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Commercial production trial with high POMS tolerant triploid Pacific oysters in approved New South Wales estuaries

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In submitting this report, the researcher has agreed to FRDC publishing this material in its edited form.

Contents

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Executive Summary

This report details a collaborative project undertaken to investigate the opportunity to reinvigorate the triploid Pacific oyster farming industry in NSW estuaries affected by Pacific oyster Mortality Syndrome (POMS). The project was instigated as a result of a visit to the Hawkesbury growing region by Federal Minister, David Littleproud in 2018 (currently Minister for Agriculture, Drought and Emergency Management). The participating organisations were Australian Seafood Industries (ASI), Cameron of Tasmania and Oyster growers in the Hawkesbury and Georges Rivers. The major objective of the project was to explore the potential for incorporating POMS resistance into triploid oysters using new instant induction techniques allowing use of the latest ASI genetics to allow assessment of the performance of highly POMS resistant triploid Pacific oyster spat in these oyster farming locations.

The Hawkesbury and Georges Rivers have been devoid of Pacific oyster farming since the catastrophic POMS outbreak in 2012. Recent advances in the POMS resistance levels in the ASI selective breeding program for Pacific oysters in Tasmania were unable to be taken advantage of due to the regulatory requirement for triploid Pacific oysters in these regions. Current techniques mean that there is a lag in incorporating highly resistant diploid lines into commercially available triploid Pacific oysters. The instant induction methodology allows the most recent ASI diploids to be used to create triploid oysters.

The aim of this project was a proof of concept to investigate if these new techniques were able produce triploid Pacific oyster spat with commercially viable levels of POMS resistance. The supply of triploid spat supported by this project was produced by Cameron of Tasmania hatchery and following biosecurity clearances was deployed to trial sites in the Hawkesbury and Georges Rivers in June 2019. Data and performance of the stock was monitored prior to the summer POMS occurrence window. Mortality data collected during and after POMS events (summer 2019-2020) showed that 50-70% survival was observed after the first event and very low levels of mortality were observed in a second POMS event. Unfortunately the Hawkesbury growing region was subsequently affected by a large flood event which saw very low salinities and subsequent mortality in the triploid Pacific oysters, which compromised this project significantly.

Despite the impacts of the flood event, the project provided useful outcomes for the growers in POMS affected NSW growing regions. The participating growers have indicated Pacific oyster farming would be viable with the observed POMS survival rates. This has been evidenced by growers purchasing spat in the following season. The implications of this are significant in terms of economic activity in these under utilised growing areas. Since the 2012 POMS outbreak there has been very low levels of oyster farming in the Hawkesbury and Georges Rivers. Disease has not only precluded growers from Pacific oyster farming but also Sydney rock oyster growing due to the presence of QX disease. The Hawkesbury in particular has a very large number of oyster leases which are under utilised due to the presence of disease. Significant economic benefit will be created through restocking of these leases to allow a return to commercial production. Prior to POMS the Hawkesbury River was approaching $8 million p.a. oyster sales. It may take some time, but based on the outcomes of this project, it may now be possible that the Hawkesbury and Georges Rivers could again reach these levels of production. This would have significant flow on effects for local economies.

Keywords

Pacific oyster, Triploid, Selective breeding, Pacific oyster Mortality Syndrome

Introduction

The virus Ostreid Herpes Virus type 1 (OHsV-1) causes the disease known as Pacific oyster Mortality Syndrome (POMS) that was diagnosed for the first time in Australia in the Georges River in NSW in 2011 and then in the Hawkesbury River in NSW in 2013 and Tasmania in February 2016. The disease was devastating, particularly to the Hawkesbury River farmers where 98% loss of oyster stock occurred, coupled with inability to access QX resistant Sydney Rock Oysters for the next two seasons. The oyster farmers on the Hawkesbury River have not had income from oyster farming or had access to either Sydney Rock Oysters or Triploid Pacific oysters with adequate disease resistance since 2013. Continued monitoring confirms that POMS (and QX) persist in the wild stocks in the river system.

