Mesh Crop Covers for Pest Control in Commercial Crop Production

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Permanent Agriculture and Horticulture Science and Extension

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Farm, like you'll live for ever.

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Citation Guide

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1. Introduction

With the ongoing success of the Future Farming Centre's research into mesh crop covers for potato pest & disease control (www.bhu.org.nz/future-farming-centre/information/crop-management/crop-production/mesh-crop-covers-for-potato-blight-and-pest-control) and the increasing interest among commercial growers & farmers in New Zealand in using mesh covers, not only for potatoes but other field crops and perennials, this short report explains the history of mesh crop covers, their benefits and their current use in commercial production.

2. Mesh crop covers

2.1. Origins

Mesh crop covers 'evolved' from the spun bonded (non-woven) frost cloths, such Agryl® (Figure 1).

Figure 1. Spun bonded frost cloth. Photos Agryl Novagryl.

Growers using frost cloth for season extension and frost protection found that the covers were also proving to be a highly effective pest barrier. However, spun bonded materials are not particularly strong, so their lifespan is from single use to two to three years at best. They also have low breathability so that using them in the middle of summer is unsatisfactory as crops can overheat and sweat underneath them.

Plastic manufactures therefore developed mesh crop covers to provide the physical barrier effect of frost cloth, but, with much greater breathability and lower temperature increases, meaning they can be used all year round and much stronger so they can be used for many years. Berlinger *et al.,* (2002) describes the co-development between growers, plastic manufacturers and scientists for the control of glasshouse pests in Israel.

2.2. Material

Mesh crop covers are typically made from high density polyethylene (HDPE) or occasionally polypropylene (Figure 2), which are also used to make fishing line, with titanium dioxide as a UV protectant. The threads are woven, rather than knitted into the sheets. They are therefore exceptionally strong and last a very long time, with mesh sold in Europe having a ten year guarantee on it, with growers getting as much as 15 years use out of sheets before they are recycled.

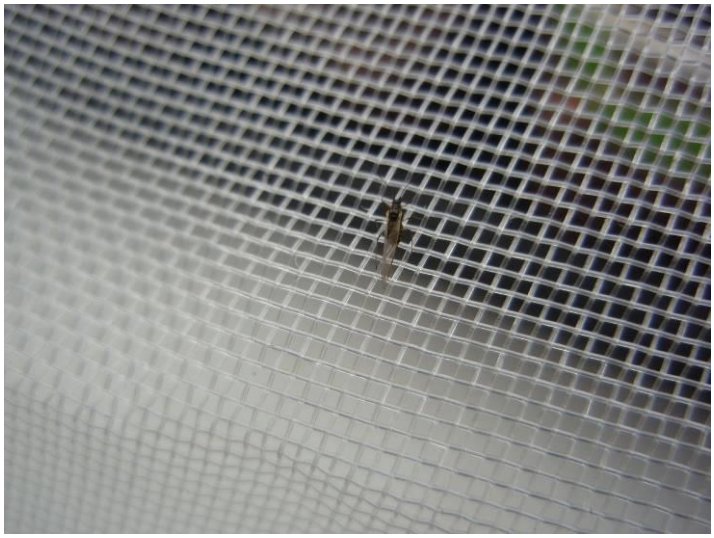

Figure 2. Mesh crop cover (0.6 mm holes) with winged aphid.

2.3. One-stop pest control shop

One of the key attributes driving the uptake of mesh is its universality. It can be used on pretty much any crop, both annuals and perennials (Figure 3), to control a very wide range of pests, both invertebrates, such as thrips, flies, beetles, bugs, scales, weevils, caterpillars, moths, butterflies, wasps, aphids, psyllids, grasshoppers, fruit flies, etc., and vertebrate pests such as birds, rabbits / hares, deer, possums, cats, dogs, etc., in other words pretty much any pest that comes into a crop from the outside, which is why it is described as a 'one stop pest control shop'.

