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Field Nursery for Hard Clam Seed

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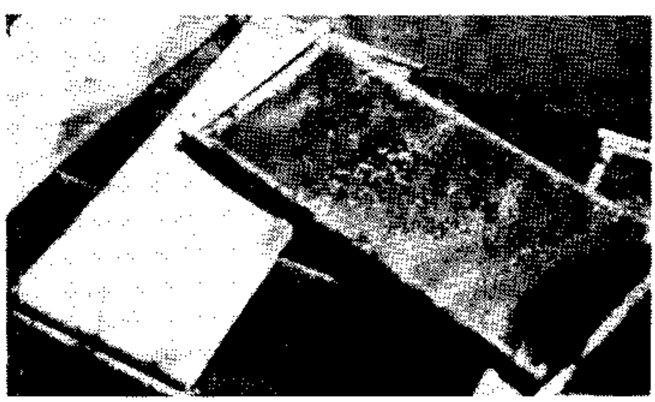
The aquaculture of the northern quahog or hard clam, *Mercenaria mercenaria*, in New Jersey has grown steadily for the past 15 years. There are presently six clam hatchery/nurseries and one land based nursery system in the southern coastal area. Of the six hatcheries, two provide seed for sale and the other four are operated by the shellfish growers for their own use. Aside from the 10 or 15 people involved in these hatcheries, there are about 50 other growers who rely on hatcheries, in or out of the state, for their seed.



Rigid polyethylene nursery bag

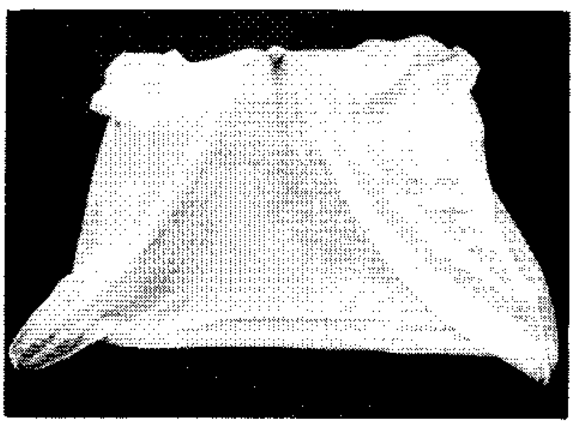
Buying seed is the most expensive part of a planting operation. Seed are typically planted in individual plots which are then covered by plastic predator exclusion screens. The seed costs vary from \$20 to \$30/1000 for 10 to 15 mm seed. Seed can be bottom planted at 8 mm, but the larger the seed upon planting, the better the survival. The cost of planting each plot, depending on the seed cost and prevailing local method, can be from \$350 to over \$800, excluding the predator screen. Plots typically are from 14' x 20' to 14' x 100'. There are two methods used to grow seed to planting size, onshore nurseries where water is pumped to the clams and field nurseries where seed are placed in protective containers.

Several aquaculture suppliers sell products which have been designed for the field nursery phase of clams and oysters, but clam growers have been reluctant to use them. Only a few culturists in the Mid-Atlantic consistently incorporate a field nursery system into their operations, while the practice is common in Florida and parts of New England.

Over the course of four years, experiments were done to determine if growers could economically provide their own plantable seed by using a field nursery. The tests were designed and carried out through the cooperation of three industry members, the Rutgers Haskin Shellfish Research Lab and NJ Sea Grant Marine Advisory Service. Initial funding was provided by the Rutgers Fisheries and Aquaculture Technology Extension Center, but after the initial work, the industry participants wanted to explore the techniques further and funded the work themselves.

Field Trials

The first investigation centered on the density at which nursery bags could be stocked to raise small seed (5mm) to field plantable size of 10 to 15mm. In the first part of the experiment (1992) a clam farmer purchased 200,000 1 - 2 mm clam seed and raised them to planting size in screen boxes made of 5/4" cedar with 670 micron (diagonal) mesh screening and transferred to 1.5 mm mesh bags (ADPI SMB-1) then to 2 mm mesh bags (ADPI SPB-1). Clams were then graded so they held on 5 mm mesh for the next part of the experiment. Graded clams were placed into 3/16" or 4.7 mm, 36"L x 19"W x 2.5"H mesh bags (ADPI OBC-1) for the final growing to field plantable size (10 - 15 mm). Each bag was then placed either on a rack or on the bottom. Seed was stocked at densities of 2000, 3000, 4000, 5000, and 6000 clams per bag (ADPI OBC-1), and five of each density were placed on the bottom and five of each density on a concrete reinforcing bar (rebar) rack. The work was done in Dry Bay, a shallow enbayment adjacent to the Intracoastal Waterway in Atlantic County.



