

**Crop Formation: "Julia Set", Stonehenge, UK****Laboratory Code:** KS-03-154**Material:** Wheat heads only. *Triticum aestivum*, bearded - Soissons variety.**Formation:** July 8, 1996; spiral 915 ft. long with 149 circles of various diameters and arranged geometrically around a central downed swath.**Sampled:** July 13, 1996, by Mr. Chad Deetken, Vancouver, Canada.**Brief Summary:**

These brief statements are intended to supply the reader with a quick overview of the laboratory findings related to the "Julia Set" crop formation and to provide relevant information regarding the relationship between the results obtained in this particular event and those obtained from our previous examinations of several hundred others, from 1990 to the present. The words "statistically significant" mean that one can be confident that there is a greater than 95% probability that the data are anomalous, relative to the normal or control samples. This level of significance is accepted at all levels of scientific research and in all scientific journals, as being meaningful.

**Relevant Findings:**

- 1) a very widely dispersed spillover energy effect extending more than 300 ft. outside the formation.
- 2) a 22% reduction in weight of seeds in plants from the formation.
- 3) at two months post formation--
  - a) seedling growth rates less than 1/5 the level obtained from normal seeds.
  - b) 48 to 72 hr. delay in the onset of seed germination.
- 4) at seven months post formation--
  - a) a marked recovery in the delayed germination and growth rates.
  - b) this growth recovery was shown (through the application of an electrochemical monitoring technique) to be directly related to a reduction in the level of free radicals, which were apparently abnormally high at the time of the crop formation.
  - c) based on these data and on other published scientific work, the inference is drawn that ion plasma vortices introduced negative, free radical anions which over the post-formation seven-month interval were neutralized by antioxidants in the plants.

**Discussion of Results:**

Although the sampling was less than that required (seed heads only, no plants) for our usual comprehensive, systematic study, we were able to conduct a comparative analysis of seed characteristics and growth patterns. From seedling development data it became quite apparent that the entire field of wheat had been subjected to one specific component of the composite energies believed to be causative processes and which significantly influence the normal growth patterns of seeds in crop formation plants. This means that plants which had been considered by the field sampler to be "normal" control plants were in fact substantially altered by energies extending considerably beyond the confines of the visual crop formation. Starting at 0.5 ft. from the edge of one of the downed circle areas (see Fig. 1) and extending 300 ft. into the field there is, as shown in Fig. 2, a sharp decline in the average height of seedlings with distance away from the visual formation, the one glaring exception being the 50 ft. "control" sampling.

The two curves in Fig.2, which are very similar in outline, represent two completely separate germination trials. The results from the first trial conducted Oct. 26, 1996 had such an unusual growth distribution across the "control" sampling that the seeds were pre chilled for 27 days to eliminate any possible effect of natural dormancy, and a repeat trial was conducted on Nov. 22, 1996, with the result that there was amazing agreement between the two sets of data. This immediately tells us that the unusual differences observed in these seven "spillover" sample sets are not due to experimental errors introduced in the laboratory germination or to any aspect of seed dormancy. The peaks in the curves at the 50 ft. sampling simply emphasize the fact that the energy transitions are not always smooth and sharp: boundary layers can occur in an unpredictable manner typical of chaos mechanisms.

At the 13 day development stage all seven of the sample sets in both germination trials gave 100% germination, in spite of the fact that those sets taken at some distance from the formation did not start germinating until 6-8 days post-imbibition (or hydration). Again, this is an anomalous situation. Usually in wheat the first growth data in our precision germination tests, are taken at the four-day stage, at which point one would expect to find close to a 100% germination with very uniform seedlings. The upper growth curves in Fig.3 show two samples (C1 & C2) taken close to the formation to be in stark contrast with the two bottom seedling growth curves from samples (C6 & C7), taken at the 100 and 300 ft sampling points. Although there is a marked delay in the germination within seed sets taken at the far locations the final resulting seedlings are, as shown in Fig.4, normal, healthy plants. In commercial germination testing a delay of 48 to 72 hrs. would normally indicate pathogen, mechanical or chemical injury, any one of which would guarantee that germination would be well below the 100% level and, in addition, the plants would exhibit deformed roots and shoots. Yet here we observe seedlings displaying a very delayed germination, but without evidence of any injurious factor.

This spillover energy effect has been observed in many of the 200 or so crop formations examined over the past several years; in fact this was first discovered in a 1993 formation in Canada. In general a spillover region can extend from 5 to 50 ft. outside the downed areas, and is readily detected in our detailed analyses of node lengths and seed quality. As we have pointed out in the past, within systems following the dynamics of vortex action there is no reason why all the energy components producing the alteration in embryo growth should be confined to a region in which the horizontal air motion energy forms the downed areas. This wide spread, spill-over effect becomes more understandable when one considers the size (915 ft. dia.) of the visible portion of this formation. If we scale up from the smaller formations demonstrating spill-over, we could expect in this formation to observe an area of influence extending several hundred feet beyond the visible portion. For example if we have a formation 90 ft. in diameter and a spill-over region extending 50 ft. outside this formation, then with a formation over 900 ft. in diameter it would not be unreasonable to expect the spill-over effect to extend beyond 500 ft. outside the visible downed crop.

Another very interesting feature of this formation is the quite obvious alterations in the growth of seeds taken from plants within the circles. All of the circles in the central region of the spiral were connected by a narrow swath and those circles located on this underlying narrow path of downed plants developed seedlings which grew in a manner typical of normal seeds (Fig.5). Those seeds taken from circles located just off the swath and at what appears to be the beginning of the swath, S4 and S6 in Fig.5, give the delayed growth patterns. Sample S3 was located on this connecting path and appears to be an exception; however, these were upright plants and, being in

a higher horizontal plane, were exposed to different energy conditions. The 13 day germination of all samples shown in Fig.5 are again at 100%, and in Fig.6 the growth rate differences in two formation sets are quite similar to those found in the spillover samples.

Notice that we used the term "quite similar"; this does not, however, mean exactly the same. For example in Fig.7 the downed formation samples (S1 and S5) display relatively uniform seedling growth whereas the standing (S3) formation seedlings disclose a high growth variability. All of these sharply delineated growth differences illustrate the very complex and well-defined boundaries which can form between the various hierarchy of energy forms being expressed in a crop formation field. Also it should not be assumed that the energy system operating within the confines of the downed formation circles is exactly the same as that functioning in the area of pseudo-controls outside the formation. This was made quite clear by the finding that seeds from all six of the visible formation samples were significantly reduced in weight (Table I) compared with those from plants outside the visible formation.

In other words, at this point in our investigation it appeared that one component of the energy influenced the growth pattern of the seeds taken throughout the entire field, whereas another component, believed to be microwave radiation markedly reduced embryo development and consequently seed weight in plants confined to the visible formation circles.

