SHORT COMMUNICATIONS

DISTRIBUTION OF PHOSPHORUS DURING WHEAT GRAIN DEVELOPMENT*

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In a study on the development of the wheat grain (Rijven and Cohen 1961) it was found that the tissues of maternal origin, in contrast to those of the endosperm and embryo, showed early maxima with respect to protein content and enzyme activity. In some respects the pattern reflected the histogenesis and histolysis of diverse layers which at maturity constitute the grain coat or testa-pericarp.

Results of recent studies by Jennings and Morton (1963*a*, 1963*b*) on the distribution of various components in the same parts of the grain are not in agreement with this pattern; these authors found that during the ripening period the protein nitrogen values for the testa-pericarp show a continuous increase. Although it is stated that the endosperm fraction contained the aleurone layer, serious contamination of the testa-pericarp fraction with the aleurone layer seems to have occurred. The endosperm may be readily and entirely isolated during the first half of development but it becomes increasingly difficult to retain the aleurone layer in that fraction during the second half.

Contamination of the testa-pericarp fraction with aleurone layer material is also suggested by their data on total phosphorus content of that fraction; at maturity it nearly equals that of the endosperm fraction. The present examination of the development of the grain in terms of phosphorus content lends support to this belief.

Wheat plants (*Triticum sativum* L. cv. Festival) were grown in Perlite at 21°C for 8 hr from 8.30 a.m. each day and at 16°C for the remainder of the day in the Controlled Environment Research Laboratories (CERES) at Canberra. The plants were subjected to the natural daylight of the period May–September 1963, and were watered daily with half-strength Hoagland nutrient solution, which was first modified to contain phosphate at half the prescribed strength. Grains used for analysis were taken from the first flowers of spikelets in the middle of the ear. The grains were weighed fresh and then dissected, taking care that the aleurone layer remained with the endosperm. On days 32 and 40 after anthesis, in a separate series of dissections, the aleurone layer was incorporated in the testa-pericarp fraction. This was done by pressing halved grains between glass slides so that the starchy endosperm was extruded, and then scraping the internal surface of the aleurone layer with a scalpel to remove residual starchy endosperm. For each fraction 6–9 replicates were used. After digestion of individual grain parts with concentrated perchloric acid, their phosphorus content was determined using sulphomolybdic acid solution and chlorostannous acid as reductant. Individual estimates agreed within a 20% range.

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The results, as shown in Figure 1, demonstrate that after the initial rise the phosphorus content of the testa-pericarp decreased and finally amounted to only 3·8% of that of the whole grain. Although the values for the aleurone layer may be on the high side because of insufficient removal of starchy endosperm, there is clearly a high concentration of phosphorus in the immediate vicinity of the testa-pericarp.

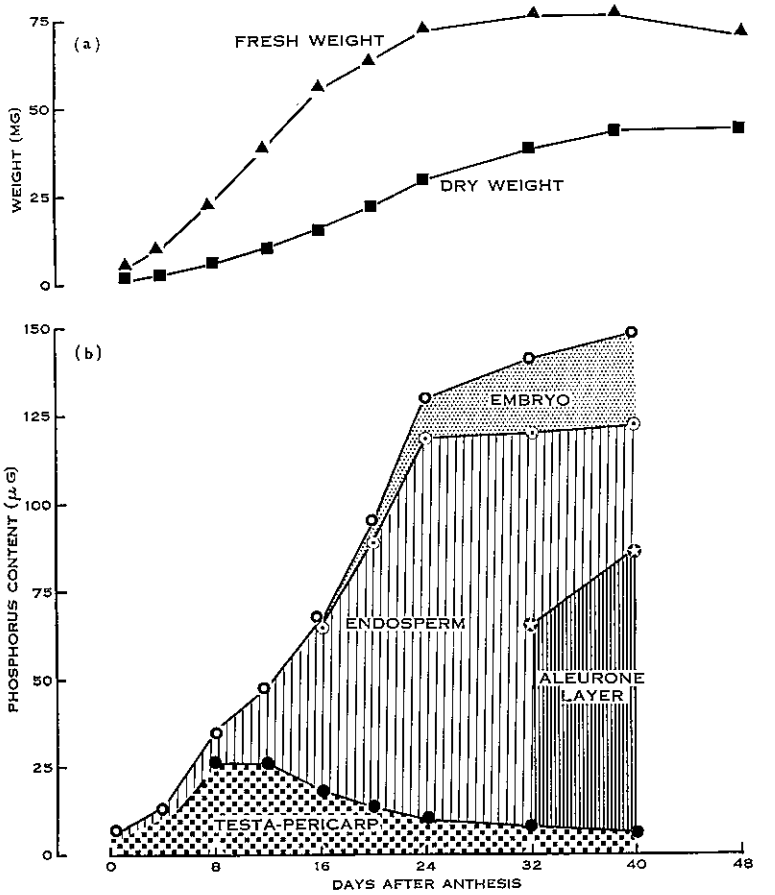

Fig. 1.—Weights (*a*) and additive plot of phosphorus content of parts of developing wheat grains (*b*). Although present before day 23 the aleurone layer was analysed separately only on days 32 and 40.

The values of Figure 1 also suggest a movement of phosphorus from the starchy endosperm into the aleurone layer during the final ripening stages. However, this would require further investigation.

The decrease in phosphorus content in the testa-pericarp has been confirmed in Gabo wheat, the variety used by Jennings and Morton.

In a comparison of the present set of results with that of these authors differences in absolute value besides those in trend may be noted. Whilst here at maturity the total phosphorus content attained the value of 148 μg for the whole grain and 5·7 μg

for the testa-pericarp fraction, those of Jennings and Morton were close to 65 and 28 μg respectively. It is therefore difficult to explain the contrast in the testa-pericarp fraction on the basis of phosphorus stress.

It is concluded that aleurone layer material has grossly contaminated their testa-pericarp fraction, but the correct interpretation of their data is still uncertain because presumably this contamination did not occur at the earlier stages.

The question arises how under these conditions the DNA content per grain in the testa-pericarp fraction can remain essentially constant throughout development as found by Jennings and Morton. Perhaps the combination of a gradual histological degeneration of the testa-pericarp and a correlated increased contamination with aleurone layer may account for the apparent constancy of the DNA content of that fraction.

References

JENNINGS, A. C., and MORTON, R. K. (1963*a*).—*Aust. J. Biol. Sci.* **16**: 318.

JENNINGS, A. C., and MORTON, R. K. (1963*b*).—*Aust. J. Biol. Sci.* **16**: 332.

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