Zeitschrift: Mitteilungen der Schweizerischen Entomologischen Gesellschaft = Bulletin de la Société Entomologique Suisse = Journal of the Swiss Entomological Society

Herausgeber: Schweizerische Entomologische Gesellschaft

Band: 54 (1981)

Heft: 3

Artikel: Fruit fly quality monitoring : the spectral sensitivity of field-collected and laboratory-reared olive flies, Dacus oleae Gmel (Dipt., Tephtridae)

Autor: Remund, U. / Economopoulos, A.P. / Boller, E.F.

DOI: https://doi.org/10.5169/seals-401994

MITTEILUNGEN DER SCHWEIZERISCHEN ENTOMOLOGISCHEN GESELLSCHAFT
BULLETIN DE LA SOCIÉTÉ ENTOMOLOGIQUE SUISSE
54, 221–227, 1981

Fruit fly quality monitoring: The spectral sensitivity of field-collected and laboratory-reared olive flies, Dacus oleae GMEL. (Dipt., Tephritidae)

U. REMUND[1], A. P. ECONOMOPOULOS[2], E. F. BOLLER[1], H. R. AGEE[3], and J. C. DAVIS[3]
[1] Swiss Federal Research Station for Fruit-Growing, Viticulture and Horticulture, CH-8820 Wädenswil, Switzerland
[2] Entomology Laboratory, Democritos Nuclear Research Center, Aghia Paraskevi Attikis, Greece
[3] Insect Attractants, Behavior, and Basic Biology Research Laboratory, Agricultural Research, Science and Education Administration, USDA, P. O. Box 14565, Gainesville, FL 32604, USA

Changes in spectral sensitivity measured by the electroretinogram technique (ERG) on wild and artificially reared olive flies, *Dacus oleae* GMEL., of three age groups are described.

The electroretinogram technique (ERG) provides a physiological measurement of visual sensitivity at the receptor level, and was developed especially for quality assessments of artificially reared fruit flies (AGEE & PARK, 1975). Using this technique the authors detected changes in spectral sensitivity and related them to diet, genetic stock, temperature extremes, and handling procedures employed in rearing *Anastrepha suspensa* LOEW. We used the same ERG technique to measure the spectral sensitivity of field-collected and laboratory-reared olive flies.

MATERIALS AND METHODS

The instrumentation and electrophysiological techniques employed in this study are described in detail by AGEE (1973, 1977), AGEE & PARK (1975), and AGEE & CHAMBERS (1980). The 3 insect strains tested had the following histories. The wild strain was collected from infested olive fruits in the «Dionissos» area, located ca. 350 m above sea level, ca. 30 km northeast of downtown Athens, Greece. The area is surrounded by mountains. The F-20 strain originated from wild pupae collected in the «Sembronas» area, located ca. 600 m above sea level in the center of Chania Province in western Crete, Greece. The area is surrounded by mountains. This strain was reared artificially for ca. 20 generations (about 2 years). The F-130 strain originated from wild pupae collected in the «Marathon» area, located ca. 42 km east of Athens (Greece) near the sea. This strain was reared artificially for ca. 130 generations (about 13 years). The 2 laboratory strains were reared under the same conditions during their last 20 generations, i. e., the same temperature, humidity, and light conditions, and the same larval and adult diet.

During the 13-year period for the F-130 strain, and the 2-year period for the F-20 strain, the rearing media, adult food, and handling conditions for both strains changed gradually to the present rearing system. Wild insects were shipped in the

pupal stage by air from Democritos, Greece to the fruit fly laboratory in Wädenswil, Switzerland. Pupae of all 3 strains were stored at 25 °C, 55 ± 10% RH and a photoperiod of 16 h L (1500 lux in the cage) and 8 h D. Emerged flies of both sexes were held under the same conditions in 1-liter cages with water supply and food strips (sugar-yeast hydrolizate, 4 : 1). The females had the opportunity to lay eggs into artificial oviposition devices (ceresin domes of 10 mm diam.) (PROKOPY *et al.*, 1970). Insects were always tested between the 4th and 13th h of their photoperiod, and all were dark-adapted for 30 min prior to testing. The spectral sensitivity to wavelengths 350–650 nm was determined. The depth to which the electrode penetrated the insect eye ranged from 30 to 50 micrometers. The visual sensitivity of the 3 strains and 3 age groups tested was compared with Nemenyi's nonparametric multiple rank test.

