Gravitropic Responses in Simulated Crop Formations, 1997

Laboratory Code: KS-04-04
Material: Wheat stems and heads *(Triticum aestivum)*.
Formed: Circle pairs produced, June 3, June 13 and June 25, 1997
Engineered and Sampled By: Mr. George Reynolds. Elkton, Maryland.
Formation Characteristics: Circle pairs 3 ft. and 9 ft. diameter - formed using a plank with ropes attached at the ends, then applying full body weight to the board as it was moved around in a circular motion for three or four ratations, thus forcing the plants down to create the simulated crop circles.

Relevant Findings:
1) If samples are taken within a 72 hr. period after a crop formation occurs, gravitropism can account for not more than 10% of the observed node expansion. In crop formations taken within this 72 hr. interval the node expansion, if present, ranges from +40% to +200% relative to the normal controls.

2) Over fertilization does not influence the node lengths or node bending.

3) The plants were a deeper green in the over fertilized area, but the overall growth of the plants was the same as in the strip with normal fertilizer.

Gravitropic Responses in Plant Stem Pulvini:

When maturing cereal grain plants are mechanically forced into the horizontal or flattened position a process of vertical recovery is initiated, the effect of which can be observed in just a few hours after the damage. This gravitropic response results from the vertical, active transport of auxin (IAA) to the lower side of the stems where it locally increases cell growth rates, thus producing an upward bending of the horizontal plant stems.[1] At the stem growth nodes this gravitropism effect produces a bending and lengthening of the pulvinus region which in the case of plants within crop formations would be independent of the external vortex energies.

In our studies of the stem node lengths as related to the crop formation energies it became important to quantitatively define the role of gravitropism in the downed formations. Although there is considerable literature related to gravitropism in *Avena* coleoptiles, one finds a paucity of information dealing with stem node responses under normal field conditions. For this reason, carefully engineered, man-made crop circles were formed and sampled in winter wheat grown in Maryland, during the 1997 growing season. In addition to examining gravitropism we were also interested in the influence of over-fertilization on the stem nodes and other possible changes in the plants.

This stem node study begun on May 5, 1997, was carried out in commercially grown wheat in which two strips 12 ft. x 400 ft. long, were staked out in a N-S direction, with a12 ft. separation between. One test strip ("Strip-A") was given twice the normal amount of fertilizer (pelleted urea, 46% nitrogen); the second strip ("Strip-B") was treated with the normal amount of fertilizer (same as rest of the field grown for commercial harvest).

On June 3, 1997, after sampling upright, normal "base line" plants, two circles (3 ft. and 9 ft. in diameter) were formed at the southern ends of both Strip-A and Strip-B. These four circles were formed using a plank with ropes attached at the ends, then applying full body weight to the board as it was moved around in a circular motion for three or four rotations, thus forcing the plants down to create simulated crop circles. Additional, identical pairs of circles were then created on June 13, 1997 at locations about 100 ft. north of the first circles, with a third set created on June 25, 1997, just prior to harvest, at a further distance of another 100 ft.

At various intervals after the creation of each circle pair, two to four sample sets were collected from the downed circles and from upright plants 10 ft. to 250 ft. from the downed areas. The node lengths (Nl) were recorded from each plant in a 15-20 plant sample set and routine statistical analyses performed. The first two sets of test circles were formed when the plants were in rapid development and growth and an obvious gravitropic response, consisting of upward bending plants, was noted 48 to 72 hrs. after the circle sets were created.

In summarizing the node length variations we have combined the data from the 3 ft. and 9 ft. circles in each set since, within corresponding sample sets, there was no significant difference between the Nl means. The results in Fig.2 show the node length changes in the Strip-A and Strip-B circles relative to the normal upright "control" plants. Each point represents the mean node length change in a total population of 60 to 80 plants, with the standard errors indicated by the vertical bars. The dashed lines in Fig.2 indicate the sigmoid type of growth curve which is a ubiquitous characteristic of tissues in the cell wall extension, growth phase[2]. The linear regression analyses, solid lines, have essentially identical slope constants, a clear indication that over fertilization does not influence the gravitropic response.

The plants taken three days after forming the circles have a mean node length increase of about 10% in both test strips. Within our data base we find that the majority of crop formations discovered in the field have been sampled within a time frame of a few hours to three days after their arrival and the node changes in these formations range from 40% to over 200% node length increase relative to their upright controls. In those cases the gravitropic responses would therefore have very little influence on the overall node expansion analyses.

