THE ROLE OF PHENOTYPE STRUCTURE IN THE POPULATION DYNAMICS OF GYPSY MOTH IN THE LOWER DNIEPER REGION

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INTRODUCTION

One of the characteristic features of the gypsy moth population in the Lower Dnieper area is its variable larval coloring. Phenotype frequency has been recorded over the years in separate micropopulations at different density levels. The data show the population to consist mainly of gray larvae in all life stages, and their abundance varying from 85 to 99.6 percent. Larvae with a black stripe along the back (black type) range from 0.4 to 15 percent of the population. Depending on the phase of population gradation, the phenotype concentrations in a population can vary. At high and low density levels, black stripe larvae are very rare and make up only 0.4 to 1 percent of the population, while at the onset of population growth, their relative quantity rises up to 15 percent.

Thus at the commencement of population growth, when individuals are typically the most viable and fecund, relatively large growth is recorded for the black phenotypes. Such a dynamic ratio of phenotypes in a population supports Dobrzhansky's (1970) assertion that genotype value is inversely proportional to its abundance in a population.

Hence the question arises of adaptive selective value of black stripe genotype. The data of Kolybin and Zelinskaya (1969) and Kolybin (1976) as well as our own show that these black types from the areas of different population density differ according to a number of ecological and physiological indices. In particular, their higher fecundity, egg weight, and survival rate promotes fast population growth.

GENETIC BASES OF LARVAL COLORING

We tested the genetic bases of these differences between morphs by crossing different phenotype specimens in several generations to obtain data on inheritance patterns of larvae coloration and other biological characteristics of broods. The results show that in crossings of gray females and black males, or black females and gray males, yield two types of larvae--gray and black striped specimens in a 1:1 ratio. On the other hand, in crossings of black females and black males also yield two types of larvae --gray and black striped, but in a 1:3 ratio. Crossings of gray females and gray males does not yield only gray larvae. The test showed larvae coloring to be simply inherited: gray phenotype larvae being recessive homozygotes and the black phenotype being determined by the dominant "black" gene.

Analysis of the phenotype ratios in a population and its changes depending on level of population density suggests that in the gypsy moth population we investigated, balanced polymorphism

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occurs. Essentially, it functions to maintain the most favorable ratio of homo- and heterozygotes in the given habitats. It is an adaptive reaction of a population to its environmental conditions evidenced in phenotype structure. I should note that a balanced phenotype ratio, inclined toward a predominance of gray larvae (homozygotes by coloring), is maintained due to the higher viability of homozygotes in certain sets of ecological conditions. Deviations in phenotype ratio occur under conditions deviating from the optimal ones.

ATTRIBUTES OF PROGENY FROM DIFFERENT CROSSES

Analysis of biological attributes of a phenotype crossing over a number of generations showed that in crossings of two gray types, fecundity of the next generation decreases for each, and the average weight of an egg increases in a second generation and decreases in the next ones. When we compared egg clusters obtained in crossing of gray female homozygotes with black male heterozygotes, the fecundity of the progeny turned out to be about two times higher than that of a pairing of heterozygotes ($P = 0.01$), but close to the fecundity index of a pairing of two homozygotes ($P < 0.5$). The fecundity index varies depending on the combination of parental pairs by phenotype feature, while average egg weight index has a different mode of variability. In all variant crossings of heterozygote females average egg weight in the progeny was more than two times higher than that of the homozygotes' progeny ($P > 0.001$).

Of considerable significance is the fact that even in crossings of brothers and sisters, the fecundity indices and egg weight values correlate with phenotypes of the parents in the crossing.

Comparison of the fecundity indices in all progeny of phenotype crossings--a maximum of 544 eggs and a minimum of 115 eggs--showed that the substantial variability of this index depended on parental phenotypes. The coefficient of variation in fecundity is very high, amounting to 61.4 percent. On the other hand, that of the average egg weight is only 13.29 percent.

Data on progeny variability from different parental crossing are of special interest. Beginning with the third generation the specimens of gray coloring turned out to be the most viable. The viability of gray and black specimens in the laboratory experiment was compared with the phenotypes ratio at different stages of population dynamics in nature. These data showed population heterogeneity to increase owing to a greater probability of sexual encounter between different phenotypes. This may lead to increase in both viability and fecundity and, consequently, to greater population density.

In subsequent generations, when population density increases, the probability of sexual encounter between hetero- or homozygotes decreases owing to the greater frequency of homozygotes. However, the achieved potential for viability increases owing to phenotype hybridization and promotes both population growth and outbreak. Population abundance decreases with the overcoming of high heterogeneity.

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