RESULTS

A statistical comparison (Nemenyi's multiple comparison) of the sensitivity of all 3 strains and of all 3 age groups to 490 nm (peak sensitivity of the olive fly) is summarized in table 1. A statistical comparison of the entire spectral sensitivities of all three strains at each of the three age groups gave the following results: At 22 days, wild flies are significantly more sensitive at wavelengths 430–540 nm than F-130 flies. At 10 days, wild flies are significantly more sensitive at wavelengths 380–560 nm than F-130 flies. At 1 day, wild flies are significantly more sensitive at wavelengths 410–540 nm than F-20 flies and at wavelengths 450–550 nm than F-130 flies.

Table 1: Significance levels of Nemenyi's multiple comparison of spectral sensitivity ranks at 490 nm wavelength (non parametric statistics)

strain and age in days		wild			F-20			F-130		
		1	10	22	1	10	22	1	10	22
wild	1		-	-	-	-	-	.05	.05	-
	10			-	.05	-	-	.05	.01	.1
	22				.01	-	-	.01	.01	.05
F-20	1					-	-	-	-	-
	10						-	-	-	-
	22							-	-	-
F-130	1								-	-
	10									-
	22									

We found no statistical significance between the three age groups tested, but a certain tendency to higher spectral sensitivity with increasing age of the flies.

Fig. 1 illustrates the changes in spectral sensitivity of 1-, 10-, and 22-day-old olive flies from the wild strain of Democritos. Each point on the curves represents the arithmetic mean of a sample of 7 to 10 individuals composed of both sexes. We observed that the olive fly has a secondary peak of sensitivity in the ultraviolet (365 nm) and a major broad peak in the 480 to 500 nm regions of the color spectrum.

Fig. 2 represents the changes in the spectral sensitivity of 1-, 10-, and 22-day-old olive flies reared on artificial diets at Democritos (F-20). Each point on the curves represents the arithmetic mean from a sample of 10 individuals composed

