	1.85	0.42	----------
Circle	*2.17	0.65	+17.3%

*- P<0.05

SEEDLING GROWTH - no significant difference between the root or shoot growth in this sample set.

III. Fred Watnaugh Farm - (seed heads only)

CELL WALL PIT EXAM. - bract tissue, N=30 per sample (dia. in microns)

Sample	ave.	s.d.	Relative change
Control	1.45	0.27	---------
Circle	*1.98	0.56	+36.6%

*- P<0.05

SEEDLING GROWTH - the set of curves at the right side of Fig.2 very clearly disclose the positive growth response in the circle seeds, which at the 8-day point are significantly greater than the control set.

IV. Roy Tetzlaf Farm - (stems only)

STEM NODE DIAMETER - as in the Skinner samples there was an indication of expansion at the node-2 position, but insufficient samples for a statistical analysis.

Code: G17-16 Species: *Zea mays* (U.S. Corn).

Source: - Medina, New York; Lee Roberts Farm

Collectors: - Tom Nesser and sent via. Linda Moulton Howe.

Formation: - Circle - discovered 10-7-91

Comments: - formation probably occurred within three weeks prior to its discovery.

Test samples: - stalk sections which appeared to be a lower node. Later excellent samples of seeds were received - from center of circle (lab.samp-A) from west edge of circle (lab. samp.-B) and the control taken 50 ft.outside (samp.-C).

EXTERNAL APPEARANCE - no apparent difference in the stem material. After arrival the seeds were immediately removed from the cob and given a three week dry-down period to reach the normal storage moisture (about 13%). When the seeds were viewed under oblique, white light illumination, differences were observed in the external appearance of the seeds. The pericarp membrane covering the embryo region disclosed a much higher density of lateral wrinkles in the A and B samples when compared with the C-controls.

These wrinkle patterns suggest a greater degree of endosperm shrinkage in the circle samples. This was confirmed in consultation with a corn breeder, who also pointed out that this effect is common in lodged plants receiving sub-optimum conditions of development. When the vascular system is partially shut off the seeds do not receive their full compliment of nutrients and hormones, as a consequence they end up with reduction in endosperm, lower vigor and viability.

CELL WALL PIT EXAM. - since this was the first *Zea mays* sample examined in this exploratory program it was necessary to locate (in the control sample) the tissue type with the most distinct cell wall pit formations - this turned out to be the bract type tissue located at the base of the seed (still adhering to the cob). Data from pit measurements in this tissue are summarized below (N=30 per sample, dia. in microns).

Sample	ave.	s.d.	Relative Change
C-control	2.60	0.63	-----------
B- edge	*3.06	0.76	+18%
A- center	*3.66	1.19	+41%

*- P<0.05

SEEDLING GROWTH - the data summarized in Fig.3 show that both circle samples have significantly higher growth rates than the control seeds. These higher rates are exactly the opposite of what would be expected from seeds having the appearance of sub-optimum development conditions (as discussed above). It is also noteworthy that although the difference is not great, the edge of the circle samples (B-group) seem to be slightly less affected by the forces than the center of the circle (A-group) samples, this difference is also reflected in the cell wall pit diameter data.

COMMENTS

A brief scan of the scientific literature revealed several studies from which one can begin to understand this very positive growth response in seedlings from germ plasm which from all outward appearances should be very weak and low vigor. Very preliminary data from laboratory studies indicate that this effect can be simulated; however, more extensive experimentation must be conducted before this aspect of the studies can be discussed in detail.

There are several factors brought out in this current work which should be of value when considering future crop circle investigations. Some of these points are summarized below.

1)-there appears to be a commonality of anatomical changes in circle plants obtained from quite different geographical locations. The most consistent common factor is the cell wall pit enhancement.

2)-quantitative evaluations of cell wall pit diameters in mature bract tissue can provide a method for discriminating between genuine formations produced by external forces and the artificially formed hoaxes.

3)-the positive growth response should take care of arguments concerning natural crop lodging as a cause of changes in crop circle plants, such as the nodal swelling.

4)-plant growth from crop circle seeds indicates the presence of complex energy mechanisms within the formations. Because of this complexity the growth curves cannot serve as an isolated determining parameter in the crop formations.

5)-the positive growth response appears in those sample sets from crop formations occurring at mid to late crop maturity.

