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Opinions and comments on Levengood WC, Talbott NP (1999) Dispersion of energies in worldwide crop formations. Physiol Plant 105: 615–624

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This communication presents a 2-fold comment on the above-mentioned paper about the effect of pulvinus length increase in crop-circle formations (Physiol Plant 105: 615–624, 1999). In the first place, a correction is suggested for the physical model which was employed by the authors. Secondly, an alternative model is presented. It is demonstrated that this model fits well to their experimental data and suggests that the pulvinus length increase in crop-circle formations is caused by an electromagnetic point source, located at a finite height above the field in which the formations appeared. The same model does, however, not fit a hand-made formation, investigated earlier by the author.

Discussion

In their paper, Levengood and Talbott (1999) suggest that inside crop formations absorption of electromagnetic radiation causes an increase in pulvinus length, N_L, as a result of local heating and thermal expansion of the pulvini. The authors assume a linear relation between the stem pulvinus length, N_L, and the fraction of the energy, I, absorbed into the pulvinus tissue, that is

$$N_L = b(I/I_0) \tag{1}$$

where b is a proportionality constant and I_0 is the radiation source intensity. Equation 1, however, explicitly assumes that at low levels of I, that is, at long distances from the source, or in the case of strong absorption, the pulvinus length, N_L, approaches a value of zero. This, of course, will never be the case.

A more appropriate choice is to define

$$N_L - N_0 = b(I/I_0), \tag{2}$$

where N_0 is the undisturbed (control) pulvinus length.

With the use of Equation 2, a corrected analysis was performed employing the values of N_L, N_0 and the corresponding distances from the epicenters as reported by Levengood and Talbott (1999). As in the latter reference, data points corresponding to the central 'tufts' in the formations were omitted in the analysis. It was found that the Pearson product moment correlation coefficient, R (Levengood and Talbott 1999), decreases in one of the reported cases. In the other two reported cases, however, no significant changes in the correlation coefficients were found (see Table 1, second column).

The second part of this comment concerns the model for the electromagnetic radiation, allegedly involved in the creation of crop-circle formations. For the fraction, I, of the total energy striking the plant at a distance, d, from an electromagnetic source of intensity I_0 Levengood and Talbott (1999), use the following expression:

$$\frac{I(d)}{I_0} = e^{-acd} \tag{3}$$

where a is the specific absorption coefficient of the air and c the concentration of absorbing molecules. Equation 3 is only valid for absorption of 'plane' electromagnetic waves, i.e. characterised by wave fronts with negligible curvature at the

Table 1. Results of the BOL analysis on data sets from different locations. Data fit is in terms of the Pearson coefficient

Location	Levengood and Talbott (1999)	Corrected exponential	BOL	
				h (m)
Devizes	0.91	0.75	0.87	1.9
Chehalis	0.99	1.00	1.00	9.5
Sussex	0.98	0.96	0.98	7.8
Nieuwerkerk	–	0.54	0.54	17.0

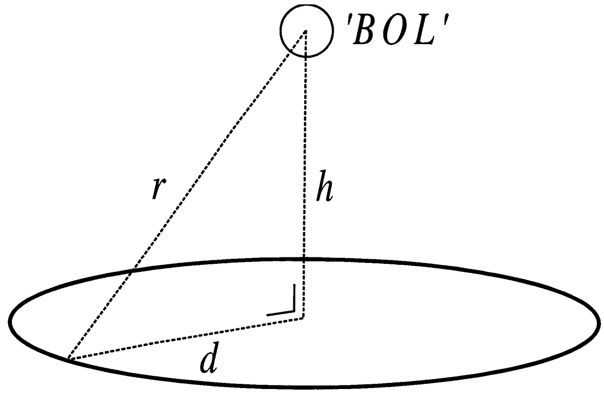

Fig. 1. Schematic representation of the proposed coordinates of the BOL in relation to the circular imprint.

