Kidwell, M.G. and J.B. Novy. Brown University, Providence, Rhode Island USNA. The distribution of hybrid dysgenesis determinants in North American populations of **D.melanogaster.**

A collection of more than 200 isofemale lines from 21 locations in N. America was made in order to test their potential for various hybrid dysgenic traits. The majority of isofemale lines were established from natural population collections made during the 1977-79 period and tested shortly thereafter. Several additional lines collected before and after this period were included in some of the analyses. The number of isofemale lines tested per location varied from five to twenty. For the P-M system of hybrid dysgenesis, the traits tested were gonadal (GD) sterility, male recombination, and transmission ratio distortion. SF sterility was the only I-R system trait tested. Both hybrid dysgenesis components were tested with respect to the two sterility traits, using the standard Cross A and A* assays (Kidwell 1979). Lines were tested for male recombination and transmission ratio distortion in the second and third chromosomes by crossing with females from the multiple marked stock al b sp; ve st ca. F_1 males were then individually backcrossed to females of the multiple marked stock.

Table 1 presents means and standard errors for male recombination (Cross A) and GD sterility and SF sterility (Cross A and A*) for all locations sampled during the 1977-79 period. In Figure 1 the GD sterility values for Cross A and Cross A* are plotted for those locations from which at least ten isofemale lines were tested. It is seen that, with the exception of the Niagara, Ontario 1975 collection, all locations show rather similar distributions, indicating strong P cytotype and polymorphism for the P/Q types. The exceptional line from Niagara showed a pattern indicating a Q/M' polymorphism which is very common in many European populations (Anxolabéhère et al. 1984).