In past studies unrelated to crop formations we have observed growth alterations in plants induced by very subtle gradients which are electrochemical in nature [1]. The question was then asked - if similar electrochemical mechanisms are operating throughout the entire field containing the Julia Set, then is there a way we can detect this, given the fact that we have no normal or control plants? There was no simple or immediate answer to this question. What was needed was an approach by which we could examine the subtle biochemical changes taking place in the seeds.

In our efforts to resolve the growth anomalies (Fig's.2-7) we utilized a bioelectrochemical technique which provides quantitative information relevant to induced changes manifested during respiration cycles within living plant systems [2]. All of the so called higher living organisms carry out respiration, a process which involves the chemical reduction and oxidation (hence the term redox) of cellular components controlling these vital energy cycles. This technique employs an electrode system which allowed us to monitor the respiration activity in germinating seeds. From past studies related to the redox method it has been clearly established that a germinating seed exhibits "bursts" or cycles of respiration, during which the intracellular mitochondria release very active molecules known as free radicals. If these cycles of free radical output become too frequent the development of the embryo or seedling will be severely retarded. **At this juncture there is an important point to keep in mind. Numerous biochemical investigations have shown that free radicals are implicated as major environmental factors influencing the development of the organism.[3].**

In March 1997, experiments were initiated to examine the respiration patterns in the Julia Set seeds. With an accumulated database of over two decades of research we know the expected range of redox responses from normal wheat seeds, as well as from many other plant species; therefore, in these studies we used a U.S. winter wheat variety ("Chieftain") as a control and in order to make sure the redox system was operating normally. In a routine redox test a single seed is placed in a vial containing a wad of sterile, moist cotton in a manner as described in reference [2]. A test set consists of four vials prepared in this manner, with each vial containing a seed from a different sample group. The time  $t_0$  at which the four seeds are placed in the vials, is defined as

the initial imbibition, or start of seed hydration and germination. In normal wheat seed we have found that one reproducibly-active period of free radical output is around 48 hrs. post imbibition.

The vials containing the Julia Set seeds (and control) were allowed to germinate (under dark conditions) for a period of 48 hrs.; then the 4-vial set was sequentially examined in a repeating manner until a total of 12 sequences. At a rate of about 6 min. per sequence, a test was completed in approximately 72 min. The redox ratio (Rr) was calculated (see ref. [2]) for each vial in each test sequence. From these Rr data it was immediately apparent that the seeds from the Julia Set were releasing significantly greater amounts of free radicals than the normal control seeds. The upper curve (samp. C1) in Fig. 8 is representative of the Rr variations in the formation seeds. The redox responses in the normal control seed shown in the bottom curve display normal peaks of redox activity which are of greatly reduced amplitude compared with the C1 seed from the "Julia Set". Seeds from five other formation samples were examined in this manner and in every case, the redox ratios were higher and more variable than the controls [Only one formation response curve is shown in Fig. 8 to avoid the visual confusion too many curves in the same figure, thus allowing the redox differences between the control and the formation samples to be clearly observed].

During the initial imbibition testing it was noted that in every test, seed germination occurred at 24-48 hrs. post germination. These data were in stark contrast with the germination results taken four months earlier, and clearly indicate that the seeds were recovering from the energy affects shown in Fig's 2-7. To confirm this a complete re-germination test was conducted on March 7, 1997, roughly four months after obtaining the Fig.2-7 growth data. The March germination confirmed the redox vial observations, namely, all of the seeds from the Julia Set were now approaching the normal levels of germination and seedling growth. If these large amplitudes of free radical output (as shown in Fig. 8) are indeed related to a recovery process, then one might postulate from reference [3], that the level of free radicals in the seeds could influence the seedling growth taking place in the March germination trials.

To test this hypothesis the dispersions in the seed growth data were examined by using the Coefficient of Variation [4] obtained from the 48 hr.-12 sequence tests. This coefficient was examined in relation to the seedling growth rates taken at the 4-day development stage in the March, 1997 germination tests. These data (plotted in Fig. 9) give a significant, linear regression curve with a  $r=0.79$  correlation coefficient. The slope is negative as would be expected. That is, the higher the Coefficient of Variation (V) the greater the content of free radicals and the lower the growth rate of the seeds. What we are seeing here is very strong evidence that the component of energy affecting a region extending at least 300 ft. outside the visual formation, is ionic in composition.

As pointed out many times in the past, an ion plasma is a likely source for inducing ionic gradients within developing seeds. It has been shown [5] that induced ion gradients will produce immediate alterations in the distributions of intracellular organelles. If these intracellular ions produce anion free radicals, as is clearly indicated in the redox responses (Fig. 8), the short term germination and seedling development would be greatly retarded. Also, as indicated here, as the respiration continues the natural antioxidants in the seeds would gradually neutralize the induced free radicals and the seeds would slowly return to more normal germination and seedling development. The rate of return to normal growth would (as shown in Fig. 9) depend on the degree of ion impact at time zero. Those sampling locations receiving the highest levels of free

radicals would be the slowest to return to normal development. Again we have a situation typical of a thermodynamic system far from equilibrium and organized into plasma type energetics.

### Details of Findings:

Seed Weights - were obtained from the same samples used in the germination testing. With the vernier adjustment on a "Torball" laboratory balance the weights were obtained to a precision of 0.01 g. The seed weight data are summarized in Table I for all the sample sets.

Table I  
Mean weights of 20-seed test samples taken from the KS-03-154 formation.

<u>Sample Group</u>	<u>ave.</u>	<u>sd</u>	<u>N-samples</u>	<u>Weight Change</u>
Outside "Controls"	0.594	0.049	7	-----
Formation	0.465	0.042	6	-22% (P<0.05)

### Seed Germination Trials:

The 13 sets of samples were initially germinated on Oct. 26, 1996 in the "as received" condition. Seedling measurements were conducted at the 4, 6, 8, 10 and 13 day growth stages. The growth rate curves from this first germination trial disclosed an unusually high variability, particularly in the seven sample sets taken at various distances from the formation (labeled "controls"). Although these seeds were germinated several months after sampling, there was a possibility, although very slight, that there could be remnant dormancy effects. Generally in wheat seed the dormancy has dissipated by four to six weeks after harvest; however, as a precautionary measure the sample sets were pre chilled at 4° C for 27 days.

On Nov. 22, 1996 the germination tests were repeated after pre-chilling and under the same conditions as applied in the initial tests. The remarkable similarity between the seedling growth in test No.1 and test No.2 is shown in the Fig.2 curves, where each data point is the mean 13 day seedling height from test samples taken at the indicated distances (diamond points = test No.1 and squares = test No.2). The close agreement between these two sets of data, taken a month apart, clearly shows that the growth changes are not due to variations in the testing procedure or growth chamber conditions. The peak at the 50 ft. location demonstrates the quite abrupt changes in the energy distributions which can take place in dissipative, chaotic systems. The dramatic differences in rates of growth are shown in Fig.3 (samples from germ. test No.1) for two sets of samples; C1 and C2 representing those taken in proximity with the formation (.5 and 2 ft. outside) and C6 and C7 taken at quite some distance (100 and 300 ft. outside). Samples C3, C4, C6 and C7 all exhibit a pronounced retardation in germination (appearing in both germination trials).

