Marker-assisted breeding technology for the eastern oyster - R/6840-0005

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Research Summary

The eastern oyster (*Crassostrea virginica* Gmelin) is one of the most important marine resources in the US. During the past 50+ years, however, over-fishing, habitat destruction and diseases have decimated eastern oyster populations in much of the mid-Atlantic region including Delaware Bay. The prolonged decline in the oyster fishery has brought social and economic hardship to coastal regions. Oyster aquaculture has the potential to ease the economical pain of coastal communities and to satisfy the demand for high quality oysters without adding additional fishing pressure to wild stocks. Many states and federal agencies have been actively promoting oyster aquaculture and restoration.

Experimental oyster spat

Oyster aquaculture in New Jersey and much of the Northeastern region faces many challenges. The lack of domesticated stocks with desirable traits for aquaculture is a major impediment. The eastern oyster faces three major diseases in the northeastern region: MSX (caused by the parasite *Haplosporidium nelsoni*), Dermo (caused by the parasite *Perkinsus marinus*) and JOD (juvenile oyster disease, caused by the bacterium *Roseovarius crassostreae*). The diseases present a major threat to oyster aquaculture, as each of the three diseases can cause up to 90% mortality in susceptible stocks. Rutgers University has been breeding oysters since the early 1960s. Strains resulting from the Rutgers breeding program have shown strong resistance to MSX. However, the Rutgers strains have only moderate resistance to Dermo, and their growth rate is unremarkable. Further improvement of the Rutgers strains, especially in Dermo-resistance and growth, is urgently needed, and progress depends on the development and application of advanced genetic technologies.

Lab analysis

(Over)

Making crosses in the hatchery

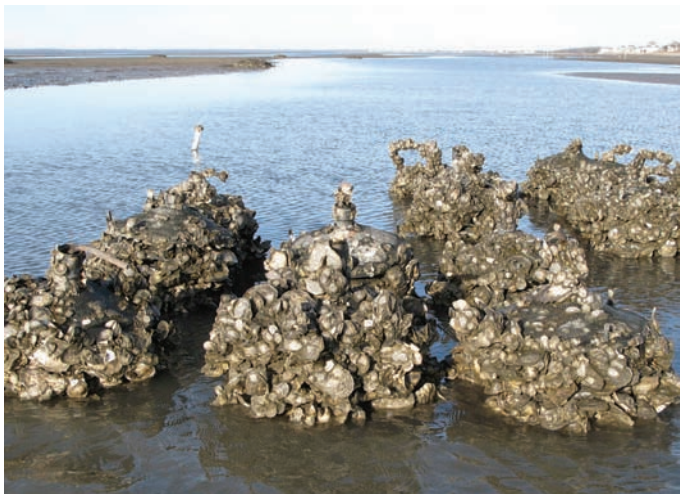
9 x 9 + 81 families			Males								
			NEH			NEF			NEG		
			1	2	3	4	5	6	7	8	9
Females	NEH	1	3x3 NEH x NEH 9 families			3x3 NEH x NEF 9 families			3x3 NEH x NEG 9 families		
		2									
		3									
	NEF	4	3x3 NEF x NEH 9 families			3x3 NEF x NEF 9 families			3x3 NEF x NEG 9 families		
		5									
		6									
	NEG	7	3x3 NEG x NEH 9 families			3x3 NEG x NEF 9 families			3x3 NEG x NEG 9 families		
		8									
		9									

Table 1. The production of 81 families using 9 x 9 factorial cross of three selected lines for testing marker-assisted breeding. The 81 families are pooled and reared in a common garden environment. Parentage will be determined using SSR markers after field evaluation.

At the present time, most oyster breeding programs are based on individual/mass-selection. Mass-selection can lead to rapid inbreeding which hinders long-term gains. Family-based evaluation is clearly more effective for oyster breeding, but it requires the production and maintenance of hundreds of families. Most oyster hatcheries don't have the necessary resources to produce and maintain hundreds of families. The problem can be solved by the use of genetic markers and marker-assisted breeding (MAB). In MAB, many families can be produced and pooled at larval stages. The pooled families are cultured as one group in a common-garden environment. After field evaluation and measurements, genetic markers are used to determine parentage and assign progeny to their families. MAB eliminates the need to maintain hundreds of separate cultures and therefore greatly reduces the cost in space and manpower. By culturing all families in a common-garden environment, MAB provides the most powerful way to estimate genetic breeding values, by removing environmental effects that are otherwise confounded within families.

This NJ Sea Grant Omnibus Research Project will test and develop genetic markers for MAB. We have developed 100+ highly polymorphic microsatellite markers. We have produced and pooled 81 families (Table 1). We will evaluate them in the field and then use a set of genetic markers to separate them. The successful application of MAB may greatly speed up the development of superior oyster stocks for aquaculture production.

Oysters deployed at an oyster farm



Wild oysters