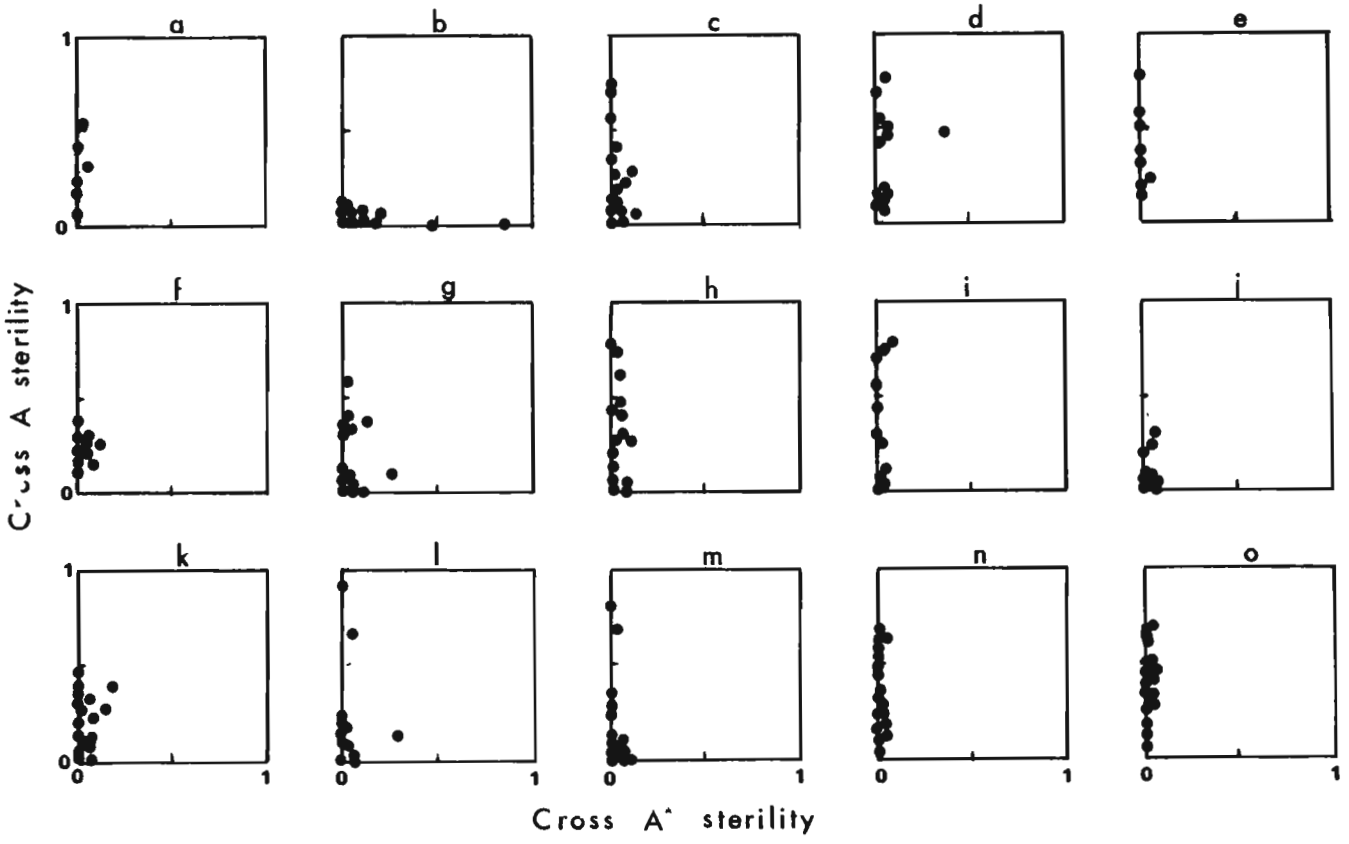

Figure 1. Distributions of GD sterility frequencies in isofemale lines collected at 15 N. American locations during the period 1971-82. **a.** Coolspring, Maryland 1971; **b.** Niagara, Ontario 1975; **c.** Amherst, Massachusetts 1977; **d.** Athens, Georgia 1977-78; **e.** Des Moines, Iowa 1977; **f.** Lubbock, Texas 1977; **g.** Madison, Wisconsin 1978; **h.** Raleigh, North Carolina 1977; **i.** Pequot Lakes, Minnesota 1977; **j.** Portland, Oregon 1979; **k.** Sonoma Valley, California 1979; **l.** St. Catherines, Ontario 1977; **m.** St. Paul, Minnesota 1979; **n.** El Rio, California 1982; **o.** Miami, Florida 1977-78.

