VARIATIONS IN THE PHOTOENVIRONMENT WITHIN FRUITS OF A Pu Pur AND gp PEAS

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Several well defined genes specifically alter pod characters, including color. Recessive gp plants produce yellow pods which lack normally developed chloroplasts in the typically green mesocarp. Pu Pur in an A background give purple pods due to the production of high levels of anthocyanin within the exo- and outer mesocarp. Such dramatic characters are bound to profoundly alter the normally important photosynthetic function of pods and could also have a more direct photomorphogenetic effect on the developing seeds. We have measured the percent transmission through various pod layers in a range of genotypes as part of a wider investigation into variation in the photosynthetic machinery in pea fruits.

Fig. 1 shows the percent transmission through the outer layers (exocarp, mesocarp and sclerenchyma) of normal green (JI 141), purple (JI 755) and yellow (JI 73) pods. This is therefore equivalent to the light received by the inner endocarp and similar to that penetrating to the seeds. Measurements were made on 20-day-old pods (from anthesis), using a modified Ulbricht Sphere in a Unicam SP8-100 spectrophotometer. The spectra are typical for these three pod types, additional variation in other genotypes being swamped by the operation of these pod color genes.

The spectrum for the green pod (Gp) shows distinct transmission troughs in the blue and particularly red (685 nm) regions. These can be shown to be largely due to the specific absorption by photosynthetic pigments located within the chloroplasts of the extensive mesocarp and associated with RuBP carboxylase activity (1). It is photosynthesis within this layer which produces most of the (approx) *25%* contribution that green pods make to the carbon economy of the developing seeds.

In purple pods (A Pu. Pur) light penetration beyond the exo- and outer mesocarp is very restricted, being appreciable only in the red. The small trough at 680 nm indicates some specific absorption by chlorophyll and we have observed some moderately developed chloroplasts even in the inner mesocarp. However, they must all be operating in a heavily shaded environment and their photosynthetic contribution can be no more than minimal.

Yellow pods (gp) exhibit the opposite extreme. Here the exo- and mesocarp are far more translucent, again with evidence of little specific absorption by chlorophyll. The decline in transmission towards 400 nm is not due to specific absorption by photosynthetic pigments to any extent. However, although little light is usefully absorbed by the mesocarp, more penetrates to the inner endocarp (and seeds). This region of parenchyra is thin but is particularly well endowed with fully developed chloroplasts and associated biochemical machinery (1) and exposed to the elevated levels of CO_2 of the pod space. The endocarp in yellow pods is therefore a very favorable photosynthetic environment and we have estimated that in this line 251 of the 680 nm light incident on this layer is specifically absorbed. This could not only make a significant contribution to the photosynthate for seed growth, but also affect the O_2/CO_2 regime surrounding the seeds.

Similar endocarpic effects can operate in green pods but in the A. Pu Pur lines they are very minor. A study of the orange pods of the orp lines described recently (2) would be interesting since here the additional pigmentation is within the sclerenchyma and should therefore only affect light availability to the inner endocarp and seeds.

1. Price, D. N. and C. L. Hedley. 1980. Ann. Bot. 45:283-294.
2. Swiecicki, W. K. 1981. PNL 14:65-66.

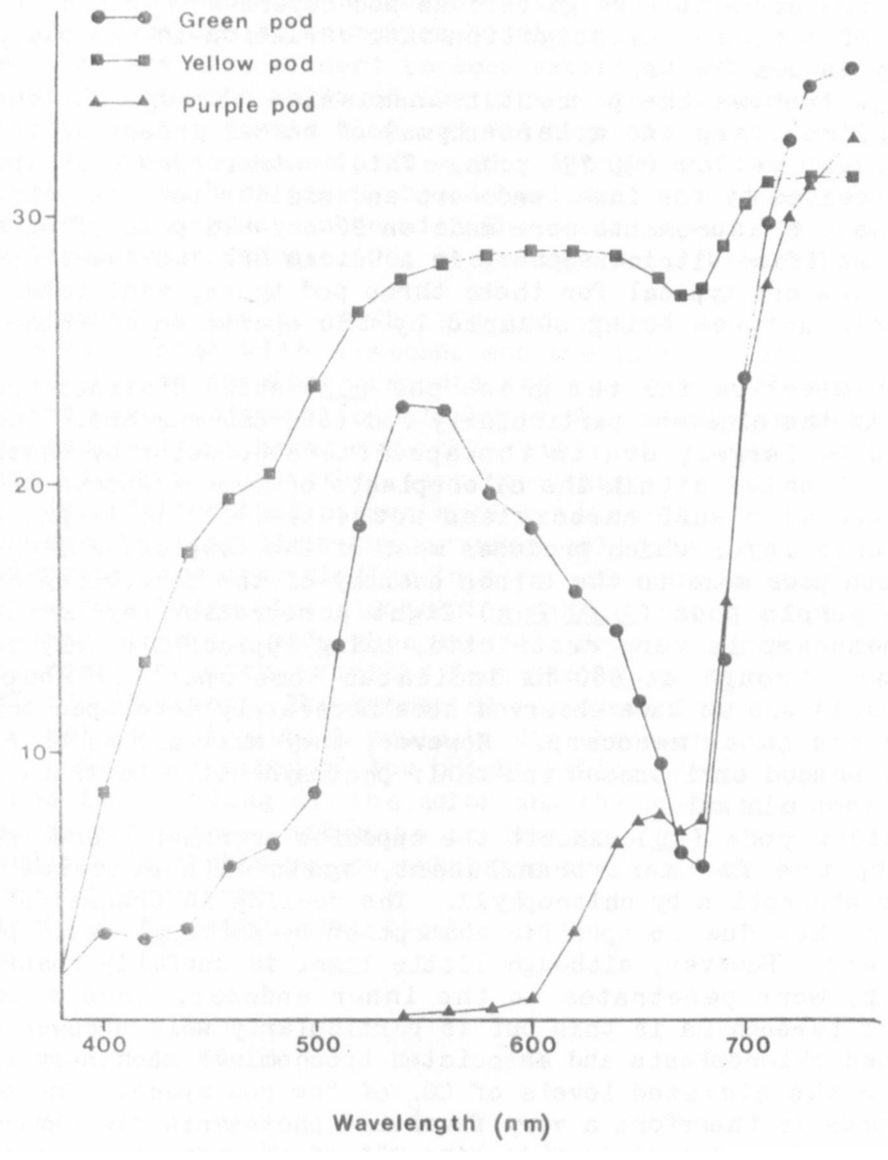

Fig. 1. Percent transmission through the outer layers (exocarp, mesocarp, and sclerenthyma) of green, purple (A Pu Pur) and yellow (gp) pods.