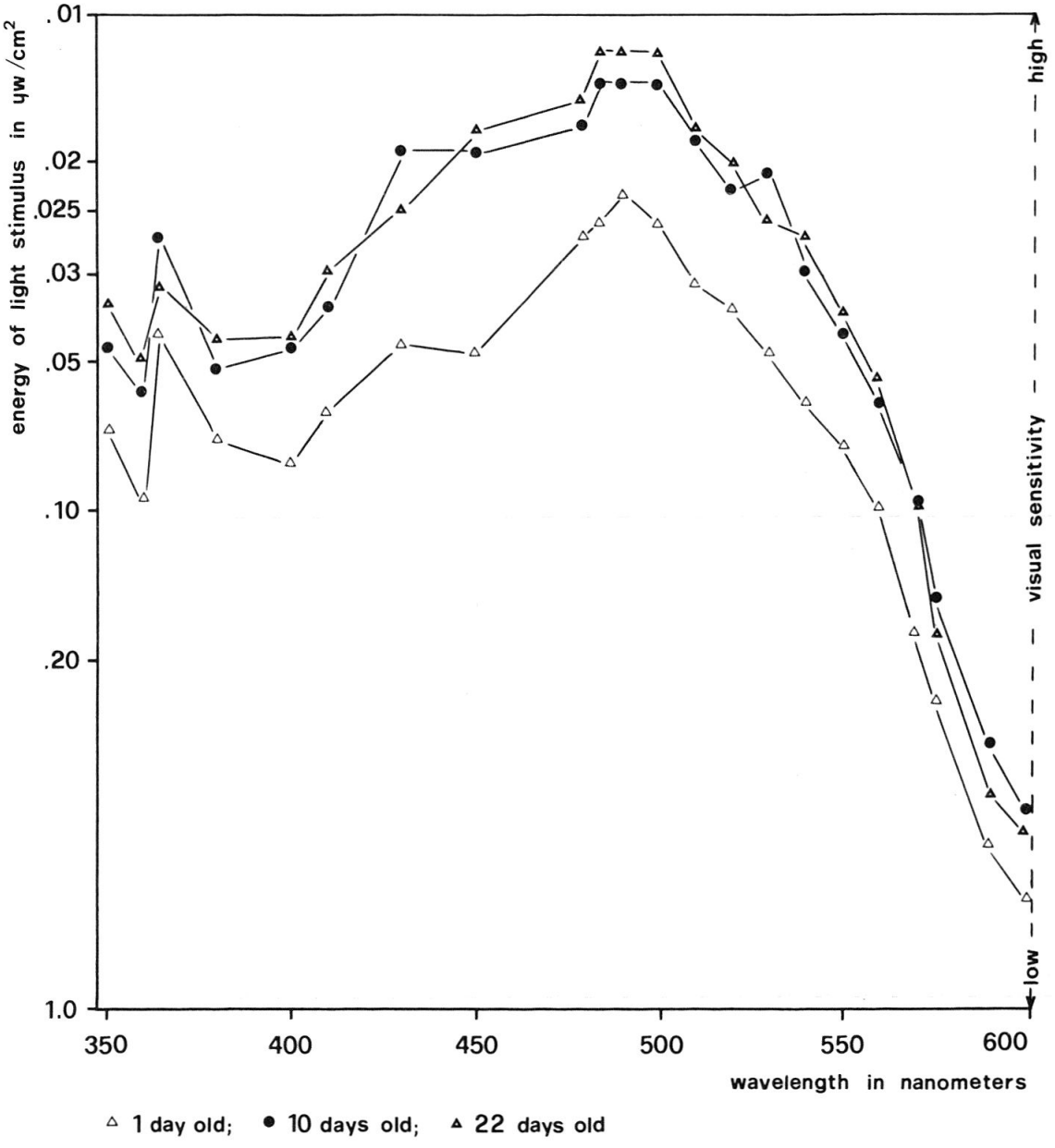

Fig. 1: Spectral sensitivity of *Dacus oleae,* wild

to both sexes. Peak sensitivity at 490 nm was considerably reduced (in 2 cases the difference was significant) in the F-20 strain, i. e., F-20 flies were: 10, 25, and 26% (1-, 10-, and 22-day-old) as sensitive as the comparable wild strain.

Fig. 3 illustrates the spectral sensitivity situation for the same 3 age groups after 130 lab-reared generations on artificial diet. Each point on the curves represents the arithmetic mean of 8 to 10 measured individuals of both sexes. The spectral sensitivity was extremely reduced compared with the wild flies of the same age groups (table 1). F-130 flies were 9, 9, and 10% (1-, 10-, and 22-day-old) as sensitive at 490 nm as the wild strain at 490 nm. It was also apparent that there was no difference between the 3 age groups of the F-130 generation.

Fig. 4 demonstrates the spectral sensitivity of the three strains at the most sensitive age (22 days).

Comparison of the spectral regions to which olive flies are most sensitive shows a relatively large sensitivity «peak» for the 10- and 22-day-old wild olive flies (485–490–500 nm) and smaller peaks for the F-20 and F-130 generations (490–500 and 490 nm). The F-130 generation flies, especially, produced an extremely pointed sensitivity peak at 490 nm wavelength.