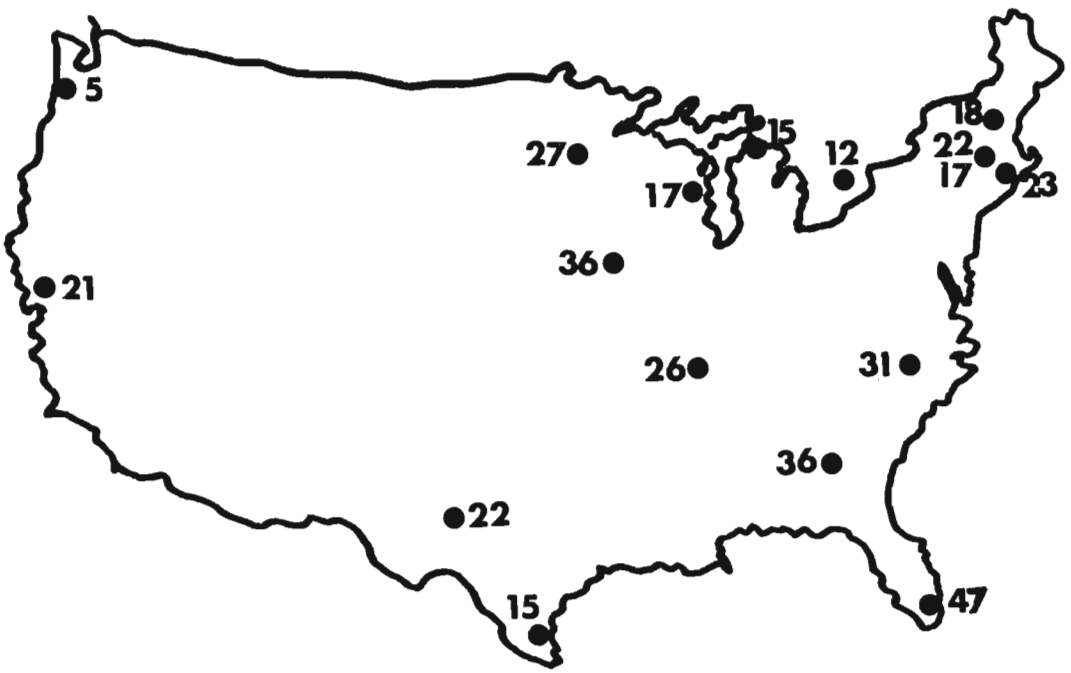

Figure 2. Geographical variation in P factor activity in N. America. The numbers are mean frequencies of GD sterility (Cross A) for isofemale lines collected at 17 locations during the 1977-79 period.

Table 1. Mean values and standard errors of male recombination, GD and SF sterilities in isofemale lines from those locations sampled during the period 1977-79.

Location	Year	MR %*	GD %	SF %
Amherst, MA	1978	2.2 ± 0.32	21.6 ± 5.60	61.8 ± 5.40
Athens, GA	1977	4.3 ± 0.73	36.4 ± 6.67	44.9 ± 6.22
Bowling Green, KY	1978	2.3 ± 0.60	26.4 ±10.46	49.1 ± 5.11
DesMoines, IA	1977	6.2 ± 1.49	35.6 ± 7.00	43.9 ± 8.43
Houston, TX	1979	2.6 ± 0.75	14.6 ± 7.57	60.3 ± 12.84
Lake Charlevoix, MI	1977	3.6 ± 0.55	15.4 ± 5.96	68.5 ± 13.22
Lubbock, TX	1977	3.0 ± 0.69	21.8 ± 2.53	46.9 ± 7.97
Madison, WI	1978	N.D.	16.9 ± 4.74	46.9 ± 4.80
Markert, MA	1977	2.1 ± 0.38	16.1 ± 3.79	38.6 ± 4.84
Miami, FL	1977	6.5 ± 3.20	46.8 ± 6.85	39.2 ± 13.09
Moultonborough, NH	1977	2.5 ± 0.56	18.1 ± 5.18	46.4 ± 6.93
Pequot Lake, MN	1977	2.3 ± 0.35	27.7 ± 7.56	46.8 ± 6.50
Portland, OR	1979	1.7 ± 0.32	5.0 ± 3.66	52.3 ± 10.68
Raleigh, NC	1977	4.4 ± 1.55	30.5 ± 5.93	43.3 ± 5.49
Sonoma, CA	1979	N.D.	21.5 ± 3.40	47.1 ± 5.55
St. Catherines, Ont.	1977	1.56± 0.33	11.9 ± 4.07	47.8 ± 6.72
Weymouth, RI	1977	1.99 ± 0.23	22.7 ± 6.76	61.7 ± 5.03

* % male recombination in chromosome 2 and 3 combined, uncorrected for clustering.

As shown in Table 1 and illustrated in Figure 2, there was some variability in mean values of GD sterility (Cross A) from location to location. The standard errors are fairly large and the sampling inadequate to enable any clear geographical pattern to be detected. However, it is noted that there is a tendency for high P factor activity to be found most frequently in southeast locations and low activity to be found in northwest locations. D. D. Home (pers. comm.) has independently collected data supporting the observation of low P activity in the northwest. A large majority of 66 lines collected in the Fraser Valley region of British Columbia proved to have Q strain characteristics.

The data for all four measured traits from the 1977-79 collections were used to compute correlation coefficients (Kendal's Tau). The results are summarized in Table 2. There was a highly significant positive correlation between GD sterility (Cross A) and male recombination (chromosomes 2 + 3) and a highly significant negative correlation between GD sterility and k_3 (a measure of transmission distortion in the third chromosome). All other correlations were not significant at the 95% level of probability.