Within sample sets taken three days after forming the second circle pair (June 16, 1997), the gravitropic responses were very comparable to those shown in Fig.2, with a +9.6% in Strip-A (N=86) and +11.8% in Strip-B (N=85). These very similar 3-day responses in two sample sets formed about two weeks apart suggests that the gravitropic responses remain fairly constant over the early stages of plant development.

Plants within the over fertilized Strip-A, were a deeper green color when compared with the normal fertilized Strip-B. The node lengths in Strip-A, were however not significantly different than those in Strip-B. Thus over fertilization cannot account for the node length expansions observed in many crop formations.

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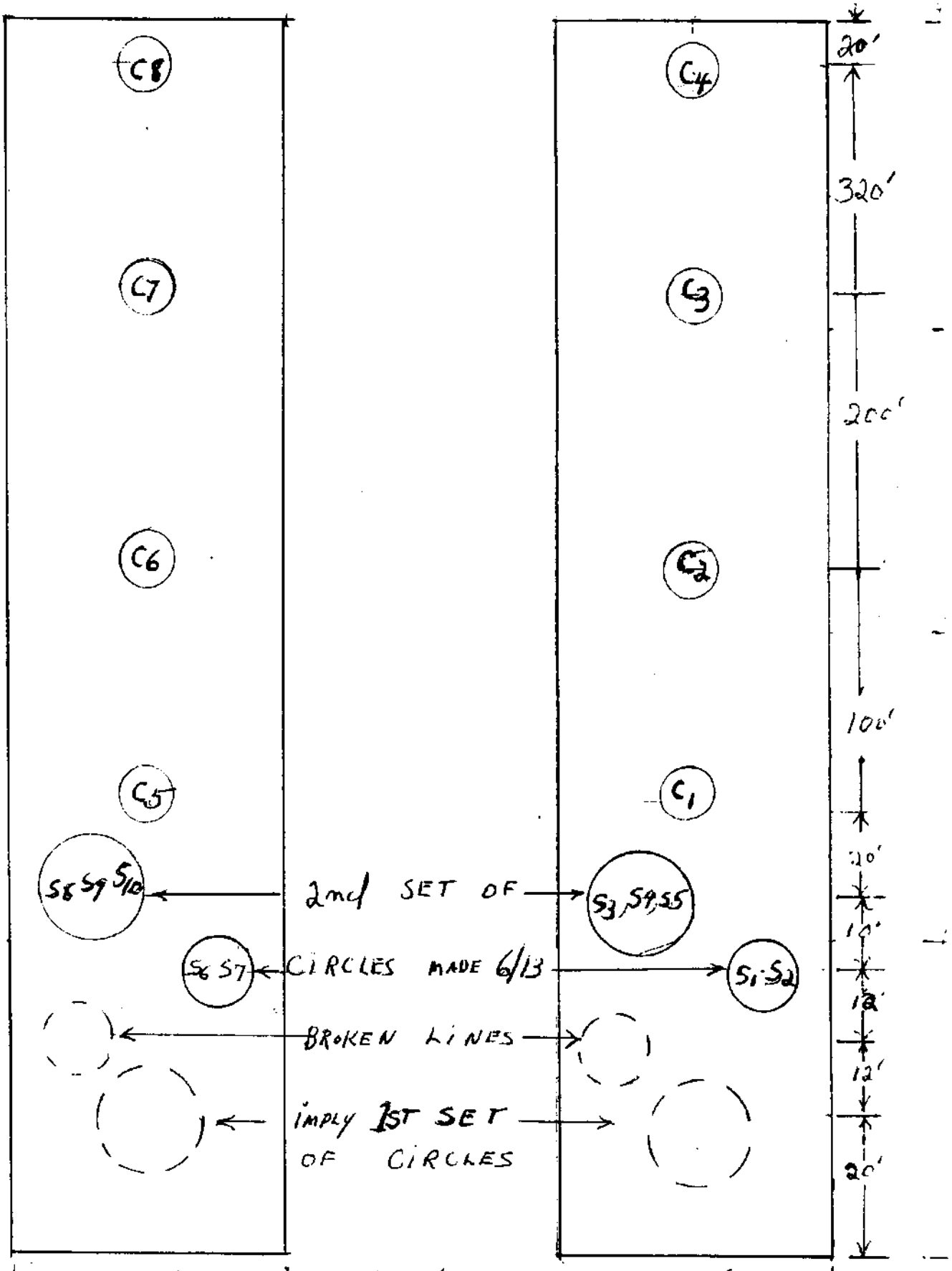
References:

1) Wilkins. M.B. *Advanced Plant Physiology.* 170-174 (Pitman, London, 1984)

2) Leopold, A.C. *Plant Growth and Development.* (McGraw-Hill, Inc., NY, 1964).