As a final comment - I concur with Montague Keen, we need on-site studies of the node swelling effect. If possible, node data should be taken in a newly formed pattern and in this same field plants should be artifically lodged. Periodic node ratio data will provide information concerning the rapidity at which the node swelling occurs.

Wm C Levengood

Dr. W.C. Levengood
Pinelandia Biophysical Lab.

Fig.1 Seedling growth in barley taken from a crop circle in England, 1991 (code: G17-12)

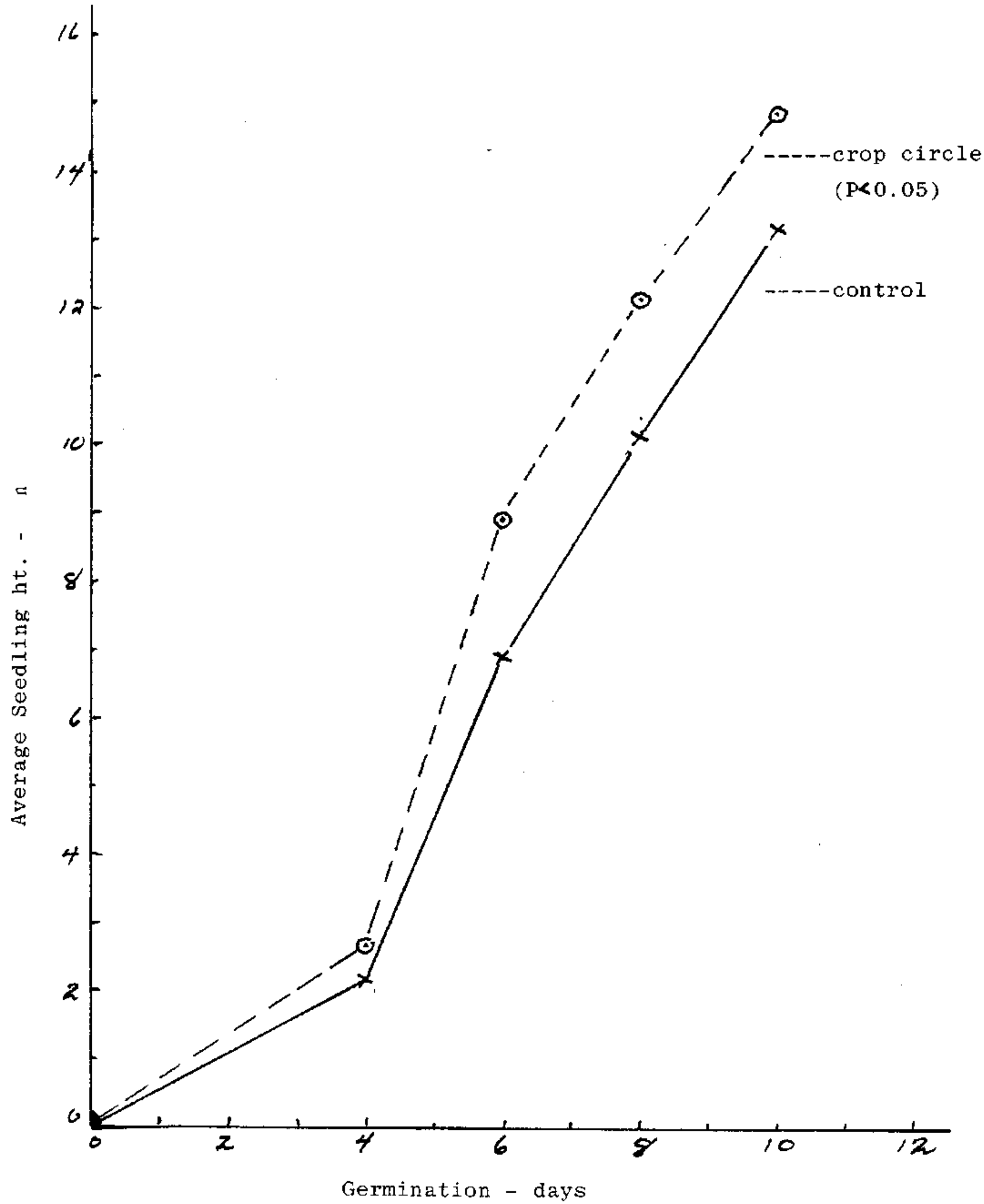

Fig.2 Canadian wheat samples showing different growth responses in crop circle samples harvested at two different locations near Vancouver, 1991 (code: G17-13)

