Drosophila is cherished as a laboratory subject.

Light of 0.01 erg cm^{-2} sec^{-1} approximates the minimum intensity reported as sufficient for photoperiodic determination of season from day length by insects (*11, 12*), a process in which circadian rhythmicity has been implicated (*11, 13*). Seasonal control of development in *Drosophila* has been reported, although little studied (*14*).

Unfortunately, there is nothing magical about moonlight (0.1 lux), for the light intensity required to photosuppress circadian rhythmicity in some other organisms is much greater. For example, the Queensland fruit fly, *Dacus tryoni*, is virtually insensitive to light while pupating (*15*), and 50 lux is required to suppress rhythmicity in sparrows (*16*). Action spectra also vary markedly (*17*).

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3. The blue light (400 to 500 nm) came from a distant incandescent filament, filtered by a Kodak Wratten 47 celluloid to an intensity adjusted to 1/1000 of my standard for 100 erg cm^{-2} sec^{-1} with the same spectral distribution [A. T. Winfree, *J. Theor. Biol.* **28**, 327 (1970)]. This was further attenuated by 0 to 23 thicknesses of Morilla No. 82 tracing paper. Calibration against the standard was carried out with an RCA S-11 blue-green photomultiplier tube in the linear range of voltage and intensity. The final intensity gradient, under a 23-step staircase of tracing paper, was checked by timing exposures to Kodabromide F-3 emulsion; the exposure was attenuated by a factor of 10 per eight steps. Since the pupal photoreceptor is probably in the brain, and pupae are glued in all orientations under unilateral illumination, they probably are subjected to a wide range of intensities under each step.
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Disruption of Gypsy Moth Mating with Microencapsulated Disparlure

Abstract. *Broadcast applications of microencapsulated disparlure at rates of 2.5 to 15.0 grams per hectare are capable of reducing successful mating of wild gypsy moths under field conditions. In test plots, population densities were as high as 32 pairs of pupae in an area of about 700 square meters.*

Disparlure (*1*), the synthetic sex attractant for the gypsy moth, *Porthetria dispar* (L.), is a potentially valuable agent for containing or manipulating field populations of this insect (*2, 3*). The gypsy moth has caused an average of 198,801 ha of forest defoliation annually over the past 10 years in the northeastern United States, with a high of 582,433 ha in 1971 (*4*). Field tests of an aerially applied microencapsulated formulation of disparlure (*5*) against laboratory-reared insects in simulated infestions in August 1972 provided encouraging evidence that mating could be suppressed (*3*). Since significant differences were found in lure release rates and behavioral characteristics of laboratory-reared and wild gypsy moths (*6*), tests with wild insects were required. We report here the results of follow-up field tests in 1973, in which for the first time mating success of wild gypsy moth adults was adequately suppressed or prevented in simulated new infestations.

Test plots, 400 m square (16 ha), located in central Pennsylvania, were sprayed on 30 June to 2 July and 13 to 14 July 1973 (*7*). The formulation contained 5 g of disparlure in a total volume of 1.42 liters; rates of lure other than 5 g/ha were obtained by either halving or tripling the volume of formulation applied per hectare. Gypsy moth pupae collected in the field were placed at designated points in the test plots (*8*) on 2 July (test 1) and 18 July (test 2), and each was examined daily to record adult emergence. The condition and location of each female adult were recorded daily until an egg mass was deposited. Females that had not laid eggs were left in the field, frequently 5 to 6 days after emergence, until they disappeared or the test ended. When eggs were laid, both the egg mass and, if possible, its associated female were recovered; all females were collected at the end of an 11- to 12-day test. Females were dissected as soon as possible, and the bursa copula-

Table 1. Mating success of female *Porthetria dispar* in plots treated with microencapsulated disparlure, Huntingdon County, Pennsylvania, in 1973.

Insect dispersion and density	Treatment (g/ha)	Treated		Control		
		Fertility tests (No.)*	Fertile (%)	Fertility tests (No.)	Fertile (%)	χ^2
Test 1						
Random, 2 pair/ha	5	17	5.9	23	17.4	0.37
Random, 8 pair/ha	5	68	5.9	81	63.0	49.30†
Aggregate, 32 pair/spot	5	94	13.8	82	52.4	28.34†
Test 2						
Random, 8 pair/ha	2.5	103	16.5	99	71.7	60.36†
Aggregate, 16 pair/spot	2.5	67	13.4	71	47.9	17.50†
Aggregate, 16 pair/spot	5	83	16.9	71	47.9	15.75†
Aggregate, 16 pair/spot	15	51	9.8	71	47.9	18.08†
Aggregate, 32 pair/spot	15	130	5.4	141	53.2	71.01†

* Females or egg masses (or both) recovered were tested for fertility; the numbers represent pooled totals from four replications. † $P < .001$.

trix was examined for presence of sperm; egg masses were held at 27° to 28°C for several weeks to permit embryonation, and then examined independently for fertility (*9*).

