and Wray, 1989). Anthocyanins also have an absorbance maximum between 267 and 275 nm (Harborne, 1989) and, when hydroxycinnamic acids are covalently linked to anthocyanins, another maximum occurs in the UV-B and short wavelength UV-A regions (310–330 nm; Strack and Wray, 1989).

Anthocyanins are located in vacuoles (Strack and Wray, 1989) and accumulate especially in the epidermis of leaves of several plant species including *P. sativum* (Hrazdina *et al.*, 1982), *Pinus banksiana* (Huner *et al.*, 1998), *Zea mays* (Pietrini *et al.*, 2002) and *Lactuca sativa* (Neill and Gould, 2003). These epidermally located anthocyanins can reduce the intensity of light reaching the photosynthetic mesophyll tissue. The light-screening function of anthocyanins in *L. sativa* cv. 'Dark Lollo Rosso' was recently investigated by Neill and Gould (2003). The anthocyanins were synthesised only in a part of the leaf lamina where they are confined to the adaxial epidermis. The presence of anthocyanins increases total leaf absorptance from 35 to 75% at 550 nm and from 79 to 88% at 440 nm. If we disregard leaf reflectance, these absorptance data correspond to a reduction of transmittance by approximately 2.5-fold in the green region and 1.8-fold in the blue region; thus, epidermally located anthocyanins are competent to screen out blue and green radiation.

Anthocyanin-dependent screening of the photosynthetic mesophyll from excessive light intensities has, indeed, been suggested to prevent deleterious photoinhibitory processes (Chalker-Scott, 1999; Steyn *et al.*, 2002; Gould, 2004) which arise from inefficient use of absorbed light quanta under unfavourable conditions (Osmond *et al.*, 1997; Huner *et al.*, 1998; Niyogi, 2000; Krieger-Liszkay, 2005). It has also been suggested that light screening by anthocyanins assists to retrieve nutrients from the light-sensitive, senescing leaves by preventing high light intensities damaging the resorption system (Hoch *et al.*, 2001, 2003). Anthocyanins, however, have also been found to be confined to the lower epidermis of some aquatic plants (Lee, 1986) which is incompatible with a light screening function. Anthocyanins appear to be unimportant in UV screening of leaves which agrees with the relatively low absorption of simple anthocyanins in the natural UV range (Close and Beadle, 2003; Gould, 2004).

Anthocyanins might also assume some light-screening functions in the skin of *M. pumila* fruits (Merzlyak and Chivkunova, 2000) and in the exocarp of pods from the Leguminous tree *Bauhinia variegata* (Smillie and Hetherington, 1999). The peripheral localisation of anthocyanins suggests a possible light screening function in *O. europaea* fruits (Agati *et al.*, 2005). The anthocyanins in the sub-epidermal tissues of red-grape berries (Moskowitz and Hrazdina, 1981) could also provide screening against high-light intensities.

In the petals of many flowers, anthocyanins are confined to the vacuoles of epidermal cells (Kay *et al.*, 1981). These anthocyanins produce red to magenta flower petals, but co-pigmentation with flavonoids or chelation of metal cations can shift the absorption peak in the visible region to produce blue colours that are the preferred attractant to bee pollinators (Harborne and Williams, 2000).