The hatcheries that produce most of the Pacific oyster spat for Australia and that supply the Hawkesbury River triploid (3n) Pacific oysters are based in Tasmania. The Hawkesbury River growers have continued to collaborate with ASI and other research institutes (NSW DPI, Sydney University, Macquarie University) during the development and selection of POMS resistant Pacific oysters which now have estimated breeding values (EBV's) for POMS resistance of over 90%. However, Hawkesbury River grower access to this high-level POMS resistance genetics is currently difficult because the current research and Pacific oyster breeding program in NSW are based in Port Stephens which does not have POMS. Import of resistant parent lines into Port Stephens represent a biosecurity impossibility at present due to biosecurity import/export restrictions between NSW and Tasmania. Access to POMS resistant triploid Pacific oysters is even more complex due to the extensive timelines and complexities associated with producing suitable tetraploid (4N) and diploid (2N) parent lines that are crossed to produce triploid (3N) spat as per the current spat import protocol to supply triploid spat to the Hawkesbury River.

Triploid Pacific oysters incorporating the new highly POMS resistant parent lines have therefore NOT been commercially evaluated anywhere in Australia.

Hawkesbury River growers proposed an innovative program utilising relatively new triploid induction technology available via Cameron's of Tasmania. The proposal involved acquiring funding to support Cameron's to produce highly resistant triploid Pacific oyster spat directly via induction and utilizing the same export/import protocols in place between Tasmania and Hawkesbury River NSW and assist farmers to evaluate the commercial viability of Pacific oysters with the new POMS resistant genetics. Effectively a 'proof of product' test, as the proof of concept is established through the ASI field testing of family lines in Tasmania for resilience to POMS.

This project allowed Hawkesbury River growers to access, import and fairly assess/record survival and performance and to provide meaningful feedback to ASI on the ability of the selected family lines to withstand environmental infection of POMS under commercial growing conditions in NSW.

Objectives

1. Determine if POMS resistant triploid ASI oysters can improve the commercial viability of POMS affected NSW oyster farms, especially the Hawkesbury River.

2. Develop with ASI/CSIRO a recording and reporting format to assess the performance of triploid POMS resistant ASI Pacific oyster spat cultured in the Hawkesbury River under commercial growing conditions

3. Data collected from farms will determine performance and survival of predicted high POMS resistant triploid ASI Pacific oysters cultured in POMS affected NSW oyster farms.

4. Develop protocols to test/sample for OsHV-1, that are incorporated into regular assessments, to ensure that results can be reflected against a known challenge to POMS.

Methods

A commercial production trial with high POMS tolerant triploid Pacific oysters in approved NSW estuaries was undertaken between April 2019 and July 2020.

Triploid Pacific oyster spat were successfully produced through direct induction techniques by Cameron of Tasmania at their bio-secure hatchery in Tasmania. Highly resistant ASI family lines using YC15 families with EBV's for POMS resistance between 80 and 90% were used in the production of the triploid spat in January 2019. The project team worked with the Tasmanian and NSW authorities to extend the existing NSW import protocol to allow Cameron of Tasmania to ship the trial batch to the Hawkesbury River growers. The triploid spat was subjected to, and passed, the bio-security requirements for shipment to NSW. Spat were received by the ten participating growers from the Hawkesbury River estuary on the 17th or 18th of April 2019. Each grower received approximately 200,000 spat, divided over two size classes; 1.6 mm (~60,000 spat) and 2 mm (~140,000 spat). The number of spat allocated to each grower was estimated by weight.

The spat was farmed by each grower on their own leases and maintained at a commercial density and in units typically used by each grower to effectively capture a 'proof of product' test and assess the commercial viability of the spat. A recording template was developed and provided to each grower to record the data that was required to understand individual farming practices, stock management and survivorship and growth of the triploid spat. The data and observations of each participating grower were collated and are summarised below.