Figures 3 and 4 present histograms for the overall distribution of GD sterility and male recombination, respectively, when all isofemale lines from different locations were pooled together. The difference in form of the two distributions might be explained by the greater sensitivity of male recombination, over that of GD sterility, to low levels of transposase enzyme. One striking implication of these distributions is that commonly used strong P strains, like Harwich and π_2, are very atypical of P strains in general. The distributions also provide further justification for treating Q strains as a weak subset of P strains.

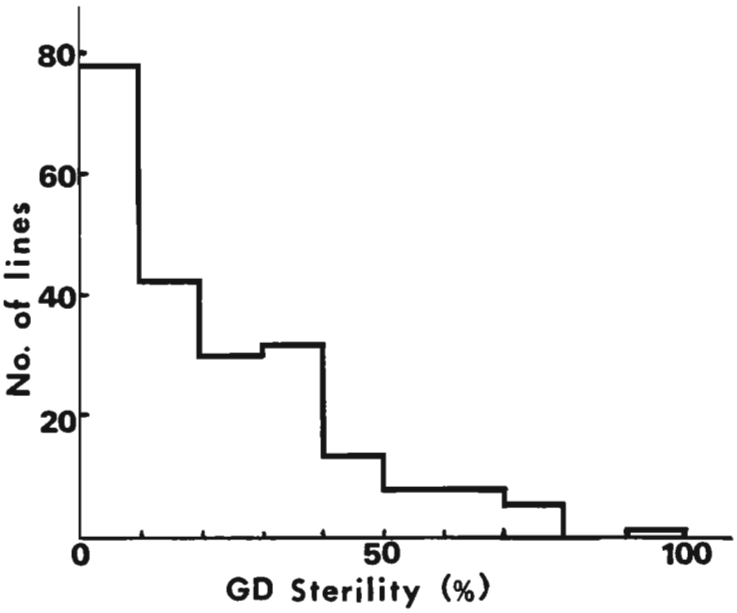

Figure 3. The pooled distribution of GD sterility frequencies (Cross A) for all those N. American isofemale lines tested during the period 1977-79.

Table 2. Rank sum correlation coefficients (Kendall's tau), and their respective probabilities (P) between location means for selected pair of dysgenic traits (1977-79 collections).

		Dysgenic traits				
		P-M				I-R
		GD	MR	k_2	k_3	SF
GD	τ	--	0.484	-0.126	-0.385	-0.238
	P	--	0.001**	0.218	0.009**	0.066
MR	τ	--	--	-0.053	-0.195	-0.123
	P	--	--	0.373	0.115	0.231

GD = gonadal sterility; MR = male recombination in chrom. 2 and 3; k_2 = transmission ratio distortion in chrom. 2; k_3 = transmission ratio distortion in chrom. 3; SF = SF sterility.

Figure 5 shows the GD sterility results of samples of isofemale lines collected every year at a single location, Weymouth Street, Providence, R.I., over almost a decade. The distributions of P factor activity and cytotype differ very little from year to year and are typical of those seen for other N. American locations (Figure 5). Although the mean GD sterility frequencies (Figure 6) vary from year to year, there is no clear temporal trend over the tested period.

SF sterility was the only I-R system trait tested. Not one of the more than 200 isofemale lines examined showed any clear indication of being other than inducer (I). However, the degree of inducer activity was variable. This is illustrated in Table 1 and Figure 7 which shows the overall distribution of Cross A SF sterility values for all isofemale lines tested.

The most important conclusion from this study is that there is very little qualitative variation from one location to another in N. American populations with respect to either P-M or I-R system properties. For the P-M system this represents a significant difference in distribution pattern from other continents, such as Europe, Asia and Australia, where extensive qualitative variability has been observed (Anxolabéhère et al. 1984; I. Boussy, pers. comm.).