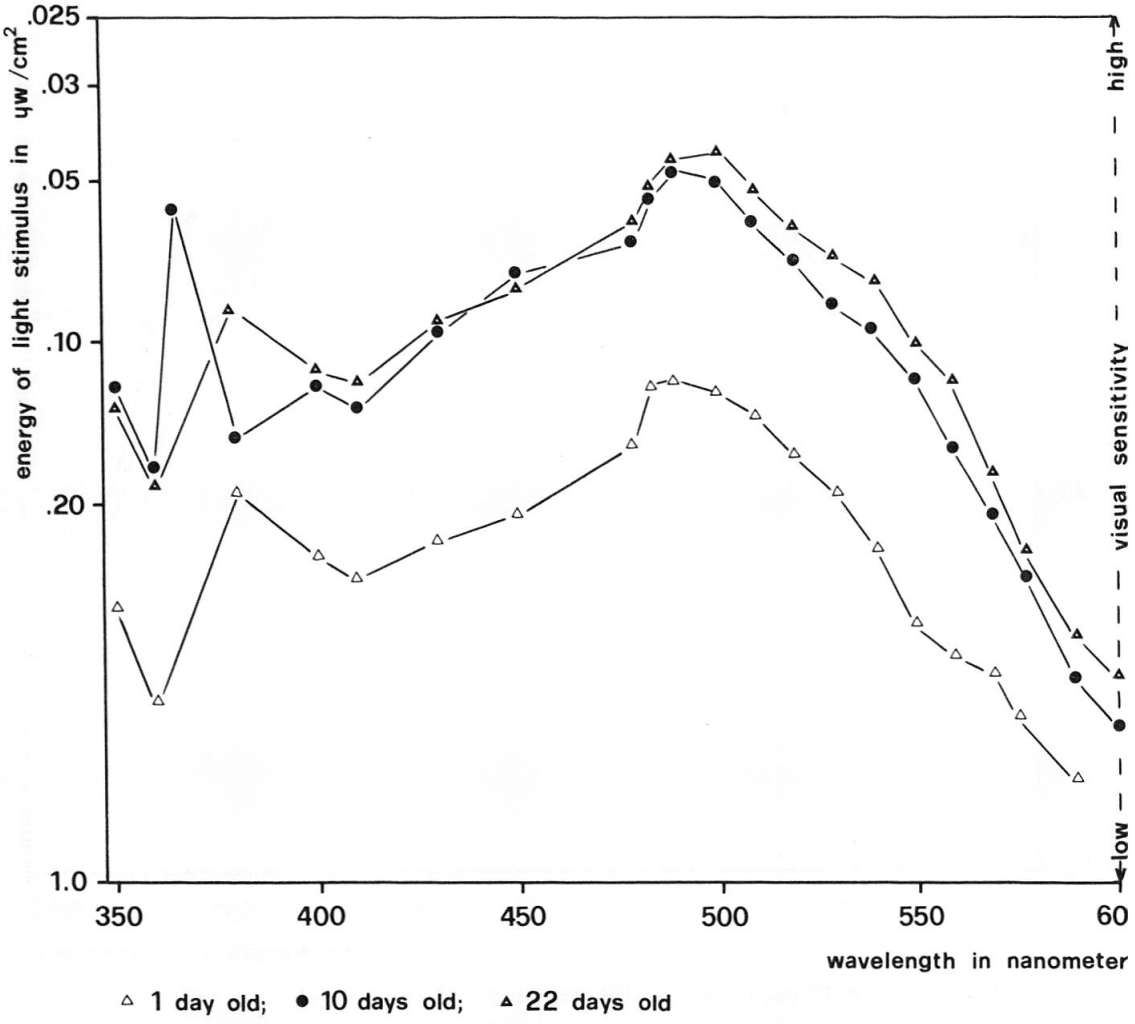

Fig. 2: Spectral sensitivity of *Dacus oleae,* F-20

DISCUSSION

Decrease in the spectral sensitivity of mass-reared fruit flies is not a newly discovered phenomenon. Reduction in sensitivity often becomes more evident with increasing numbers of generations reared on artificial diets under laboratory conditions. Spectral sensitivity is influenced not only by the genetic stock of the mass-produced insects, but also by changes in dietary components from generation to generation (AGEE & CHAMBERS, 1980). In the olive fruit fly there is evidence that change in eye coloration during colonization could be due to the larval diet. PROKOPY *et al.* (1975) observed that when larvae of wild flies were reared for 1 generation on artificial diet, the eye coloration at the very beginning of the F-1 adult stage was different from that of wild flies. When larvae of wild flies were reared for 1 generation on olives, however, the eye coloration of the F-1 adults was not different from that of wild flies. It could be that the observed tendency of reduced spectral sensitivity of 1-day-old adults in the present study is related to a difference in eye pigmentation. However, in the F-130 flies it appears that this change in eye color at the beginning of adult life is not very important.

The present data suggest that genetic selection may contribute to changes in visual sensitivity during colonization. Although we used flies which originated from different localities of Greece, this probably does not affect our conclusions as in recent studies it has been found that flies from different geographical areas do not differ much genetically (TSAKAS & ZOUROS, 1980).