Reported disease activity and environmental events

First POMS event
POMS activity was documented by growers throughout the trial. The first reported mortality event occurred in late November 2019 with five percent mortality of 6mm stock held in intertidal baskets. No other mortality was noted until late December, a different grower noted up to 30% mortality in 12 mm stock unrelated to the ASI trial. Tissue samples were collected but not tested for OsHV-1 as the laboratory was closed for the Christmas period. A third grower reported between 30% and 40% mortality of 6mm stock from the ASI trial that were held in floating baskets in early January. Samples were collected and returned a negative result for OsHV-1.

Mortality is typically recognised during the intermittent grading or handling of stock. It should be noted that it may take a few weeks for a grower to identify mortality in their smaller stock, especially over the busy Christmas period where growers focus on the harvest and sale of their larger stock. Such activities may account for discrepancies in the dates of mortality among growers from nearby leases. Further, POMS activity has been found to vary between nearby leases and even within leases, possibly due to environmental and hydrological factors. Although such factors have proven difficult to assess in small scale-studies, this trial did identify commercial viability of triploid spat.

Flood event
On February 7th 2020 the Hawkesbury River catchment received 340 mm of rainfall over a four day period. The Hawkesbury River and its estuaries were subjected to extensive flooding with freshwater. Salinity levels were monitored by growers and were found to have decreased to zero at the mouth of the Hawkesbury River (surface to six metres depth). Stock was submerged for excessive periods of

time during the flood event. Further, the Hawkesbury River catchment received a further 230 mm of rainfall over the following two months which prolonged the effects of the flood event. The estuary was not reopened for commercial harvest and stock sales until May 1st 2020.

As was normal practice for many oyster growers, stock was not handled during or after the flood event for a period of time deemed suitable for recovery. Handling time-points varied between growers and this is representative of varying management strategies within the industry. Consequently, it was not possible for some growers to count the mortality of the triploid stock directly following the flood event. A similar approach was taken by the growers not to handle their stock following the first POMS event. Most farmers still hadn't worked their oysters after the mortality event in January or before the flood event. It is difficult to get figures on whether the mortality recorded in the data sheets was due to the POMS event or the flood event. Growers had reported growth, including a volume explosion and excellent winter growth prior to both events.

Second POMS event
A second POMS event was reported by a number of growers in late April 2020. Growers received spat, unrelated to the ASI trial, in the first week of April. Growers recorded close to 100% mortality of the spat by the end of the month. Tissue samples were collected and returned a positive result for OsHV-1 when tested by NSW DPI. There were no reports of mortality in the ASI trial, though this may be due to a reduction in the number of growers maintaining observations and reporting data. It is an interesting observation, that these Cameron of Tasmania stock (10month old at the time) showed high resistance for the second POMS event with very few losses compared to nearby younger stock (weeks old) from others exhibiting 90 percent mortality.

Results, Discussion and Conclusion

Although this trial was affected by an unforeseen and major flood event that impacted data collection, there was evidence of ASI spat survival following a POMS outbreak. Growers recorded between 50% to 70% survival of spat following the first POMS event, which was predominantly restricted to smaller size classes. Four growers continued to monitor their trial oysters in to 2020, following the second POMS event. Of these four growers, they recorded between 10% and 45% of the original allocation of spat had survived to at least April when stock was last checked. Other growers did not continue to monitor stock following the flood event and consequently, had no record of mortality following the second POMS outbreak. The majority of these growers recorded major mortalities (in excess of 50%) following the flood event. One grower commented that the majority of spat were lost during the flood event and other growers not monitoring their stock at all. Some growers did not sample between the POMS and flood events which has restricted the data in this report.

The majority of growers performed visual inspections for mortality during grading. Some growers assessed loss as being minimal during the first few months of deployment and reported mortalities as nil. The majority of growers provided their opinions on each event and observations of visual survival. Looking back overall the farmers were happy with the results after the mortality events. Most were saying up to 50% mortality for still quite juvenile oysters. Having the oysters spread over all areas did prove useful as some got lucky and came through the events better than others.