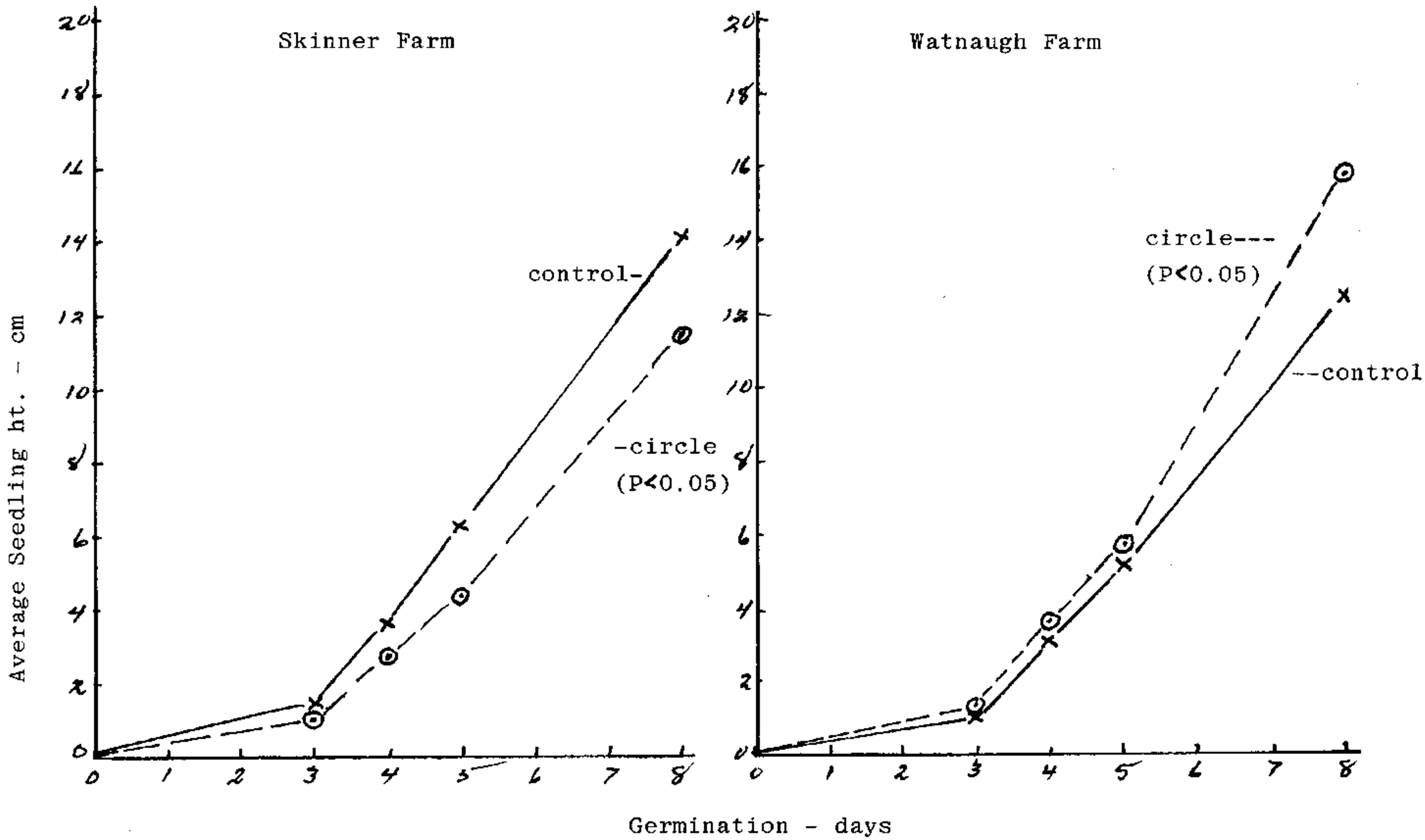

Fig.3 Positive growth responses in corn (Zea mays) harvested in a crop circle near Medina, N.Y. 1991 (code: G17-16)