This delayed germination can be more readily appreciated when it is realized that in regular commercial germination testing the first count is conducted at four days post imbibition. Here we do not find seedlings until 6-10 days after imbibition, but at the 13 day stage all seedling

samples in both trials disclose 100 % germination. If the seeds had been injured by chemicals, pathogens or mechanically (not indicated visually) they would not have germinated at the 100% level. The uniformity of growth and the absence of any abnormalities in the shoots and roots (Fig.4) also rules out seed injury.

Seeds from within the visible area of the formation also gave quite unique seedling growth patterns. The three downed (S1, S2 and S5) samples taken from circles which were located on the center swath (see Fig. 1) of the formation produced seedlings of "normal height" (see Fig.5). Since as it turns out we do not have control samples as such, in this case we can only make a general comment concerning "normal" seedling height. From our considerable database obtained from normal control wheat seedlings grown under the same experimental conditions, these three samples are in the range expected from 13 day seedlings. The growth of seeds taken from downed plants in circles S4 and S6, off the central swath, disclose the growth retardation effect clearly seen in the bar chart in Fig.5 (seedlings again shown at the 13 day stage). Sample S3 is from a circle on the central swath, but from standing plants in the center of a downed circle. What these data seem to indicate is the presence of horizontal and vertical layering, or confinement, of the energies.

In Fig. 6 are two sets of seedling growth rate curves, one set (S1 and S2) from circles lying on the central swath of the formation and the lower set (S4 and S6) from circles lying outside this swath. The differences here are as pronounced as within the set of spillover "control" samples, in other words one aspect of the energy seems to be operating independently of geometric confinements. In the swath-connected standing formation sample (S3) we have a situation where the seed heads of the upright plants are located in a zone of energy producing quite different growth responses than the swath connected downed plants. The 13 day seedlings in Fig.7 show a much greater variability in the seed growth from the upright S3 sample than from the downed, S1 and S5 samples. This may indicate that the heads on the upright plants were in an energy transition zone relative to the downed plants. Unfortunately there was insufficient sampling to thoroughly examine additional, subtle aspects of these energy interrelationships.

#### **Explanation of Growth Anomalies:**

Four months after the above results (Fig's. 2-7) were obtained, the seed retardation effect had appreciably dissipated. By applying an electrochemical - redox technique [2], the details of which are outlined in the Discussion of Results section, we were able to demonstrate that the pronounced retardations of germination and seedling development were the result of high concentrations of very active free radical molecules (Fig.8) induced by the energies involved in the crop formation. The higher the free radical level the lower the growth rate of the seeds (Fig.9), thus accounting for the severe growth reductions (Fig's 2-7) observed in the early germinations. An organized ion plasma complex could readily induce intracellular free radical production which, over time, would be slowly neutralized by natural antioxidant metabolites

#### **References and Notes:**

[1] Levengood, W.C.; *Electrophoresis in plant cell organelles.*, Bioelectrochemistry and Bioenergetics, **25** (1991) pp. 225-239.

[2] Levensgood, W.C., *Redox-responsive electrodes applied during plant morphogenesis.*, *Bioelectrochemistry and Bioenergetics*, **19** (1988) pp. 461-476.

[3] Allen, R.G. and Balin, A.K., *Oxidative influence on development and differentiation: An overview of a free radical theory of development.*, *Free Radical Biology and Medicine*, **6** (1989) pp. 631-661.

[4] as applied here the Coefficient of Variation (V) provided a means by which we were able to compare the dispersions within the 12-sequence redox tests. It is given by;

$$V = [s.d./ave.] \times 100$$

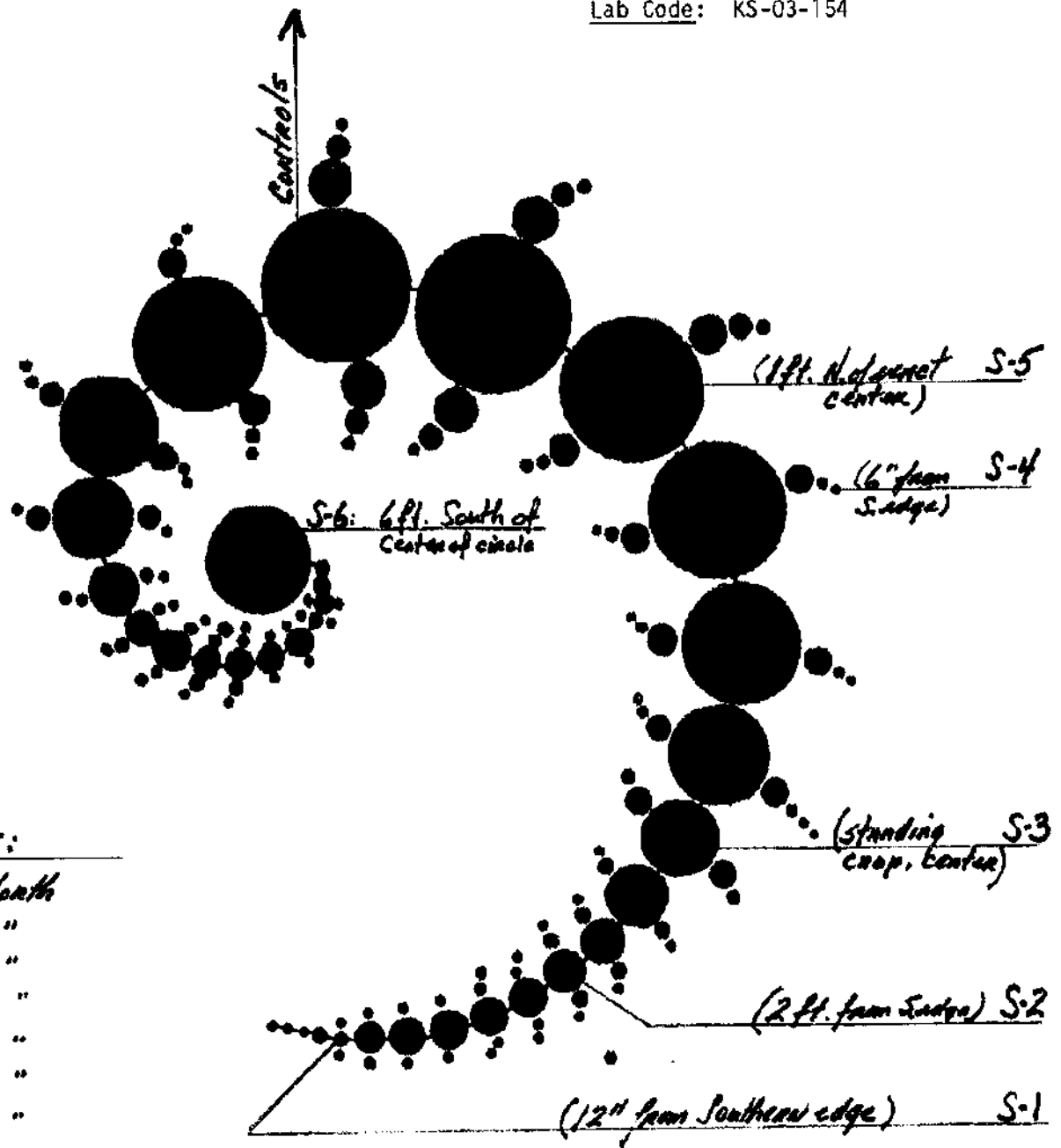
where ave. and s.d. are the average and standard deviation of each 12-sequence test. It gives us the standard deviation of the data set as a percentage of the mean, independent of the scale of measurement.

