NUMBER 13
MARCH 26,1979

This Week's Citation Classic

Paleg L G. Physiological effects of gibberellic acid. I. On carbohydrate metabolism and amylase activity of barley endosperm. *Plant Physiol.* **35**:293-9, 1960.

This paper established the basis of a new understanding of the relationship between the cereal embryo and endosperm. It gave the first indication of a hormonal effect on enzyme activity in plants, and suggested a very sensitive, short, and reliable hormonal bioassay. [The *SCI*® indicates that this paper has been cited over 155 times since 1961.]

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April 10. 1978

"I am amazed and delighted to have authored a Citation Classic. Amazed because, somehow, it seemed so unlikely, but delighted for many reasons, not least because it was essentially my first major paper, the first of a number of papers following my move to Australia. I think of the work not only as a tribute to the opportunities and attitudes at the Waite Agricultural Research Institute of the University of Adelaide, but also as the basis of a long, productive, and delicious relationship between me and the barley, malting, and brewing industries of Australia.

"The experiments in the paper were initiated by a report that the plant growth regulator (it was not then recognized as a hormone), gibberellic acid, hastened the germination process of barley.[1] (Malt, incidentally, is barley germinated and dried under controlled conditions.) Logic said gibberellin could hasten germination through a direct effect on the barley embryo, or indirectly by stimulating the supply of nutrients coming from the storage area of the seed (the endosperm). History, on the other hand, in the form of the collective wisdom of 6 to 7 decades of plant scientists, said that the latter possibility was not a possibility at all. This view was exemplified in 1953 by WO. James who wrote, 'The relationship of the germinating embryo to the endosperm is virtually that of a parasite extruding exo-enzymes into the host tissues, much as a spider treats a fly.'[2]

"Pugnacious ignorance was my shield against the historical view and the experiments demonstrated that the endosperm could indeed spring to independent and productive activity, provided the right hormonal complement was present. Further exploration by me and others established that, through the release of gibberellin, the embryo exerts a controlling influence over the metabolic activity of a tissue spatially separated from itself. Once in the endosperm the hormone controls the production and release of enzymes which break down the stored reserves. The nutrients formed are then used by the embryo for its own growth and development. Thus, the whole process occurs within a closed system and is self-regulated through a series of biological checks and balances—a perfect hormone example. James' analogy was right, but his control mechanisms weren't.

"This paper is even more memorable for me because it deals with the breakdown of starch, a process accomplished with ease and dexterity by bacteria and fungi. Despite exhaustive testing to eliminate contamination as a confusing, if not motivating, force behind the response, I can clearly recall breaking into a cold sweat during a return holiday flight from Alice Springs, while the paper was in press. I turned to my wife and said, 'They must all be right —the response must be due to contamination. What a shame because I did so like research in plant physiology.' "

References

1. **Hayashi T.** Biochemical studies on "Bakanae" fungus of rice. VI. Effect of gibberellin on the activity of amylase in germinated cereal grain. *Bull. Agr. Chem. Soc. Japan* **16**:531-8, 1940.
2. **James W O.** *Plant respiration.* Oxford: Clarendon Press, 1953. 282 p.