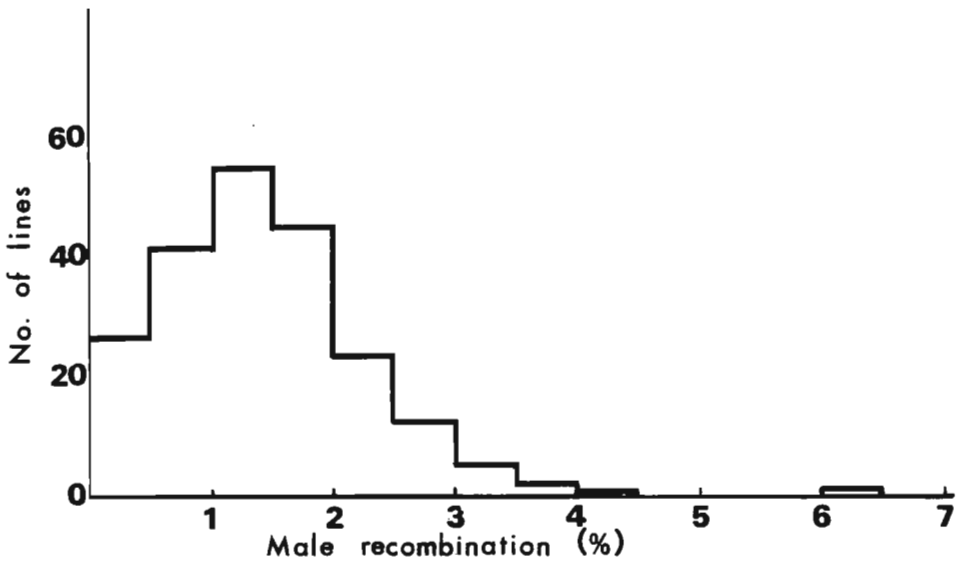

Figure 4. The pooled distribution of male recombination frequencies (Cross A) for all those N. American isofemale lines tested during the period 1977-79.

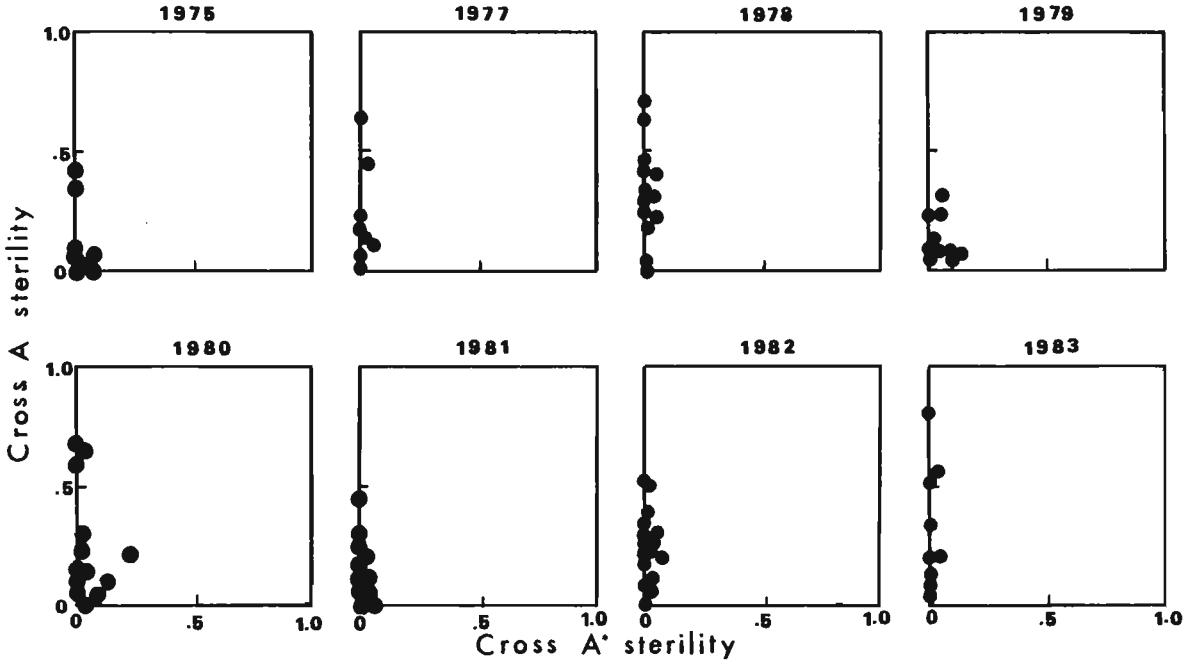

Figure 5. Distributions of GD sterility frequencies in isofemale lines collected from the same location, Weymouth St., Providence, Rhode Island, in different years during the 1975-1983 period.