[5] Levensgood, W.C., *Organelle electrokinetics within plant cells.*, *Bioelectrochemistry and Bioenergetics*, **32** (1993) pp. 165-174.

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Formation: Stonehenge "Julia Set", UK  
 Crop: Wheat (heads only)  
 Date Formed: July 8, 1996  
 Date Sampled: July 13, 1996  
 Lab Code: KS-03-154



Controls:

- C-1: 6" North
- C-2: 2' "
- C-3: 5' "
- C-4: 20' "
- C-5: 50' "
- C-6: 100' "
- C-7: 300' "



FIGURE 2: Average seedling heights at 13 days germination in two separate germination tests, showing spill-over effect of energy on "control" seeds sampled at various distances outside the visually-apparent formation (KS-03-154). [Energy effects found at .5 ft. are what would be expected in normal control seeds. Seedling growth rate is significantly depressed with distance from formation, except at 50 ft.]

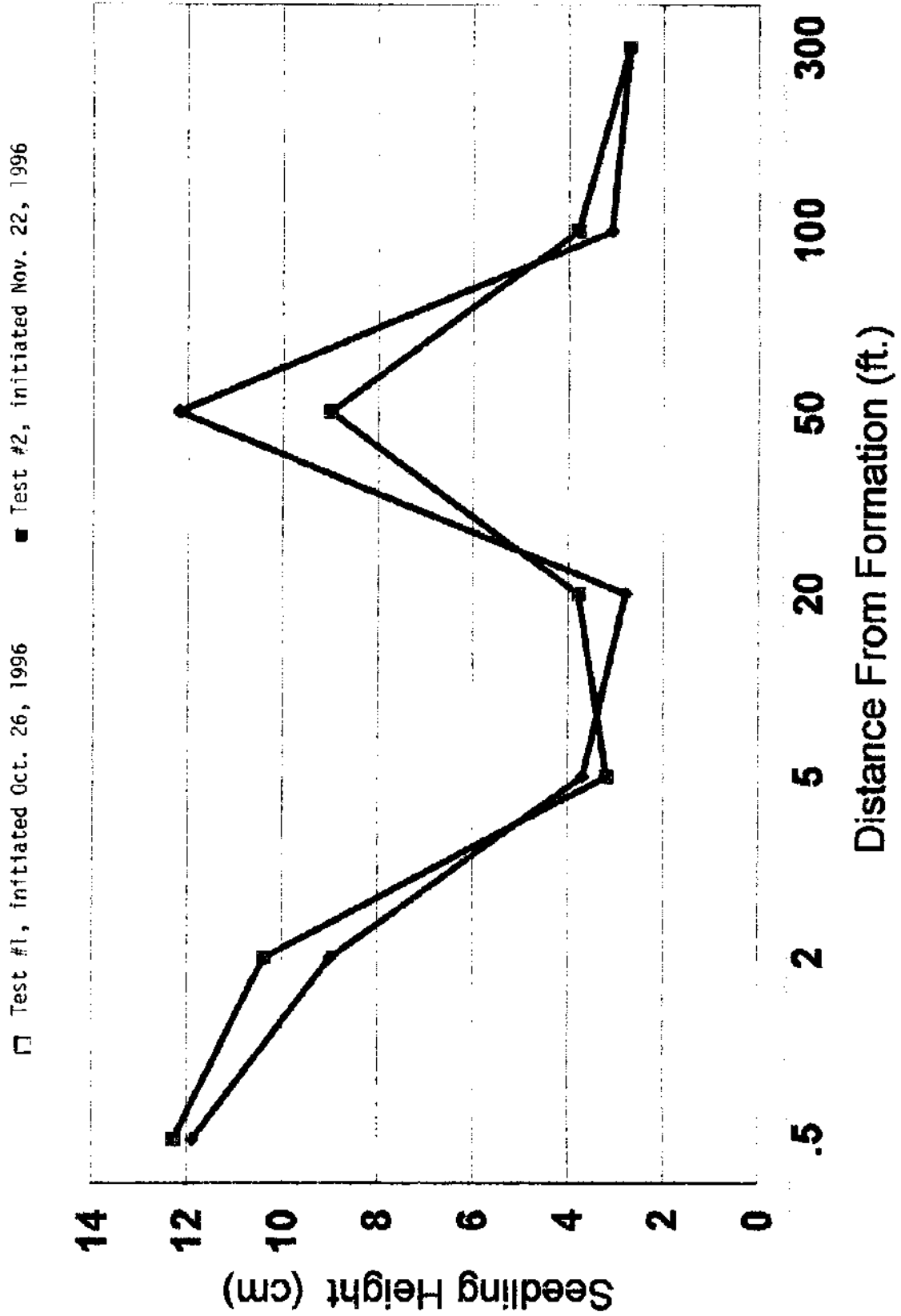


FIGURE 3: Growth-rate differences and delayed germination in seeds from four "control" sets sampled at various distances outside the visually-apparent formation (these sample sets were thought to be controls by the field-worker, since they were taken outside the downed visible formation but were, in this case, also affected by the formation energy). C1 = .5 ft. outside formation; C2 = 2 ft. outside formation; C6 = 100 ft. outside formation; C7 = 300 ft. outside formation.

