Plant Primary Perception: The Other Side of the Leaf

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In 1968 a 20-page paper appeared in a little-known journal concerning a yet undefined perception phenomenon in plants. The paper was titled "Evidence of a Primary Perception in Plant Life" (Backster, 1968), and although literally thousands of papers dealing with electrical activity in plants have been published since Burdon-Sanderson's report on the electrical activity in leaves of the Venus flytrap (Burdon-Sanderson, 1873), none have received as much public attention as Backster's paper in the *International Journal of Parapsychology.* In that paper, Backster presented evidence, based on the reaction of plants, which has been popularly interpreted as indicating that plants have a consciousness and can react, as people do, to emotionally charged situations. Backster's paper also provided the basis for the best-selling book *The Secret Life of Plants*, by Tompkins and Bird (New York, Harper & Row, 1973).

Because of continued public interest in the Backster experiments, and also because of their possible implications in biological information transfer, it was decided to attempt to repeat Backster's original findings. In that attempt two studies were performed. One study involved the reaction of plants to immersion of brine shrimp in simmering water and was structured after Backster's initial work. The second study involved the response of cells in culture to the feeding of other cells in culture and is analogous to the yogurt-feeding study that Backster reported at the 141st Annual Meeting of the American Association for the Advancement of Science in New York City in January 1975. At that time Backster reported increased electrical activity in one yogurt culture immediately following addition (feeding) of milk to a second culture.

Method and Results

Plant-Brine-Shrimp Study

The plant-brine-shrimp study consisted of two series of experiments. One series used galvanic skin response (GSR) recording methods, as Backster had done, while the second series employed a standard technique for recording potentials from the surface of leaves. Except for the change in recording method, all other aspects of the two series were identical. The following precautions, obtained from both Backster and his 1968 paper, were observed during the plant-brine-shrimp experiments: (*a*) The recording phase of the experiments were automated, and all runs were performed when no individuals were in the laboratory building. (*b*) "Communication" between plants previously used in an experimental run and unused plants was prevented by removing used plants from the laboratory before new plants were brought in. (*c*) Brine shrimp and plants were brought into the laboratory just prior to an experimental run. (*d*) All known biological material was removed from the laboratory during the experimental series. (*e*) Only mating pairs of brine shrimp were used for experimental runs. Backster mentions in his paper only that he used lively brine shrimp. However, he recommended that I use mating pairs, since such pairs would probably be in good physical condition.

The basic scheme for the plant-brine-shrimp experiments consisted of placing six vials containing brine shrimp along with approximately 15 ml of salt water and six control vials with 15 ml of sterile distilled water on the dumping apparatus. The vials were spaced so that a shrimp or control vial dropped into the hot water every five minutes. Typically, three plants were monitored during a GSR run and two plants were monitored during a run involving measurement of potential.

In the case of the GSR runs, electrodes identical to the type used by Backster were employed. These consisted of a pair of 2 cm × 3 cm stainless-steel electrodes placed on either side of a leaf and held in place with a "C" clamp. Between the electrode and the leaf surface was placed a piece of salt-agar impregnated gauze the size of the electrode plate. Additionally, the GSR amplifiers and chart recorder were manufactured by the same company that manufactured equipment used by Backster in his 1968 study. Forty-two plants were used in the GSR series. Using 3 plants at a time with 6 shrimp and 6 control vials per run allowed for data col-

lection on 504 (252 shrimp and 252 control) possible plant responses. The data indicated 14 hits and 238 misses for brine-shrimp drops and 12 hits and 240 misses for sterile-water drops. Analysis of the data using a one-tailed 2 × 2 contingency test resulted in a P value of = 0.70, indicating very strongly that there was no difference in plant responsiveness between dropping brine shrimp or sterile water into a hot-water bath.

When Cleve Backster was told of these results, he claimed I could not get a response because my recorder lacked the mechanical pen positioning device he had on his original equipment. However, my recorder did have an automatic pen repositioning device, and the manufacturer assured me that data collected in the automatic mode were completely valid.

Because of the controversy over the pen repositioning, it was decided to try a second series of experiments using a recording system that allowed for measurement of potential from the leaf surface rather than a change in resistance as recorded in the GSR series. It was felt that this system would give more reliable data because (*a*) potential measurements from plants are well described in the literature (Pickard, 1971, 1972) and (*b*) the pen repositioning and baseline shifting that occurs in GSR recording is absent in the potential recording system. Twenty-one plants were used in this series, allowing for data collection on 252 (126 brine shrimp and 126 control) possible plant reactions. Analysis of the results of the plant potential series using Student's t test yielded a P value of 0.35, again indicating no difference between dumping brine shrimp or sterile water into a hot-water bath.

Cell-Feeding Study

The cell-feeding experiments were designed to be analogous to Backster's yogurt-feeding studies reported at the AAAS meeting. At the time Backster reported increased electrical activity in one yogurt culture immediately following the addition of milk (feeding) to a second culture. The cell-feeding experiments were the direct result of a conversation with Cleve Backster during a visit to his laboratory in October 1973. At that time he was already working on the yogurt experiments, and I suggested that I might try a similar experiment using animal cell cultures, as I thought that cell-culturing would allow better control of variables such as homogeneity of cell line and feeding time. In general the cell-feeding experiments involved feeding fresh culture medium to one cell culture

while recording the electrical activity of a second culture that was not being fed. As in the plant studies, the cell-feeding experiments were designed to operate automatically.

Eighty cell cultures (40 for feeding and 40 for recording) were used in this study. The cell-feeding data were evaluated by measuring the largest peak-to-peak heights, regardless of polarity, of the recorder tracing in the periods before, during, and after feeding. Each measuring period was 45 seconds. Statistical analysis using Student's t test was performed between the feeding and post-feeding periods. The analysis indicated no significant difference between the pre-feeding and feeding periods ($P=0.87$) or between feeding and post-feeding periods ($P=0.81$).

Discussion

The data of the plant-brine-shrimp experiments and the cell-feeding experiments conducted at Science Unlimited lend no support to Backster's hypothesis of the existence of a primary perception mechanism operating at the organismic or cellular level. The data are, however, consistent with reports of others who have also attempted to replicate Backster's findings (Johnson, 1972, and Horowitz, et al., 1975). It is also significant that in both this study and the study of Horowitz, et al., the experiments were performed after consulting with and taking suggestions from Cleve Backster. Nevertheless, negative results were obtained in both cases. Additionally, the experiments reported here represent a much larger data base. Results presented by Backster in 1968 were based on 7 plants with 21 shrimp and 21 control drops; this study employed 63 plants with 378 brine shrimp and 378 control drops.

Additional work with Backster's experimental design have led me to believe that his results, in the case of the plant-brine-shrimp experiments, may represent only random electrical functioning of his electrode system. The GSR electrode system used on the plants consisted of a sandwich composed of two stainless-steel plates to which were applied salt-agar strips. The leaf was placed between the two plates. It can be observed that GSR fluctuations occur in this system even if no leaf is present, indicating that the electrode system is unstable and is most likely the cause of the pen deflections seen on the GSR recorder. Likewise, with the yogurt experiments, the preamplifers used by Backster appear to have a great deal of inherent electronic noise. I am suggesting (by inference) that

he is calling electronic noise a response from the yogurt.

It is unfortunate that the popular press has taken Backster's experiments and presented the results to the public in such a way that many people now believe plants can do something that, in fact, they cannot. The press, for the most part, never mentions that articles on the Backster effect are based on observations of only seven plants. Perhaps they need to be reminded, again, that they are making exaggerated claims from an experiment that no one, including Backster, by his own refusal to do so, has been able to replicate.

References

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