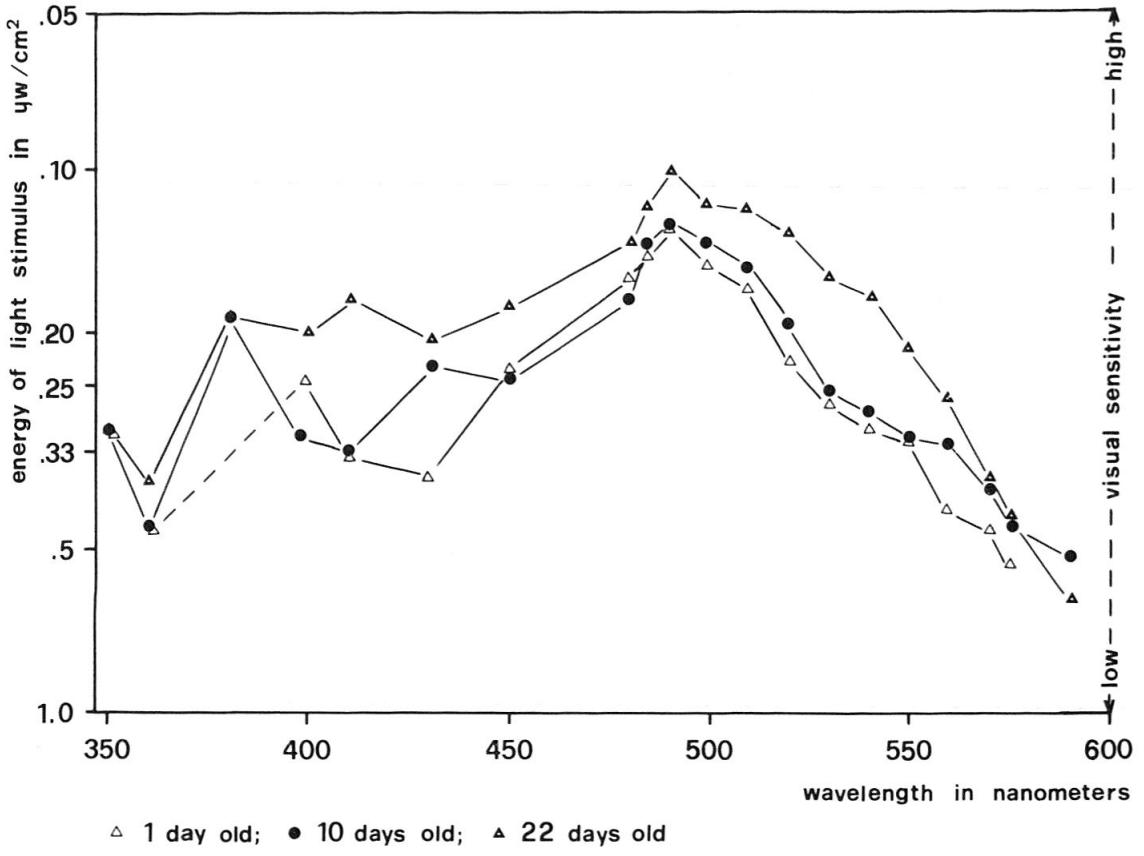

Fig. 3: Spectral sensitivity of *Dacus oleae*, F-130

The measurement of the spectral sensitivity of olive flies is only one possible component of a quality monitoring program for fruit flies (BOLLER & CHAMBERS, 1977). Results from REMUND *et al.* (1977) and ECONOMOPOULOS *et al.* (1978) demonstrated that flight ability was poorer for olive flies reared on artificial diet than for wild flies or ones reared on olives. A comparison of the wild, the F-20 and the F-130 olive flies in a startle test (BOLLER *et. al.,* 1981) showed an extremely reduced startle activity index for laboratory-reared flies compared with wild ones. Several other changes also have been observed in laboratory-rearred *D. oleae* (ECONOMOPOULUS,1980).

The above described changes in the visual sensitivity of laboratory-reared olive flies raise some questions as to the likelihood of success of such flies in the field, as vision is one of the most important sensory inputs for day-flying insects (AGEE & CHAMBERS, 1980).