Unfortunately, flood events did hit hard as most farms are still operating at a low percentage of ground used. Until we get more infrastructure in to give us more diversity we cross our fingers a lot of the time when the rains hit.

Even though the trial indicated potential for predicted high POMS resistant triploid ASI Pacific oysters in the Hawkesbury River estuary, it also highlighted the importance of farm management practices. Farm management practices varied among the growers that participated in the trail. Two growers opted to place the spat in on-shore upwellers for up to one month after receiving the shipment of oysters. A number of growers held the spat in the original bags that were used for the shipment of the oysters. A mixture of unit types were used by the growers including baskets (SEAPA and BST) and plastic trays. The majority of growers initially used baskets with a mesh < 3 mm. Once the oysters had increased in size growers gradually used baskets with a greater size of mesh or transferred the oysters to plastic trays. The majority of growers used floating lines, one grower each used hanging lines and rack and rail at some point during the trial. Four growers handled their trial oysters four times, one grower each handled their oysters two, three and six times. Only one grower handled their trial oysters each month and this was at regular intervals. Time intervals between handling varied among growers from three weeks and seven months. The majority of growers handled their oysters opportunistically and in-line with their typical handling practices. Some growers reported the POMS and flood events, tides and weather extremes prevented handling more frequently. Further, some farmers do not handle their oysters after a major stress event to prevent further mortality. As growers graded at different frequencies, used various combinations of unit types over time and varied stocking densities it is difficult to determine the effect of unit type on the performance of the oysters.

	Grower A/B	Grower C	Grower D	Grower E	Grower F	Grower G	Grower H	Grower I	Grower J	Average All
	% survivors	% survivors	% survivors	% survivors	% survivors	% survivors	% survivors	% survivors	% survivors	% survivors (total)
Aug-19	100.00	100.00		70.91		100.00				100.00
Sep-19		99.99	100.00	60.51			79.88			100.00
Oct-19	99.97	90.22	100.00	50.56		100.00	95.73			97.00
Nov-19		90.22		57.41		83.61				87.00
Jan-20		70.88					48.72			59.80
May-Jun 20	22.57	10.00				45.17	15.82			23.39

Table 1. Survival data summary of trial participants.

Summary of findings

- Triploid spat were produced by direct induction using the latest ASI Pacific oyster genetics in Tasmania. The spat produced met bio-security requirements for interstate transport and were received by growers in New South Wales.
- Growers were happy with the survival of the spat given the disease and environmental stress events experienced during the trial.
- A number of growers have re-ordered ASI spat produced by Cameron of Tasmania for stocking in 2020
- The farmers are confident that they will have a future growing triploid Pacific oysters with only 50% mortality (due to POMS) and knowing that there will be continuing improvements each year in the family lines available to them.

Implications

The implications of this research project are significant for Pacific oyster growers in POMS affected growing regions in NSW. The project outcomes have given growers confidence that with current resistant levels, Pacific oyster farming will be again be profitable. In conjunction with the advances in QX resistance in Sydney Rock Oysters the Hawkesbury region, in particular, can be reinvigorated in terms of Oyster farming activity. This will provide significant direct and indirect economic benefit to local communities.

Recommendations

Nil

Further development

Realistically the further development required for further improvements in resistance will be ongoing as part of annual incremental improvements in resistance of ASI diploid family lines. Further research around husbandry methods in this environment may provide benefit but some research has been previously undertaken in both this environment and in Tasmania.

Extension and Adoption

Outcomes of this project have been extended through regular updates to project participants who are ultimately the beneficiaries of this project. COVID restrictions have made further dissemination difficult.

Project coverage

Nil

Project materials developed

The project materials developed have been exclusively the selectively bred oysters used as part of this trial.