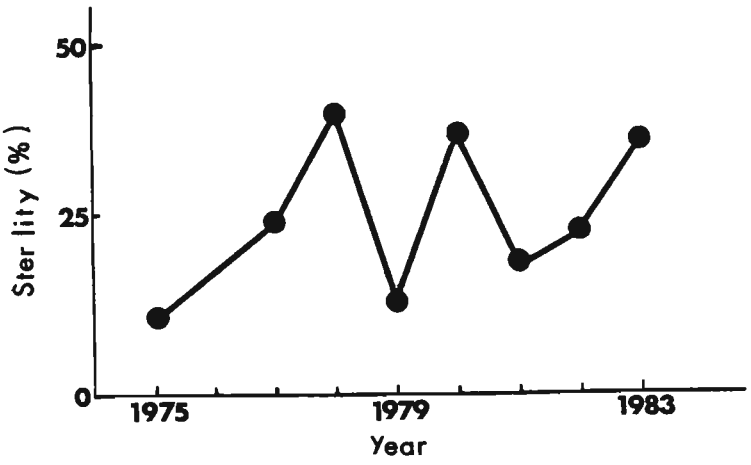

Figure 6. Mean frequencies of GD sterilities (Cross A) in isofemale lines collected from the Weymouth population in the period 1975-1983.

Acknowledgements: The authors sincerely thank the following for collecting and sending flies: P.T. Ives, M.T. Clegg, D. Cavener, W. Hollander, P. Fuerst, B. Rathcke, A. Allen, W.R. Engels, M.L. Tracey, Jr., R. Schaefer, H. Band, C. Laurie-Ahlberg, M. Green. This work was supported in part by NSF grant DEB 76-82630 and PHS grant GM-25399.

References: Anxolabéhère, D., K. Hu, D. Nouaud, G. Periquet & S. Ronsseray 1984, Génét. Sél. Evol. 16:15-26; Kidwell, M.G. 1979, Genet. Res. 33:205-217.

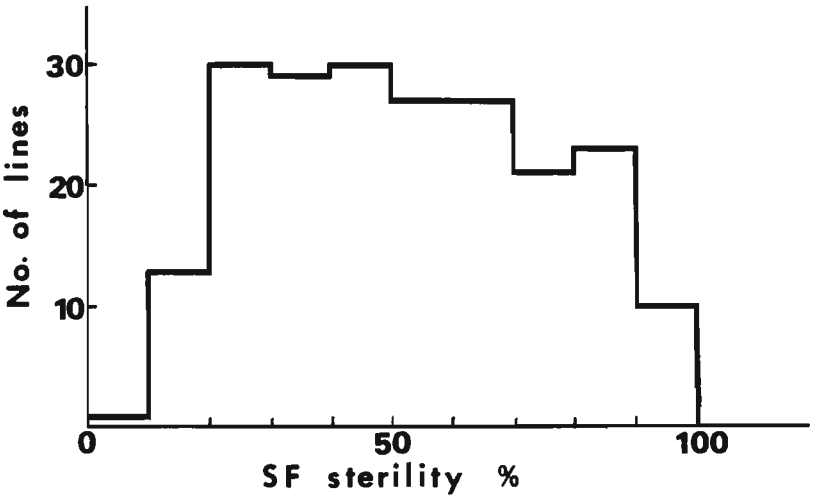

Figure 7. The pooled distribution of SF sterility frequencies (Cross A) for all those N. American isofemale lines tested during the period 1977-79.