...S & CIRCLES 1ST SAMPLING

Fig 1. — KS-04-04 Series I



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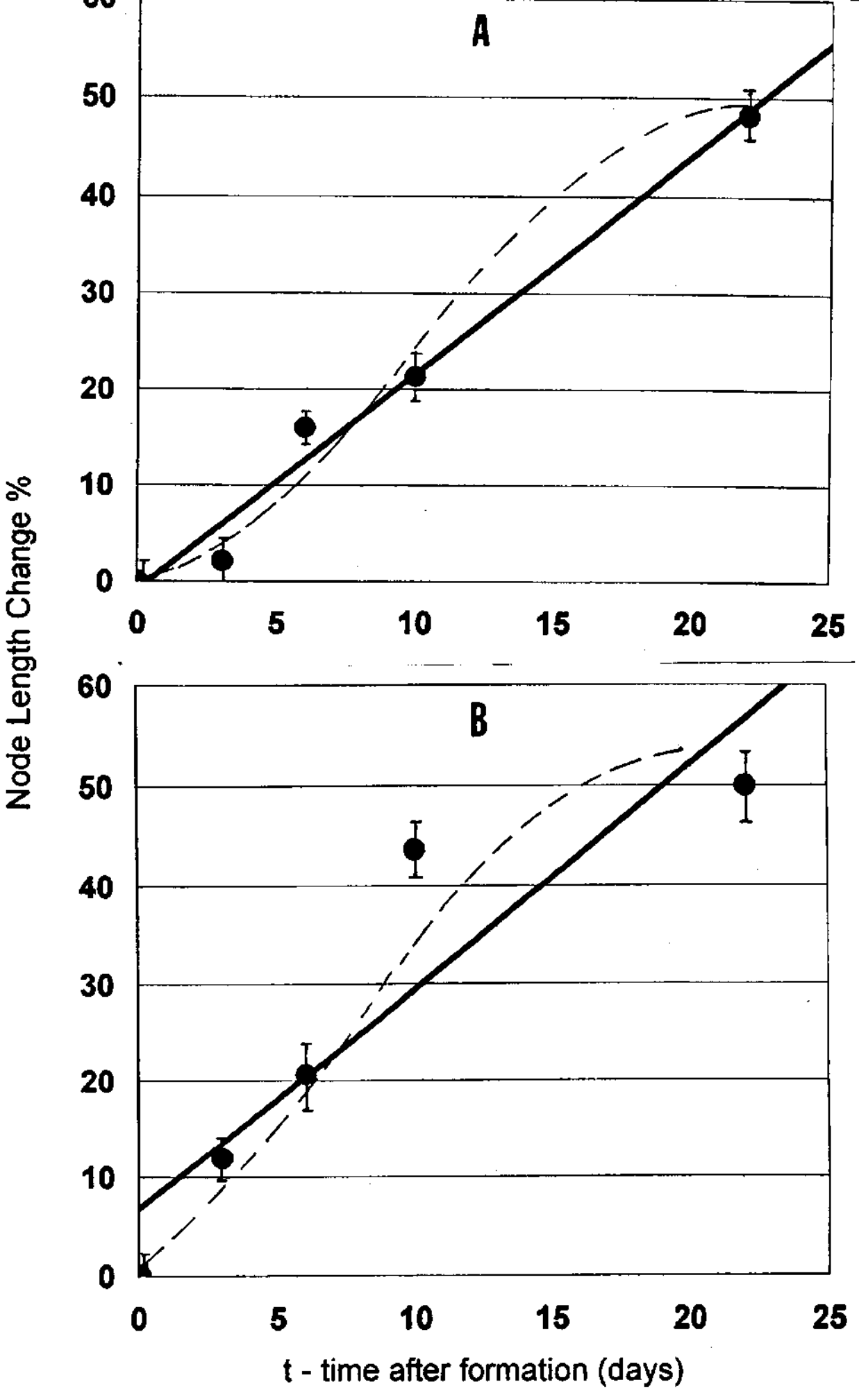
A
B
Node Length Change %
t - time after formation (days)
0
10
20
30
40
50
60
0
5
10
15
20
25

Fig 2.