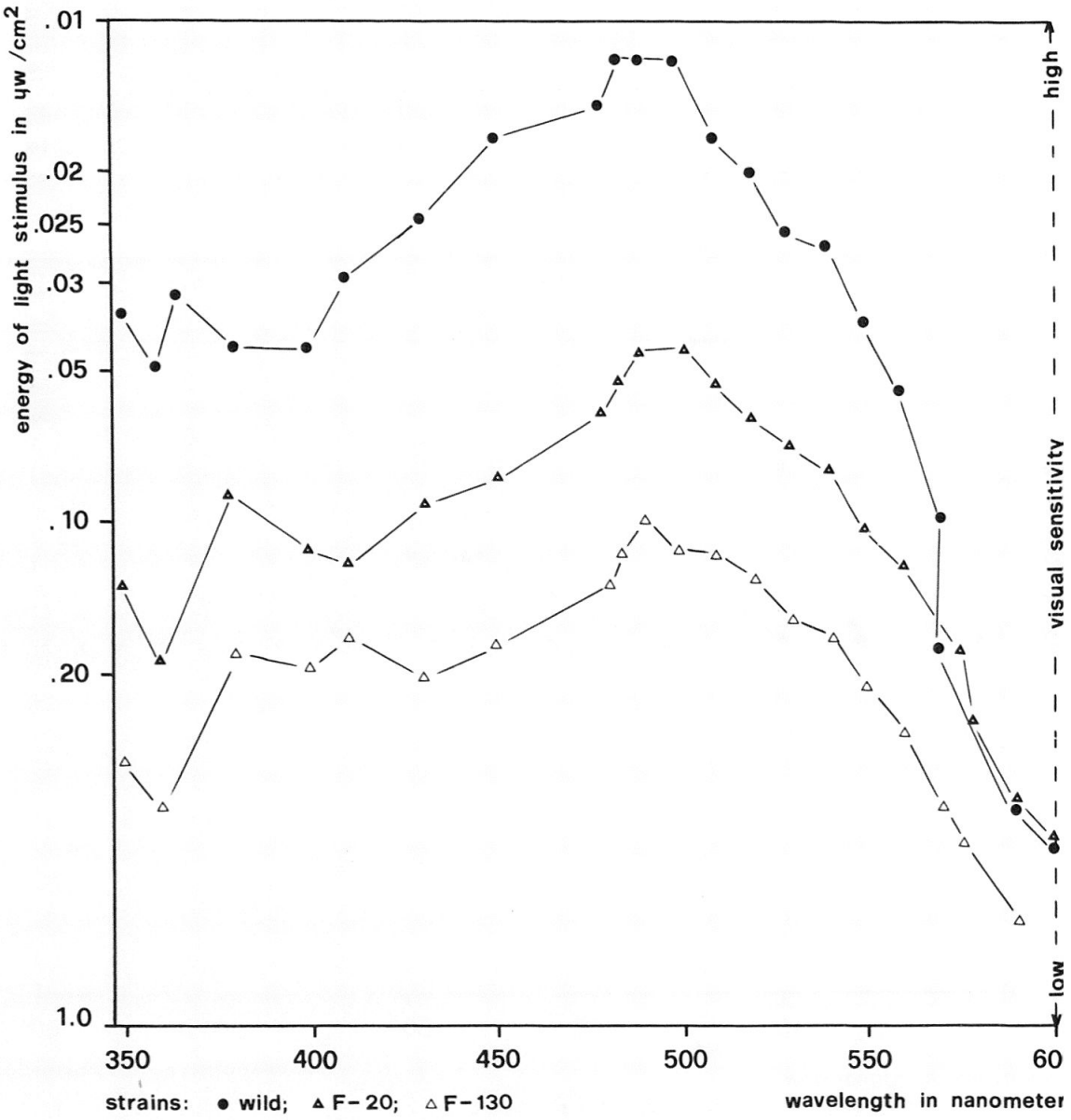

Fig. 4: Spectral sensitivity of *Dacus oleae,* 22 days old

REFERENCES

AGEE, H. R. 1973. *The spectral sensitivity of the compound eyes of field collected adult bullworms and tobacco budworms.* Ann. Entomol. Soc. Am., *66:* 613-615.

AGEE, H. R. 1977. *Instrumentation and techniques for measuring the quality of insect vision with the electroretinogram.* USDA, ARS-S Series *162:* 1-13.

AGEE, H. R. & PARK, M. L. 1975. *Use of the electroretinogram to measure the quality of vision of the fruit fly.* Environ. Letters *10:* 171-176.

AGEE, H. R. & CHAMBERS, D. L. 1980. *Fruit fly quality monitoring.* Fruit fly problems: 7-15.

BOLLER, E. F. & CHAMBERS, D. L. 1977. *Quality control.* An idea book for fruit fly workers. Bull. SROP *77/5*: 150-151.

BOLLER, E. F., KATSOYANNOS, B. I., REMUND, U. & CHAMBERS, D. L. 1981. *Measuring, monitoring and improving the quality of mass-reared Mediterranean fruit flies, Ceratitis capitata Wied. 1. The RAPID Quality Control System for early warning.* Z. ang. Ent. *92:* 67-83.