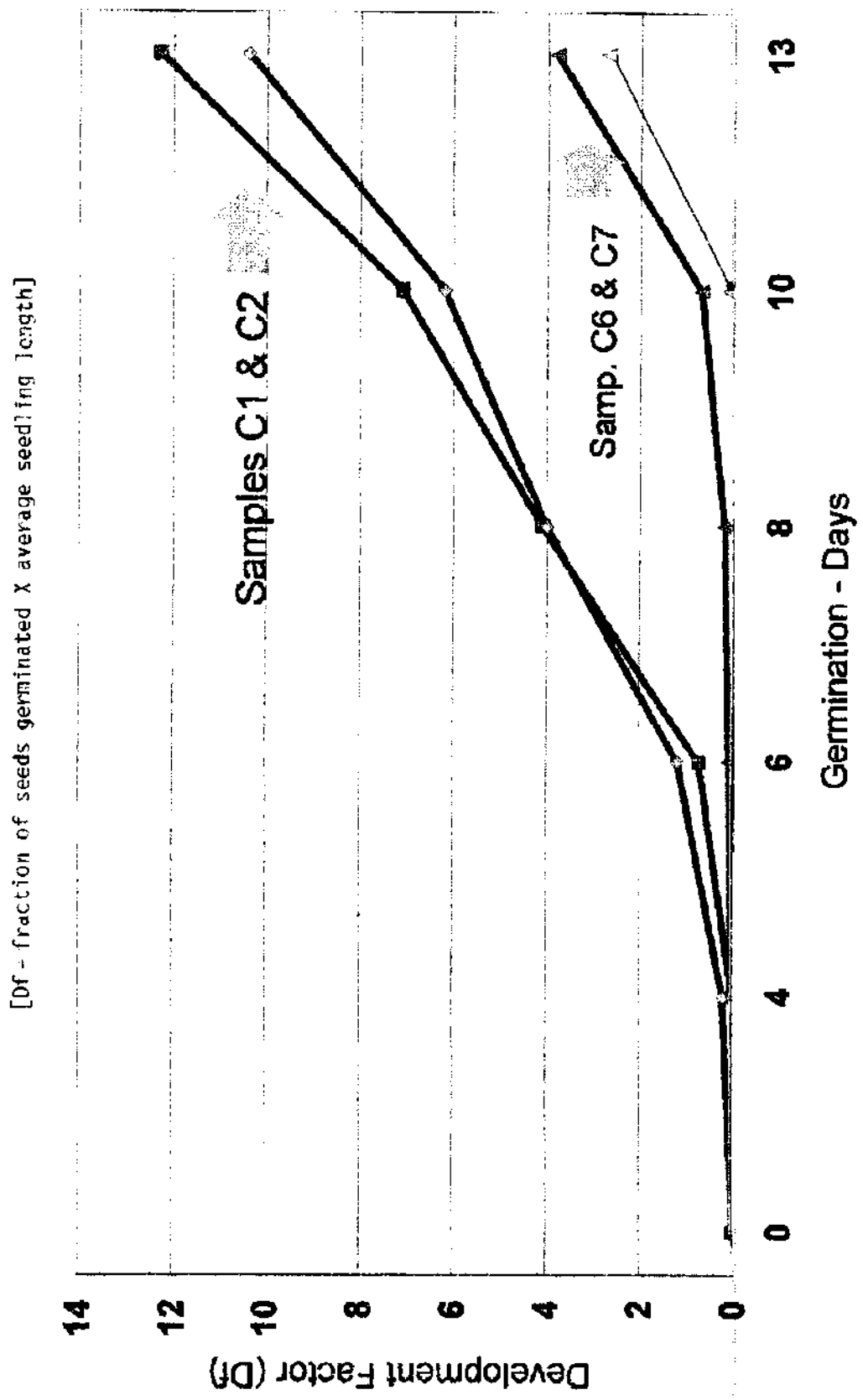


Fig.4 Seedling growth differences in affected "control" samples.  
13 day dev., C1 @ 0.5 ft., C3 @ 5 ft. & C7 @ 300 ft. from  
formation.