Tented nylon nursery bag

The second experiment, conducted from 1993 to 1995, used 5 - 6mm clam seed stocked at 3000 seed per bag. The plastic mesh bags used were ADPI SPB-1 (2mm 40"L x 18"W rigid polyethylene). Six bags were placed directly on-bottom and six off-bottom on a rack. The bags were sealed on the ends with slit PVC pipe slipped over the bags. Stainless steel hogs rings fixed on the opposing sides of the bag ends prevented the PVC from pulling-off. Another group of six were put out at a similar density (6000 seed per bag) in soft nylon small mesh bags (Fablok, fabric style No. 149 in 3' x 3') tented with an attached 1' section of PVC pipe on the bottom and staked on each corner. Two shellfish growers with significantly different sites participated. One site was a well flushed marsh creek, called Jenny's Creek, situated between two large bays and the other was an open grass bed site in Little Egg Harbor Bay (LEHB). The clams were grown for 50 days at LEHB site and 49 days at Jenny's Creek in 1993. In 1994, clams were grown for 75 days at both sites. In 1995, the soft bags were eliminated, and an on-bottom trial was conducted at the Jenny's Creek site. They were grown for 69 days.

These trials were done for three years to improve the system and carefully evaluate the economics. Each year's work however gave more information about the types of bags used and seed growth, as well as differences between the two areas where the work was done.

Results

The stocking density experiment continued until the clams could be sieved on a 1/4" screen. Those clams reaching a size of approximately 10 mm were planted. The two treatments (on- and off-bottom) proved to be significantly different. There were clear differences indicating that the on-bottom culture was superior to off-bottom for clam seed growth, but there were no effects due to density of clams in the bags.

Another result of the density experiment was that the operator found that the amount of time needed to raise the 1 - 2 mm clams to field plantable size was not only labor intensive since they had to be sieved and moved up to a larger growing container three times, but many did not reach plantable size and had to be overwintered. Mortality was close to 50% overall. The best indicator of industry acceptance was that the bayman involved decided that this method was not feasible for him in terms of time and money savings, and he sold most of the equipment designed for the very small seed.

In the second experiment, a comparison of nursery bags was done by two baymen on their own leases. It was decided in light of the first experiment's results and in cooperation with the baymen, that this trial would use a conservative density of 3000 clams per bag for the field trial. At the end of the first year, the final numbers of each treatment were inadvertently all combined and this made precise comparisons difficult. However the baymen were impressed enough with the trial results to try the experiment again the following year, using their own money to purchase the seed.

During the second experiment in the open bay site, two of the bags on the rack were severely damaged by a propeller. In the creek site, there was severe fouling of the off-bottom bags with sea squirts or tunicates, *Molgula manhattensis*. This caused some mortality, but of more importance to a field operation, they increased labor costs because squirts had to be removed before the clam seed could be planted. In the next year both sites were better marked, eliminating prop damage, and at the creek site, the bags were removed once for air drying to kill the squirts. Crab damage was noticeable in many of the soft nylon bags, thus reducing overall survival.

The average size of the seed removed from the bags in the first year ranged from 8 to almost 11mm with the creek site outperforming the open bay site by 35%, although the ranges were wide.

In 1994, visual estimates of survival in the rigid plastic bags seemed to be very good (above 95% estimate) but **measurements and calculations indicated that visual examination for dead clams is not a reliable means of estimating survival**. Crab and drill mortality was significant in the soft bags (up to 60% estimate) due to holes in the material. There were some abrasion holes in the bags on the rebar racks. Growth was still good with a slight increase over the previous year's rate, making the test interesting enough to try again in 1995.

In the final summer, the seed were planted only at one site on the bottom in the rigid plastic bags. The participants decided that the off-bottom was no better and it required more capital costs for rack construction and there was always the threat of propeller damage. The soft bags were eliminated since the crab damage was more prevalent in them.

Initial seed stocked averaged between 5 and 6 mm in mid-summer. At harvest in late October, the mean size was 13.46 mm, with a range from 11.6 to 14.5 mm, sizes well suited for field planting. Almost none of the seed were below 10 mm.

Economics

The plastic bags (3 year expected life) with stainless steel hog rings, PVC closures, identification tags, rebar stakes, and line cost about $1.68 each per year. Some expendable supplies would be replaced each year but those costs are negligible. Including labor for preparing units, sieving, deploying bags in the field, maintenance and final harvesting and sieving for planting, at $10/hour, adds $5.50 for a yearly fixed cost of $7.18. If funds for buying seed and equipment were in the bank the grower would make interest on it; we add $.26 in lost interest to the equation. Finally, adding the seed cost of $24 for 3000 5mm seed brings the total to $31.44 or about $10.50 per thousand excluding any mortality.

