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EMERGENCE OF ADULT HESSIAN FLIES (DIPTERA: CECIDOMYIIDAE) FROM OVERWINTERED PUPARIA[1]

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The Hessian fly, *Mayetiola destructor* (Say), is a pest of wheat and more rarely barley and rye. The fly usually has two generations per year in Michigan, one in the spring and the other in the fall. The summer and winter are spent as small, hard, black puparia (called "flax seeds") in the culms of the host small grains and grasses. Farmers very early found that fly damage could be avoided by planting their winter grains "late" in the season. Studies made early in this century found that the earliest date for planting to avoid the fly (the "fly-free dates") could be predicted and these dates have become an accepted practice.

The application of soil systemic insecticides offers an alternative method to control the fly. Gessford (1961) studied the emergence of the adults from the overwintered puparia as part of an investigation of the use of the systemics. He counted the number of adults that emerged each day from caged, infested wheat at East Lansing, Michigan, during the early season of 1960. He found that the adults emerged from 28 April to 22 May with a sharp drop in emergence from 7–13 May (Fig. 1). The emergence dropped with cold weather; the mean daily temperature during this period was 41 ± 1.6°F as compared to 60 ± 5.4°F and 59 ± 3.6°F for the six-day periods immediately preceding and following it, respectively. The weather data in this paper are from the United States Department of Commerce (1960); F° are used in this paper as all U.S. weather records are in F°.

The data on Hessian fly emergence were re-examined by the author and his colleagues during 1973–74 when a sharp increase in price encouraged early planting of wheat by many growers. The use of degree-days (DD) with a base temperature of 40°F (DD_{40}; the accumulated difference between daily mean temperature less 40°F) was determined empirically, but lower bases were not tested as they were not deemed reasonable at the time. No outbreak of Hessian fly occurred in 1974 in spite of the early planting of the wheat.

The Hessian fly infestation was the highest in years in 1982, and sowing of winter wheat into maturing soybean fields, at times before the fly-free date, came into practice. The emergence data were examined once again as an aid in timing possible applications of systemic insecticide to control this pest. Foster and Taylor (1975) have established a base temperature of 1.6°C (ca. 35°F) for the overwintered puparia of the Hessian fly. Accumulated DD_{35} starting at 1 January 1960 were calculated, using the sine wave correction of Baskerville and Emin (1969) when minimum daily temperatures were less than the base temperature, and substituted for their corresponding dates. The cumulative number of adults emerged were transformed to their corresponding logistic (or growth curve) values (Ruppel and Dimoff 1978) and a regression made of the logistic values on accumulated DD_{35}. Estimates of the mean and 95% fiducial limits of the 10, 50, and 90% points of cumulative emergence were made from this regression (Fig. 2).

The coefficient of determination was very high ($r^2 = 0.984$; $F = 1274^{**}$). The high coefficient was expected as both cumulative number of adults and accumulated DD are time related, but with DD incorporating temperature as well as time. The regression equation was $Y = 10.0831 - 0.007263X$. The estimated 10, 50, and 90% points (and their 95% limits) of cumulative emergence were 569 (560–577), 700 (693–707), and 831 (819–843) DD_{35}, respectively (Fig. 2). Lacking information on the phenology of the eggs

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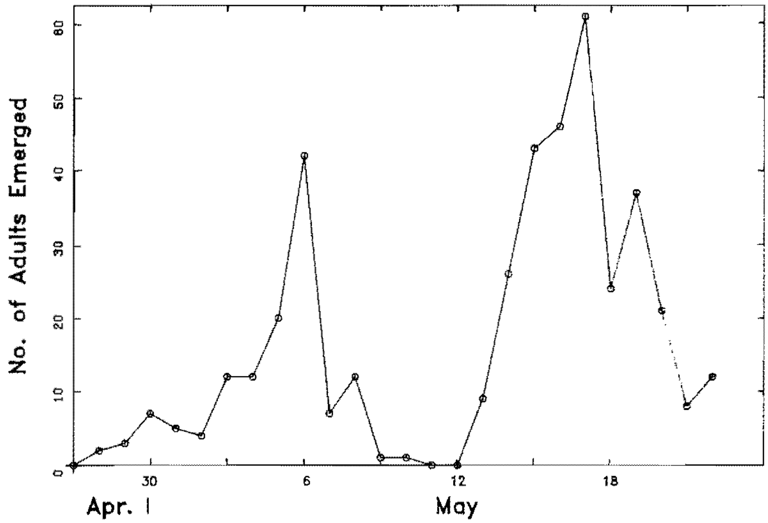

Fig. 1. Number of Hessian fly adults emerged each day in 1960 (data from Gessford 1961).

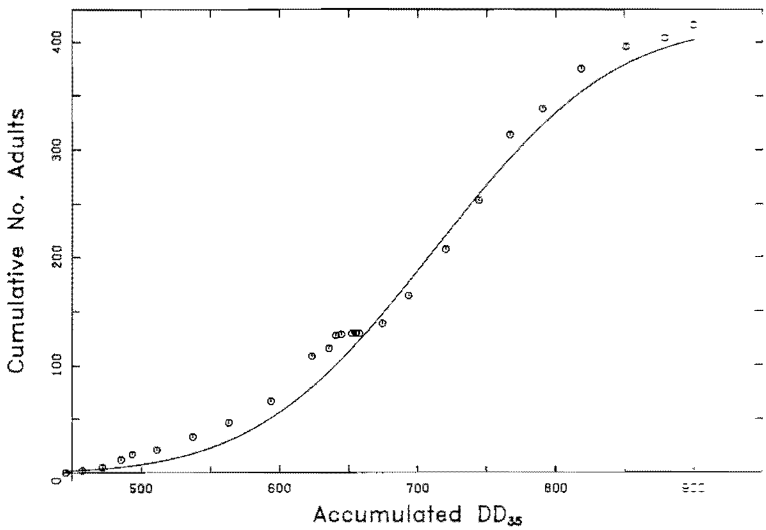

Fig. 2. Cumulative number of Hessian fly adults emerged on DD_{35} during 1960: inversely transformed from the regression equation.

and larvae, an application of a systemic insecticide near the 90% point of adult emergence would reasonably be expected to be well timed for control of the Hessian fly.

The data are from one season only and for a single part of the insect's life cycle. The conclusion is, therefore, very tentative pending further studies. The data are the best illustration that the author knows of the value of using DD in place of dates for insect phenology. Unresolved was the question of when the accumulation of DD should be started. The first of the year was used in this study. April 1 is used as the initial date for some studies and a biological index (such as the date that the first insect is found) can also be used. There were 63.5 DD_{35} on 31 March and 445.5 DD_{35} on 27 April (the day before the first adults were found). These values can be subtracted from the estimated points of emergence if these other dates of initiation of DD are used.

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