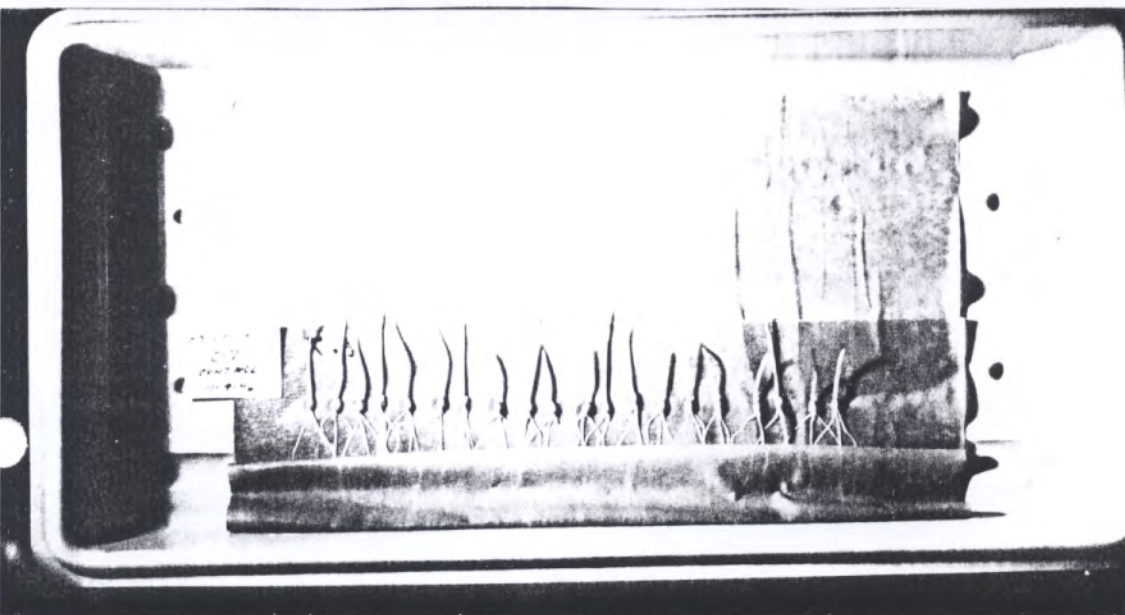
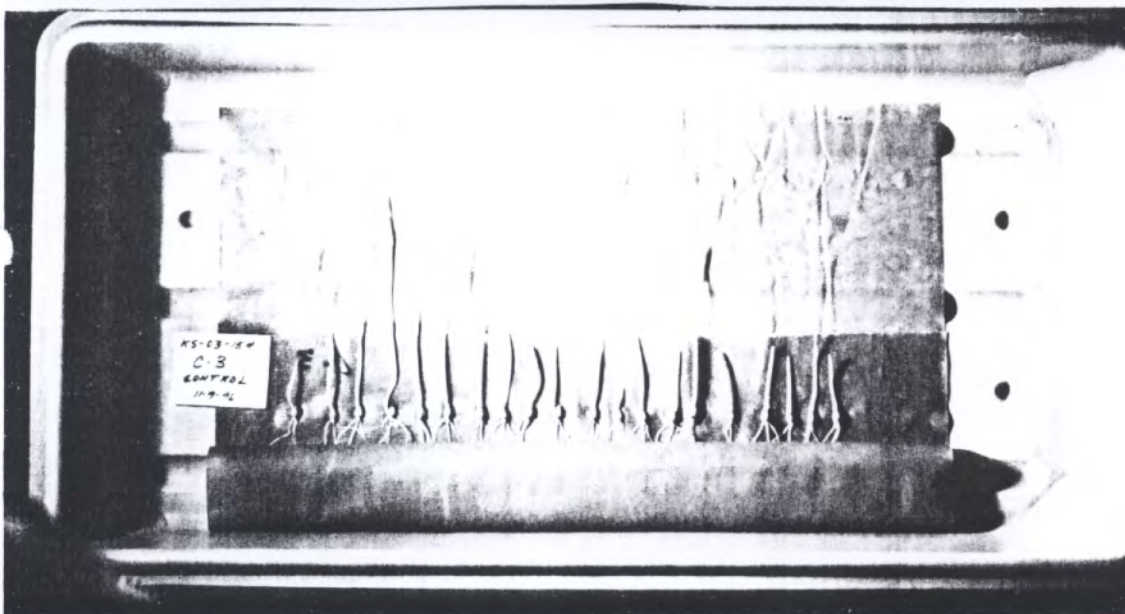
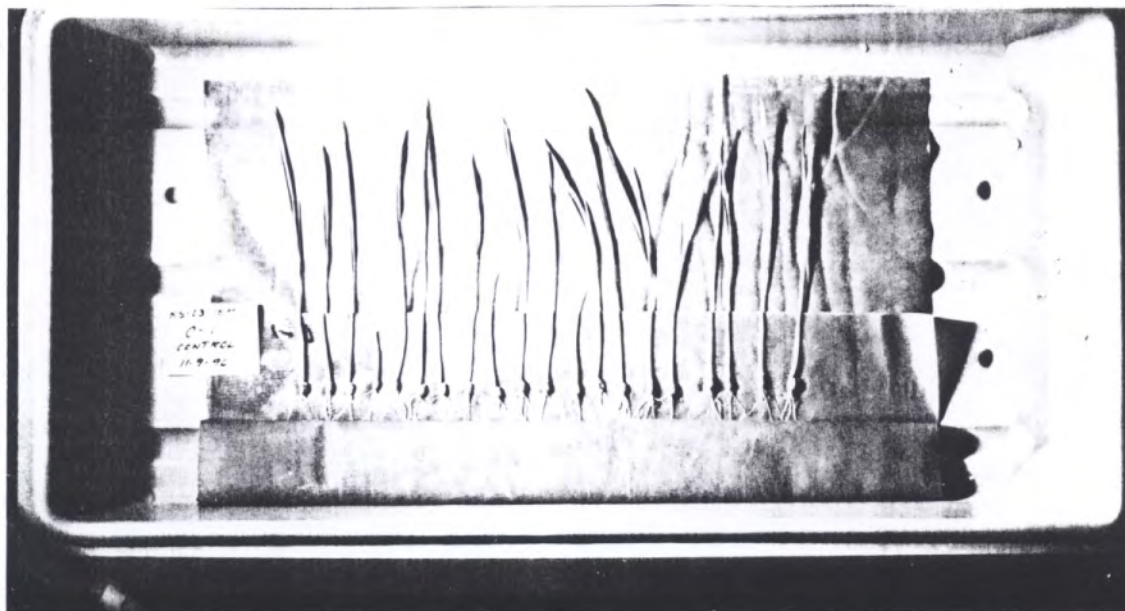
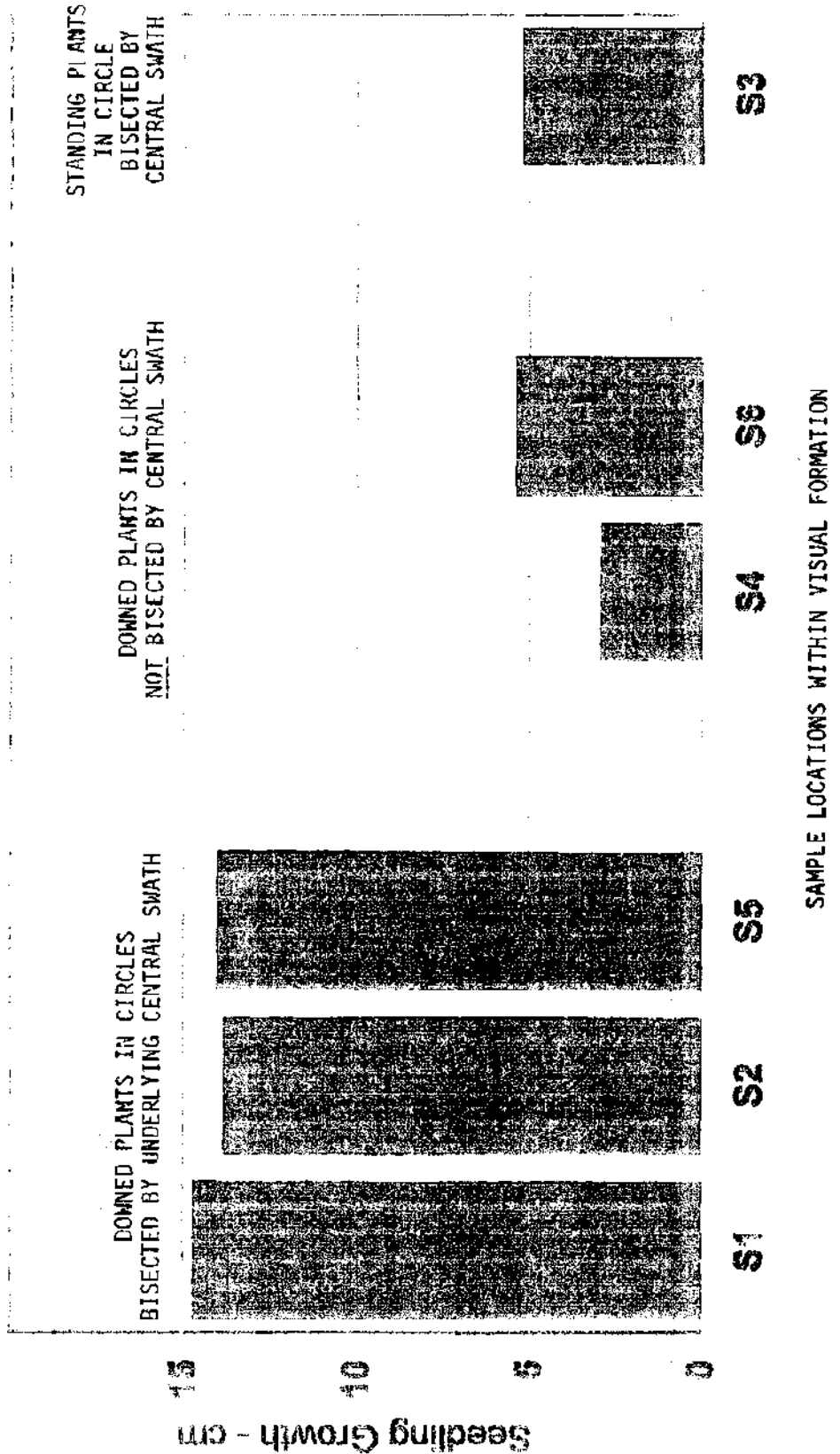


FIGURE 5: 13-day seedling growth in seeds from plants sampled at various locations within the visual formation. "Central swath" refers to the narrow connecting path of downed plants which ran along the spine of the primary spiral.