Fertility data from the four replicates of each treatment were pooled and compared with data from the appropriate check plots by means of χ^2 tests, with Yates's correction factor (Table 1). In seven of the eight treatments, suppression of mating was very highly significant ($P < .001$) in treated plots. In only one treatment, that with the lowest density of randomly placed insects, was mating suppression not significant. In three of the four replicates no females were mated; a single female was mated in the fourth replicate. However, male gypsy moths at this population density have difficulty locating females even in the absence of a treatment (test 1, random, two pairs per hectare—control). In four of eight tests less than 10 percent of the females were fertilized. On the assumption that gypsy moth populations have a net potential increase rate of 10, more than 90 percent of the reproductive potential of each generation must be eliminated to reduce populations (*2*). Our results suggest that disparlure treatments can reduce populations; with the highest application rate we used (15.0 g/ha), adequate suppression was obtained at both densities tested.

Since the adult flight season may last as long as 6 weeks at any location, it is important that disparlure retains its ability to disrupt mating over a period of time. In other tests conducted during this summer, from zero to 14.0 percent of the females, emerging from pupae placed in plots 29 days after the plots had been treated with disparlure, were fertilized during a 12-day test period. Suppression of mating, when compared with mating in control plots, was statistically very highly significant in all except the random, two pairs per hectare, dispersion (in which mating in the absence of treatment was only 17.4 percent) (*10*). This suggests that disparlure in the microencapsulated form is sufficiently persistent to reduce mating for a 6-week period after application.

Our results suggest that 15 g of disparlure per hectare may be capable of disrupting mating in incipient populations of the gypsy moth efficiently enough that population increase might be precluded. Improvements in formulation could well reduce the amount of lure required. The effective longevity of the lure against higher population densities, as well as the ability of disparlure to disrupt mating in residual populations after insecticide or pathogen treatments, or after population reduction through natural causes, remains to be determined. Ultimately, disparlure should play an important role in an integrated gypsy moth pest management program, and may aid in spot eradication and in the establishment of a barrier to further spread or reduction of the area of general infestation (or both) as has been proposed (*2, 3*).

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References and Notes

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5. The disparlure was purchased from Chemical Samples Co., Columbus, Ohio (1972), and Storey Chemical Corp., Farchan Div., Willoughby, Ohio (1973). The formulation was a slurry consisting of 17.6 percent plastic-coated, gelatin-based microcapsules (about 80 percent, 100 to 250 μm in diameter) containing a 2.2 percent solution of disparlure in xylene; 2 percent UCAR latex 680 (Union Carbide Corp., New York); 29 percent of a 1 percent aqueous solution of Minidrift (Soilserve Inc., Salinas, Calif.) plus 1.7 percent of 1 percent aqueous potassium hydroxide; and 49.7 percent water. The microcapsules were provided as a 27 percent aqueous slurry by National Cash Register Co., Dayton, Ohio.
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7. The disparlure formulation was applied from a Piper Pawnee aircraft, with No. 8010 tips on the spray boom nozzles, by J. Henderson, U.S. Department of Agriculture Methods Development Branch, Beltsville, Md.
8. Individual pupae were placed in small burlap pouches stapled to trees at breast height. A "random" dispersion consisted of randomly selected points at intervals along 8 or 16 equally spaced parallel lines traversing each plot, with enough points to provide for an average of two or eight pupae of each sex per hectare throughout the 16-ha plot. "Aggregate" dispersion consisted of 16 or 32 pupae of each sex placed individually in burlap pouches stapled to individual trees within each of four areas 30 m in diameter, which were equidistant from the edges of the plot and from each other. There were four simultaneous replications of each treatment and its appropriate control.
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Infant Color Perception

Abstract. *Human infants 4 to 6 months of age devoted more visual fixation to checkerboards composed of two Munsell hues equated for brightness and saturation than to unpatterned targets of either hue. Strength of pattern preference was positively related to degree of hue difference in the checkerboards.*

Little has been known about the infant's ability to discriminate among hues (*1*). One difficulty has been the lack of sensitive measures of infant discriminative ability, and a second has been the problem of providing adequate controls for variations in brightness which may accompany differences in hue. The most widely used measure of infant visual discrimination is the "visual preference test" (*2*), in which it is assumed that if the infant consistently gazes at certain stimuli more often than at others he must be able to perceive and differentiate among them. Such visual "preferences" have been found for a variety of stimulus comparisons, which attests to the usefulness of the procedure (*3*). One difficulty with the test is that lack of differential fixation may imply either lack of discrimination or the equal attention value of stimuli which are actually discriminable. For example, in studies where differently colored targets were paired and visual preferences were measured, no defined preferences were found (*4*). It may be that the infants were unable to make such differentiations or that their capacity was obscured because certain hues elicit as much attention as others.

One solution to the problem of equal visual fixation among a set of