ECONOMOPOULOS, A. P., HANIOTAKIS, G. E., MATHIOUDIS, J., MISSIS, N. & KINIGAKIS, P. 1978. *Long-distance flight of wild and artificially-reared Dacus oleae (Gmelin) (Diptera, Tephritidae).* Z. ang. Ent. *87:* 101-108.

ECONOMOPOULOS, A. P. 1980. *SIRM against the olive fruit fly: Differences between wild and lab-reared (normal or sterilized) insects.* In «Fruit fly problems», Proceedings of a Symposium of XVI Int. Congress of Entomology, Kyoto, Japan. Aug. 3-9, 1980. pp 17-26.

PROKOPY, R. J. & BOLLER, E. F. 1970. *Artificial egging system for the European cherry fruit fly.* J. econ. Ent. *63:* 1413-1417.

PROKOPY, R. J., ECONOMOPOULOS, A. P. & MC FADDEN, M. W. 1975. *Attraction of wild and laboratory-cultured Dacus oleae flies to small rectangles of different hues, shades and tints.* Ent. exp. appl. *18:* 141-152.

REMUND, U., BOLLER, E. F., ECONOMOPOULOS, A. P. & TSITSIPIS, J. A. 1977. *Flight performance of Dacus oleae reared on olives and artificial diet.* Z. ang. Ent. *82:* 330-339.

TSAKAS, S. C. & ZOUROS, E. 1980. *Genetic differences among natural and laboratory-reared populations of the olive fruit fly Dacus oleae (Diptera: Tephritidae).* Ent. exp. appl. *28:* 268-276.