[Note the delayed growth pattern in seedlings from downed plants which were not connected to the primary formation by the underlying narrow swath (S4 and S6), as well as in the upright, standing crop (S3) from a circle which was bisected. The marked variation in seedling growth revealed by this data seem to indicate the presence of horizontal and vertical layering or confinement of the formation energies.]



SAMPLE LOCATIONS WITHIN VISUAL FORMATION

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visually-apparent formation,  
Growth-rate differences and delayed germination in seeds from 4 downed-crop samples taken inside, showing differences between samples from circles which were bisected by underlying central swath (S1, S2) and those that were not (S4, S6).

FIGURE 6:

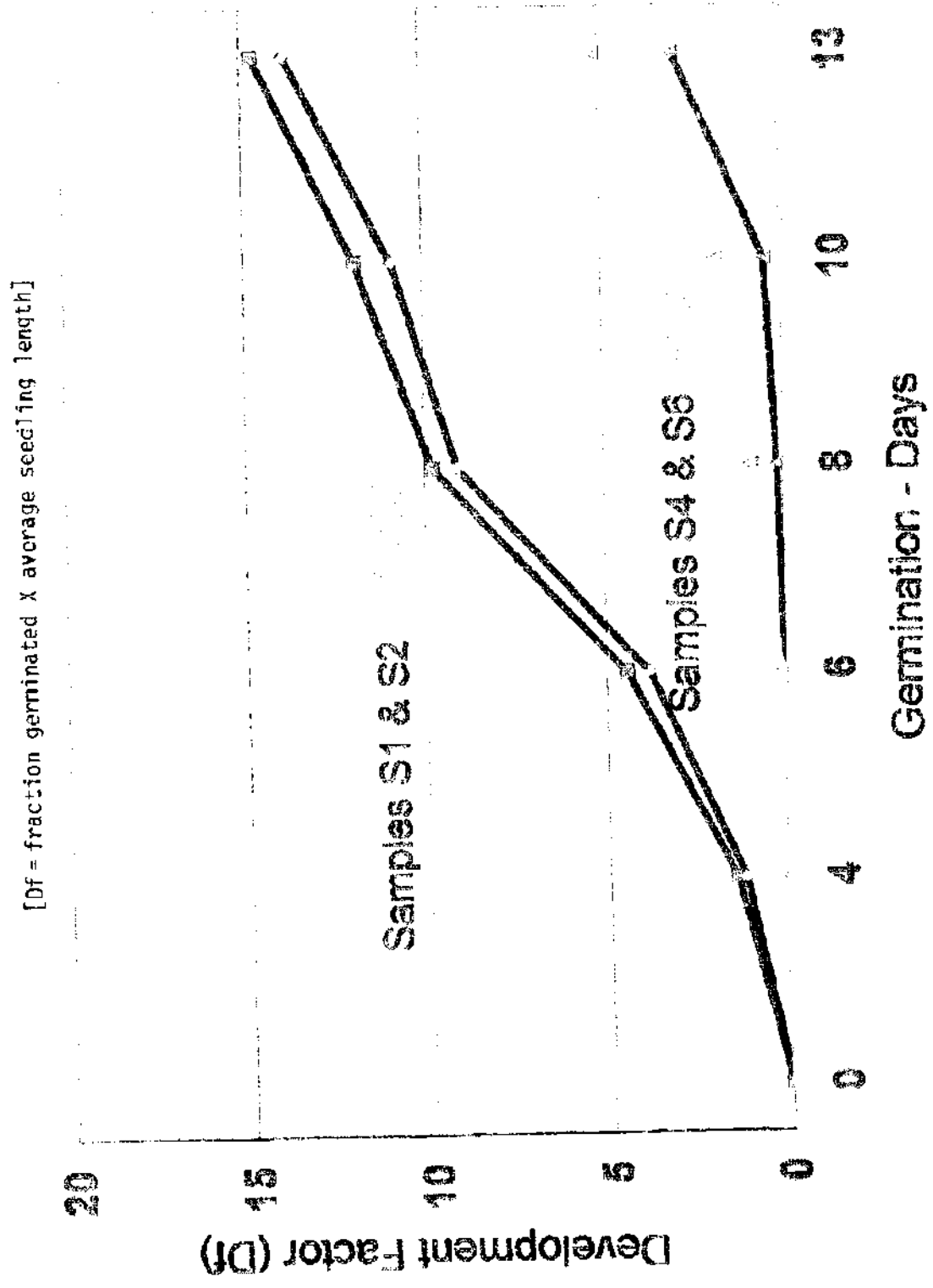




Fig.7 Seedling growth differences in affected formation samples located on central core (13 day dev.) S1 & S5 downed plants S3 upright plants. Note large variations in the S3 seedling hts.