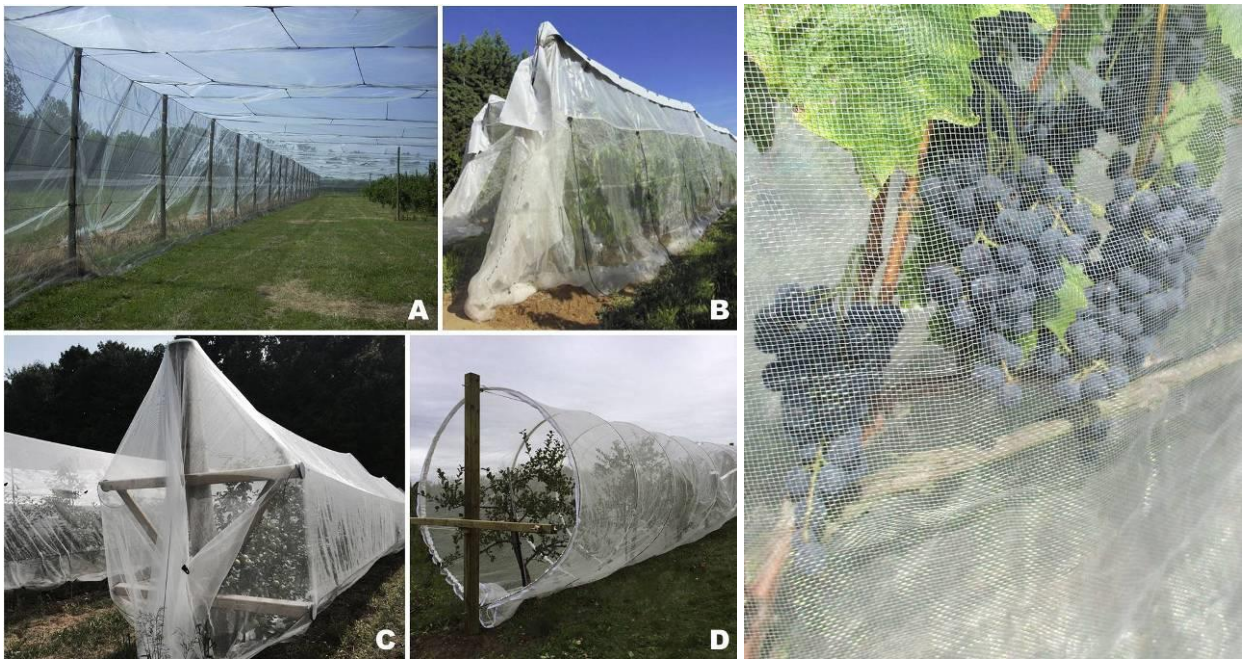

Figure 3. Different approaches to using mesh on apples crops (left, reprinted from (Chouinard *et al.*, 2016)) and protecting grapes against wasps (right).

This contrasts with agrichemicals. Individual chemicals are often restricted to a limited range of crops on which they can be used, and they may only be effective against specific pests, e.g., insecticides can't control vertebrate pests to make an extreme point. Viewed from an agrichemical perspective mesh is almost miraculous as there is no conceivable chemical that can achieve the exceptional level of control of such a diverse range of pests across practically all crops.

In addition, mesh is highly likely to control the next biosecurity pest incursion to NZ, for example if green marmorated stink bug were to arrive and spread, then growers who are already using mesh on

potatoes are very unlikely to have to make any changes to their systems as they will be fully protected from the stink bug already, while growers still relying on agrichemicals are likely to face several years of uncertainty while insecticide solutions are researched and approved for use in NZ.

2.4. Improved crop environment

Mesh crop covers are a form of protected cropping, such as cloches, polytunnels and glasshouses. For example, in the 2016-17 FFC field trials a 19% increase in growing degree days was achieved under mesh from a 1.6°C increase in average temperature and a 6.3°C increase in maximum temperature (Merfield, 2017). Mesh also reduces wind speed in the crop and wind damage, as even gentle shaking of crop foliage can cause significant yield reductions (Biddington, 1986).

Research and farming experience is finding there can be a direct yield and quality benefit from mesh crop covers, above and beyond the yield and quality increases from pest control. In some situations mesh may pay for itself solely on the direct yield and quality increases regardless of pest control benefits.

2.5. Use of mesh crop covers

Mesh covers have been in use in Israel and Europe for over 30 years, being first used in the UK in 1994 to keep root fly off cabbages in the UK. In this time manufactures and growers have refined and tweaked the technology, including all the machinery necessary to manage, lay and retrieve mesh. The industry estimates there is now some 100,000s ha in use (1,000s square km) across Europe, with individual farms having hundreds of hectares under mesh. Mesh is **not** therefore a bleeding edge technology with rough edges needing smoothing off. It is utterly farm proven over many years, so can be rolled out across hundreds of hectares, safe in the knowledge that tens of thousands of European and Israeli farmers & growers have already ironed out the wrinkles of using mesh.

Figure 4. Field scale turnips growing under mesh. Photo Wondermesh Ltd.

