RELATION OF CAROTINOID PIGMENTS TO SEXUAL REPRODUCTION IN PLANTS[1, 2]

WHEN certain typical plants, such as Cosmos (*Cosmos bipinnatus*), Salvia (*Salvia splendens*) and soybeans (*Soja max*) are exposed to a short photoperiod (7- to 8-hour day) and a relatively long one (14- to 15-hour day) they exhibit conspicuous differences in rate of growth, time of sexual reproduction and greenness of foliage. The short-day soybean plants, for instance, are lighter in color early in their development, but soon match with the long-day plants and, during the period of reproduction, become intensely green. Since the color of the foliage is due primarily to chloroplast pigments, a survey has been made during the past 3 years of the concentration of chlorophyll (α and β), carotin and xanthophyll in various parts, but mainly leaves, of these plants.[3]

The results of a large number of determinations show that in the leaves of both short- and long-day group of Cosmos, Salvia and Soja approximately the same concentration of chlorophyll is present, but plants that have changed from vegetative development to the reproductive state have an increased carotin and xanthophyll content, as the following records show:

	Milligrams in 10-gram sample of leaves		
	Chlorophyll (α and β)	Carotin	Xanthophyll
Cosmos			
Vegetative (long day) ...	20.0	0.95	1.5
Reproductive (short day)	20.0	1.17	1.85
Salvia			
Vegetative (long day) ...	25.8	1.85	2.50
Reproductive (short day)	25.0	2.07	2.80
Soja			
Vegetative (long day) ...	22.7	1.10	1.52
Reproductive (short day)	22.1	1.49	2.00

Moreover, the concentration of the two carotinoids seems to reach a maximum at the time of flowering and then decreases. This is illustrated by reproductive (short-day) soybean plants, var. Biloxi.

	Carotin and xanthophyll in leaves of soybeans
	Milligrams in 10-gram sample
Vegetative (long day) plants	
Carotin	0.32 → 0.46 → 0.65 → 0.76
Xanthophyll	1.1 → 1.96 → 1.57 → 1.25
Reproductive (short day) plants	*Flowering*
Carotin	0.35 → 0.43 → 1.26 → 1.07
Xanthophyll	1.2 → 2.1 → 2.44 → 1.77

The exact meaning of this phenomenon and its bearing on the metabolism of plants is unknown at present. There is, however, a suggestive analogy in animals. The carotinoids are present in conspicuous quantities in various organs and secretions associated directly or indirectly with reproduction (corpus luteum, egg yolks, milk, etc.[4, 5]). Furthermore, it has been observed that these yellow pigments move from certain parts of the body to the reproductive organs, as in the case of some breeds of domestic fowl, dairy cattle, etc.

The now well-established relation of carotin, and possibly xanthophyll, to vitamin A, may be but one, though important, phase of the metabolic function of the carotinoids. Are they, especially carotin, merely "provitamins" for the formation of vitamin A or have they some other important activity in sexual reproduction of both plants and animals? The premonstration which seems to indicate that predominantly more yellow pigments are present in female than male plants of dioecious species (*Rhamnus*) or races (*Mucor*)[6] is interesting evidence having a bearing on the possible physiological rôle of these substances.

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1 Contribution from the Department of Horticulture, Missouri Agricultural Experiment Station. Journal Series No. 381.

2 A phase of an investigation supported by funds from the Committee on Effects of Radiation upon Living Organisms of the National Research Council.

3 Separation and purification of all three pigments was conducted according to Willstätter and Stoll's method as modified by Dr. F. M. Schertz, of the U. S. Bureau of Chemistry and Soils, to whom the writer is indebted for cooperation in this work and the supply of pure chlorophyll, carotin and xanthophyll.

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