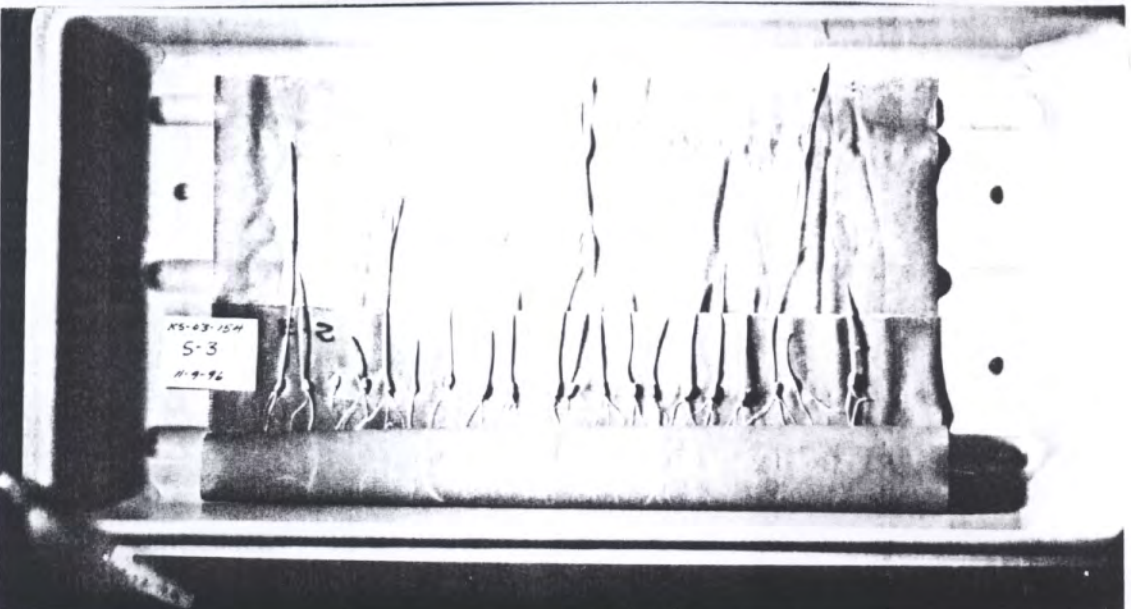
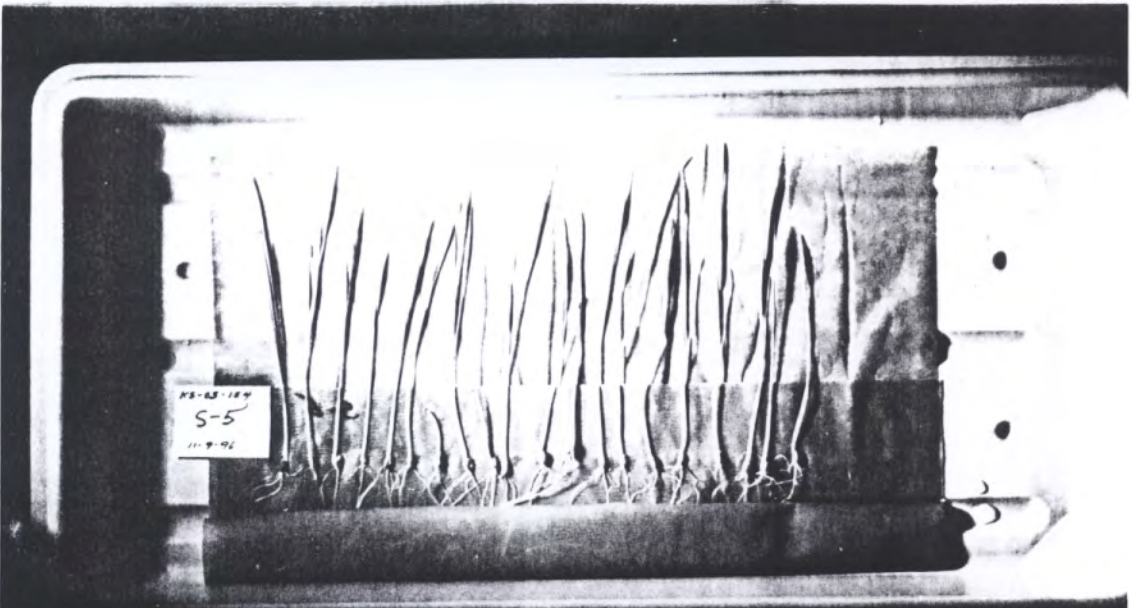


Fig 8

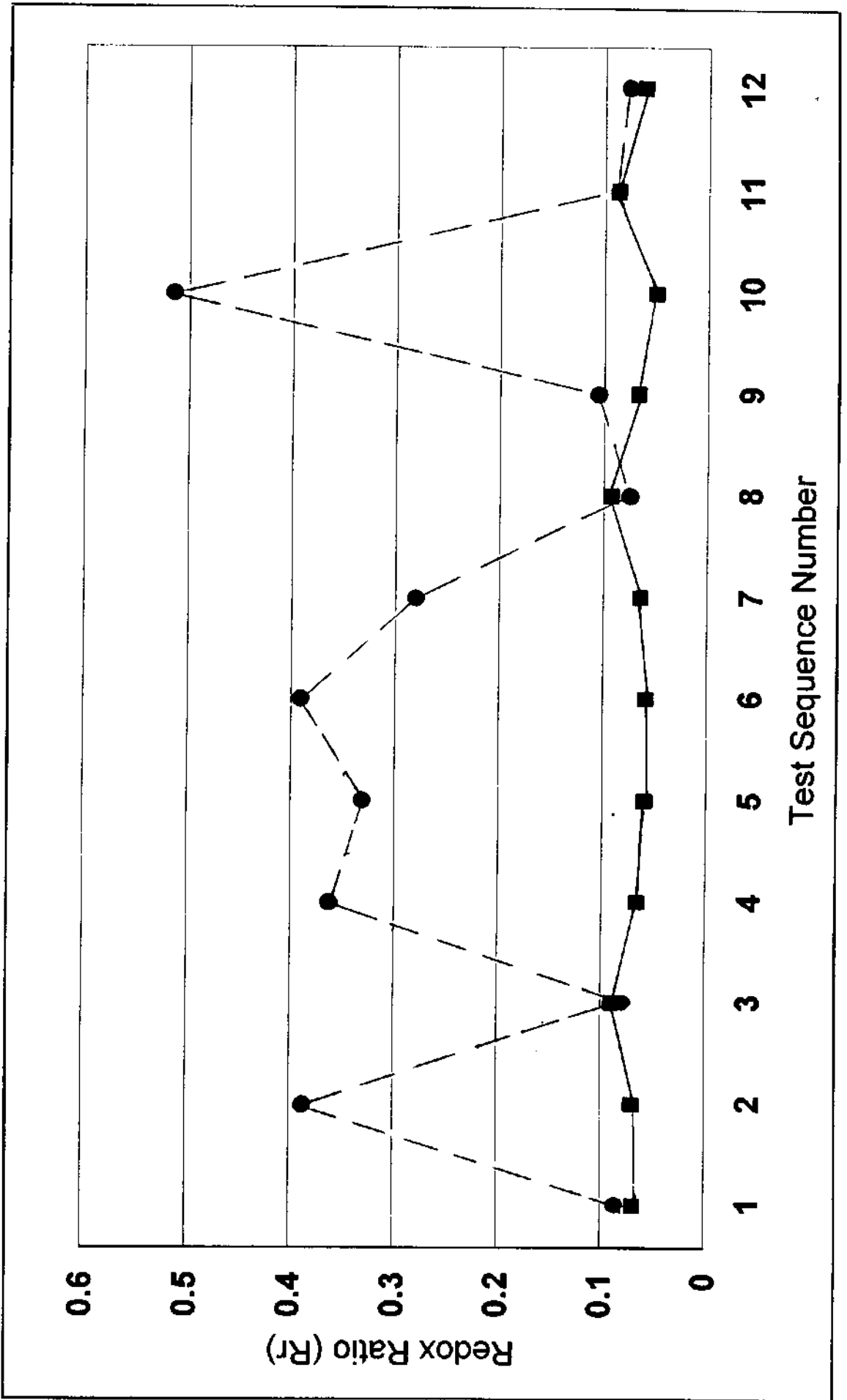


Fig 9