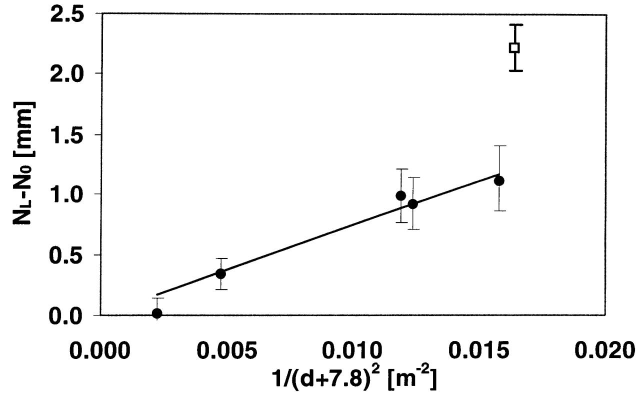

Fig. 2. BOL analysis of the 1994 Sussex formation. The BOL was set at a height of 7.8 m above the centre of the circular imprint. Straight line: least-squares best fit. Pearson coefficient: $R = 0.97$.

region of interest. However, the circular symmetry of many of the crop formations and several eye-witness reports, mentioning the involvement of 'balls of light' (referred to as 'BOLs') during the formation of a crop circle (Van den Broeke, personal communication, and Meaden 1991), suggest the introduction of an electromagnetic 'point source' rather than a plane wave. Assuming the point source to be located at a finite height above the field, for the case of simplicity, it is fair to assume that the radiation absorption in the air is negligible in comparison with the $1/r^2$ decrease of the radiation emitted by the BOL. Assuming that the BOL is located at the centre of the circular imprint, at a height, h, above the ground, the distance, r, from the BOL to a position on the ground, at distance, d, from the centre of the circular imprint, is given by (see Fig. 1)

$$r = \sqrt{h^2 + d^2} \tag{4}$$

A linear regression analysis, with y-intercept forced on zero, was performed on the data of Levengood and Talbott (1999) using the published values of N_L, N_0 and d and omitting the 'central tufts'. The new parameter, h, was optimised for best fit of the data to a $1/r^2$ fall-off. As an illustration, Fig. 2 contains the BOL analysis results for the 1994 Sussex formation for a value of $h = 7.8$ m. The results for the other formations are listed in Table 1 (third column). The Pearson coefficients are all higher compared with the previous model,

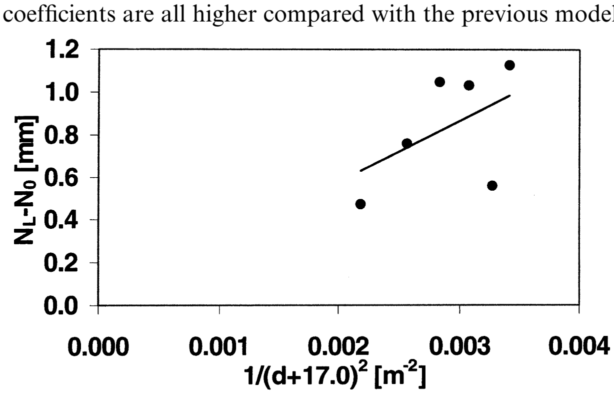

Fig. 3. BOL analysis of the 1997 Nieuwerkerk hoax with BOL at an (optimised) height of 17 m above the centre of the circular imprint. Straight line: least-squares best fit. Pearson coefficient: $R = 0.54$.

and reveal that in all three cases reported by Levengood and Talbott (1999), the node expansion correlates perfectly to the electromagnetic radiation intensity distribution on the ground, as would result from a point source at finite height above the field.

Next, the BOL analysis was performed on a data set obtained by the author 3 days after the appearance of a hand-made formation of 1997 (Nieuwerkerk, The Netherlands), employing identical methods as described in Levengood and Talbott (1999). (In this case wheat stems were mechanically flattened, whereas pulvinus length increase was assumedly an effect of gravitropism.) The results of the BOL analysis can be seen in Fig. 3 and Table 1.

Interestingly, the highest value of the Pearson coefficient, that could be obtained by manipulating the presumed height, h, of the BOL, was limited to 0.54 for $h = 17$ m. From Fig. 3, it can be confirmed that there is indeed no obvious linear dependence between the horizontal and vertical coordinates. The data points seem to miss the structured character which appears to be present in the previous cases.

Conclusions

The experimental data published in Levengood and Talbott (1999) suggest that pulvinus length expansion in crop circles is a thermo-mechanic effect, possibly induced by a kind of electromagnetic point source. Data obtained from a simple hand-made formation did not reveal the same characteristics.

By no means does the author pretend to present a 'lithmus test' for distinction between a 'genuine' crop formation, whatever it may be, and a hand-flattened area of crop. Much more data would have to be analyzed and thorough statistical studies will be necessary before such a criterion can be defined. However, the position-dependent pulvinus length, and in particular the apparent organised character of the data analysed, is interesting and stimulates further study.

References

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