Actual survival and growth were strictly recorded and the data was analyzed to determine whether or not the process was economically feasible. Survival ranged from 37% to 110%, an obvious disparity explained by variations in initial stocking volumes. Average survival was about 76%.

% Survival	Initial Seed Cost ($) per 1000			
	10	12	14	16
80	$14.72	$17.22	$19.72	$22.22
75	$15.55	$18.22	$20.89	$23.55
70	$16.51	$19.36	$22.22	$25.08
65	$17.60	$20.68	$23.76	$26.84
60	$18.89	$22.22	$25.55	$28.89
55	$20.40	$24.04	$27.67	$31.31
50	$22.22	$26.22	$30.22	$34.22

Table 1 shows the cost of 1000 10 mm seed which might be expected at varying survival rates noting original costs of 5-6 mm seed stocked at 3000 per bag, when the costs just mentioned were added in.

Most baymen tend not count their time when working but this is important to the overall economics of the experiment. Those with a knack for calculations can subtract whatever costs they choose to suit their own situation. Growers should be wary of bags with high densities of clams since the loss of a heavily stocked bag during the nursery phase can increase the costs of the other remaining seed. After analyzing the data with the industry partners, it was felt that 4500 seed would be a fair compromise for stocking density. Finally, one should ask, "At what point does the field nursery become a bad financial decision?"

Percent survival break even points have been calculated. If one uses $20 or $25/1000 as the approximate cost of hatchery bought field plantable seed, and compared it with the two initial stocking rates of 3000 and 6000 5mm seed, which could be purchased for a price between $8 and $14/1000, the situation seems satisfactory, although it is still highly dependent on the initial seed cost.

If 3000 seed are placed in each bag, the seed represents 76% of the cost at $8/1000 and 85% at $14/1000. Similar data for planting 6000 seed per bag would yield 87% and 92% of the cost due to the seed. These proportional costs are important because it is essential that a high percentage of clams reach plantable size.

Field plants Cost/1000	3000 Seed+ Poly Bag, etc.		6000 Seed+ Poly Bag, etc.	
	$8.00	**$14.00**	**$8.00**	**$14.00**
$20.00	**52.4%**	**82.4%**	**46.2%**	**76.2%**
$25.00	**41.9%**	**65.9%**	**37.0%**	**61.0%**

Table 2 shows the percent survival required to break even when 3000 or 6000 seed per bag are used in comparison to variable costs for field plantable seed.

CONCLUSIONS

When **all** factors are added in (bag cost and life expectancy, grower's labor, potential loss rate of the bags, percent survival, and greater stocking density than 3000 per bag), the data show that using the field nursery can save on the cost of field plantable seed. There is also the added benefit of being able to plant the seed at the growers leisure instead working with large numbers delivered from a hatchery at one time.

Other conclusions were that the soft nylon bags did not perform well in New Jersey for a field nursery, and racks were not needed. Some form of fouling control should be incorporated into the maintenance schedule. High densities of 6000 did not impede growth, but it might impact overall costs if bags at that density were lost.

The grower should attempt to purchase seed as early as possible to increase the time available for growth. Our initial experiments would have given larger numbers of plantable seed if the growing in the bag nursery was longer. A minimum of 60 days should be considered a minimum for this operation, with water temperatures over 20°C (68°F).

Since the seed cost is the most significant cost associated with the nursery system, it is important to insure proper distribution of the seed in the bag to allow for best growth. Bunching of numbers of seed in the corner of a bag can reduce growth and possibly survival.

Bags required for 1,000,000 seed at 3000 per bag					
Survival	**Surviving**	**Bags per**	**Loss Rate (percent of bags lost)**		
Percent	**per Bag**	**1000000**	**1%**	**2%**	**4%**
80	2400	417	4	8	17
75	2250	444	4	9	18
70	2100	476	5	10	19
65	1950	513	5	10	21
60	1800	556	6	11	22
55	1650	606	6	12	24
50	1500	667	7	13	27

Table 3 shows operating parameters for scaling up field nursery system

Bags required for 1,000,000 seed at 6000 per bag					
Survival	**Surviving**	**Bags per**	**Loss Rate (% of bags lost)**		
Percent	**per Bag**	**1000000**	**1%**	**2%**	**4%**
80	4800	208	2	4	8
75	4500	222	2	4	9
70	4200	238	2	5	10
65	3900	256	3	5	10
60	3600	278	3	6	11
55	3300	303	3	6	12
50	3000	333	3	7	13

Photographs by : Gef Flimlin

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