Mesh is also now the dominant pest management technology for an increasing range of crops. For example, since 2007, when the last effective and legal insecticide (an organophosphate) for cabbage root fly control on turnips and swedes was withdrawn by the European Union (EU), mesh has been the only way to control the pest (Figure 4). Growers report significant improvement in crop growth and returns, for example, rejects dropping from 25% to 5% when moving from agrichemicals to mesh.

2.5.1. Mesh sizes

Mesh covers come in a wide range of sheet and hole sizes.

The hole sizes start at around 0.3 mm which is small enough to keep out pests as small as thrips, up to hole sizes larger than one centimetre to keep out large pests such as birds and mammals.

Sheet widths start at about 3.5 meters which is the maximum width of the looms that weave the mesh. Larger sheets are then made by sewing sheets together, with maximum sheet widths of up to 40 m produced.

Sheet lengths are typically 50, 100 and 200 m so combined with widths of up to 40 m, the largest sheets can cover close to one hectare.

2.5.2. Management, laying and removal

For large scale field use, mesh management is almost entirely mechanised. Mesh is delivered as large rolls with the mesh folded down to the roll width (Figure 5). The roll is then rolled out down the field by tractor (Figure 5). Mesh is applied straight after planting, because as a barrier it needs to be in place before the pests move in.

Figure 5. Mesh being unrolled. Photo Wondermesh Ltd..

The only manual part of the operation is for the unrolled mesh to be pulled across the blocks of land to be covered (Figure 6).

Figure 6. Mesh rolled out by tractor and then pulled across the field by hand. Photo Crop Solutions Ltd

Field workers then temporarily secure the mesh in place by putting it in the furrow that has been machine dug to bury the mesh in and kicking a small amount of soil onto the mesh, ready for burial (Figure 7).

Figure 7. Mesh sheet held in place awaiting burial. Photo Wondermesh Ltd.

The sheets are then secured in place by the tractor that created the furrow, pushing the soil back into the furrow and the driving over it to firmly secure the mesh in place (Figure 8). Once anchored like this, coupled with the higher weight and porosity of mesh compared to frost cloth mesh wont blow away.

Figure 8. Mesh being buried in its furrow by tractor mounted tools and then compressed in place by the weight of the tractor. Photo Wondermesh Ltd.

A key point when laying mesh is to leave enough slack in the sheet for the crop to grow (Figure 9).

Figure 9. Leaving sufficient slack in the sheet for crop growth. Photo Wondermesh Ltd..

Where there is a need to remove and replace mesh during crop growth, e.g., organic growers needing to weed, alternative securing methods can be used, such as sand/gravel bags and plastic or metal anchor stakes (Figure 10).

Figure 10. Sand/gravel bags for weighing down mesh, plastic peg (photos Crop Solutions Ltd.) and metal anchor stake.

With larger sheets it is possible for staff and even smaller tractors with special lifting bars to work under the sheets. In these cases the sides of the mesh is dug in, and the ends are held in place with pegs or sand/gravel bags. In most crops the mesh is self supporting (Figure 11).

Figure 11. Lettuce growing under unsupported mesh. Photo Crop Solutions Ltd.

Depending on mesh hole size it weighs between 60 and 120 g/m^2 so all but the most delicate crops can support it. The main time mesh needs to be supported is where the parts of the crop touching the mesh are sold, and where abrasion damage is an issue, e.g., baby salads.

Mesh is removed by purpose designed, tractor mounted, bobbin systems (Figure 12).

Figure 12. Mesh removal and bobbin system. Photo Crop Solutions Ltd..

2.5.3. Irrigation and spraying through mesh

Mesh crop covers are totally permeable to rain and irrigation. The HDPE threads themselves are completely non-absorbent so all water applied reaches the crop. Where required, e.g., for fungal disease control, agrichemicals can be applied through mesh.

3. Conclusions

Mesh crop covers are a mature pest control technology that is well and truly farm proven, both in terms of its use and also its pest control efficacy across practically all crops for just about all mobile pests. Unlike agrichemicals which are inherently toxic and potentially dangerous if not used correctly and therefore operate under strict legislative control, mesh is inherently safe to use, so it faces none of the health & safety issues associated with chemicals and potential withdrawal from sale due to changes to legislation. In addition as mesh does not kill pests, and only deflects them from the crop to live and feed elsewhere, there is a vastly smaller risk that pests with evolve 'resistance' to mesh unlike agrichemicals which are already facing significant resistance challenges. Mesh crop covers are therefore the long-term future of pest management.

4. References

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