A COMPARISON OF THE OPTICAL PROPERTIES OF gp (YELLOW) AND Gp (GREEN) FRUITS

Price, D. N., M. E. Donkin, and A. Hull
Rumleigh Experimental Station
Plymouth Polytechnic, Devon, U.K.

The transmission and absorption of light by the pod wall of *Pisum* is important both for the photosynthetic capacity of the pod and the photo-environment in which the pea embryo develops. Previous work (1) has examined the percent transmission of light through green, yellow, and purple pods. We are now able to extend this by carrying out a more detailed study of transmission, reflection and, by derivation, absorptance on green *Gp* and yellow *gp* podded varieties.

Transmission and total reflectance spectra were measured using the diffuse reflectance accessory of the Pye Unicam SP 8-100 spectrophotometer. This is an integrating sphere with ports for measurement of transmitted and reflected light. The spectrophotometer was interfaced with a BBC microcomputer so that data could be transferred to the computer using programs which corrected baselines and calculated the areas under curves.

The lines of peas chosen as representative were JI 73 (*gp*) and JI 141 (Gp). The results are presented as (a) a full spectrum from 350-750 nm for pods approximately 18 days from anthesis and (b) a developmental time sequence of integrated PAR (Photosynthetically Active Radiation) from 400-700 nm.

The transmission spectra (Fig. 1A) show qualitative similarities, although there are quantitative differences; for example there is, overall, a higher transmission by the yellow pod except in the, near UV. Fig. 1B shows that the differences in transmission throughout development are greatest in the young stages. There is a bigger increase in the transmission of the green pod with age, a feature of pod senescence. Fig. 1C shows the reflectance spectra and Fig. 1D shows the integrated areas under the reflectance curves with development. In this case the full spectra are quantitatively more similar but there arc qualitative differences, for example in the red region, and the curves cross in the UV. The areas under the reflectance curves rise with ago, especially in the older stages, but the yellow pods appear to be more reflective overall. Fig. 1E shows the absorptance spectra derived by the equation 100-(% transmission + % reflectance). These spectra show qualitative similarities and compare well with other published *in vivo* chlorophyll spectra for leaves (2). The yellow pods quantitatively show a lower absorptance probably due to the presence of less chlorophyll. The developmental sequence (Fig. 1F) again shows a lowering absorptance in the green pods with age, probably due to chlorophyll breakdown during senescence.

The differences in optical properties measured here correspond to visual differences. The mutant *gp* pod has been shown to support a lower pod photosynthesis rate which may have an effect on pod and seed growth. This is probably compensated for by an increase in leaf photosynthesis. The presence of this gene is also associated with a change in the gaseous environment around the seed so that higher CO_2 and lower O_2 are found in the gp pod (personal observation). Finally we have shown here that a seed in a gp pod will also have a changed photo-environment which may have photomorphogenic effects on seed development or on the ability of the testa or cotyledon to produce photosynthetic metabolites.

In conclusion, seeds in gp pods develop in a different nutritional, gaseous, and photo-environment from those in Gp pods.

1. Price, D. N., J. E. Hayward, and C. M. Smith. 1983. PNL 15:49-50.
2. Loomis, W. E. 1965. Ecology 46(1&2):14-16.

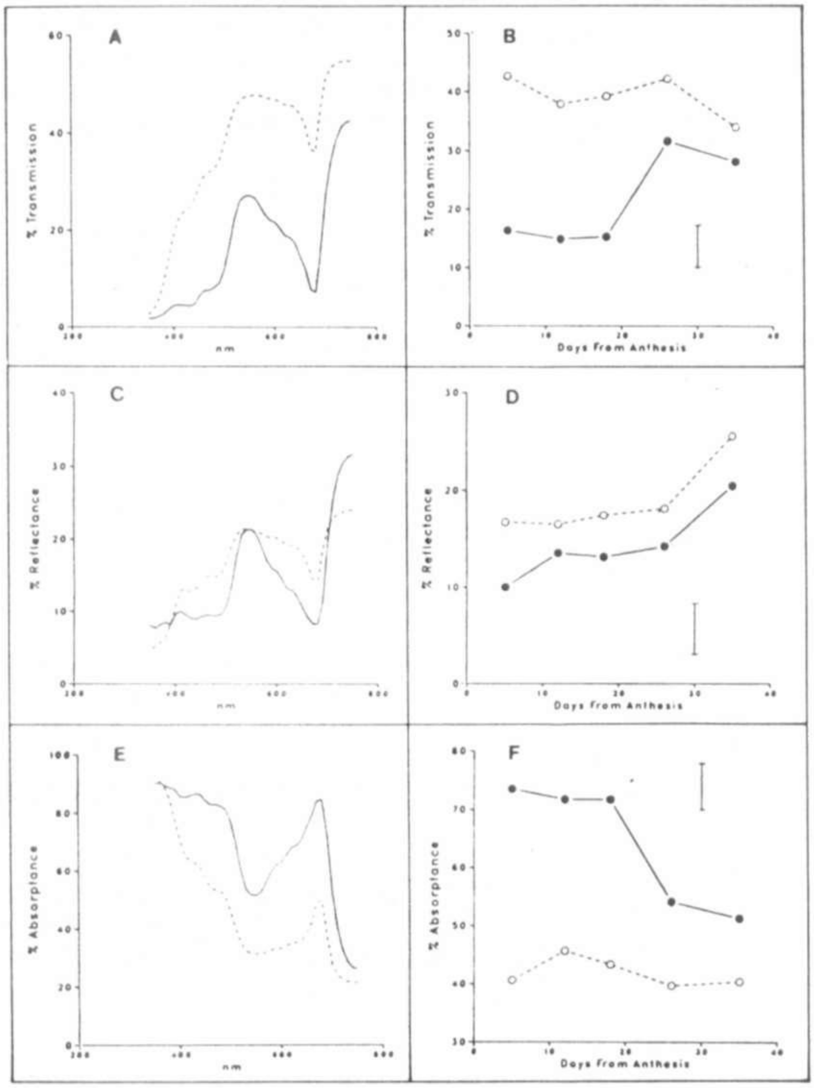

Fig. 1. A-Transmission spectra, C-Reflectance spectra, E-Absorptance spectra (typical spectra are shown, these were replicated three times). B, D, and F show the integrated area under the transmission, reflectance, and absorptance curves from 400-700 nm against Days from Anthesis.
Key: ______ GP pods; ________ gp pods.
The bars represent the Least Significant Difference at P 0.05.

*****