Grower Summary

HNS 175

Liverwort control using novel techniques

Annual 2011

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Further information

If you would like a copy of the full report, please email the HDC office (hdc@hdc.ahdb.org.uk), quoting your HDC number, alternatively contact the HDC at the address below.

HDC
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

Tel – 0247 669 2051

HDC is a division of the Agriculture and Horticulture Development Board.

Headline

- Mulch applications of *Sinapis alba* seed meal can significantly reduce liverwort establishment, although the actual mechanism of control and its true commercial potential on container grown plants has yet to be conclusively ascertained.

Background and expected deliverables

Liverwort growing on the surface of growing media is a major problem to the horticultural industry, affecting both protected and outdoor grown hardy nursery stock; the cost of hand removal of moss, liverwort and weeds at dispatch has been estimated at 4% of total annual production costs (Scott and Hutchinson, 2001), equating to over £1,700 per hectare based on 2008-9 figures (Crane and Vaughan, 2009). Zero tolerance of liverwort in certification schemes and a lack of approved chemical products make its control a technical priority for growers. There are currently no herbicides approved for use over plants under protection that will control liverwort and the use of loose fill materials (such as bark) and pot toppers over the surface of the growing media have practical limitations.

The aim of this project is to build on work completed in HDC projects HNS 126 and HNS 93c by investigating further any herbicidal effect of glucosinolate (GSL) hydrolysis products found in oil seeds on liverwort and the suppression of liverwort growth by unknown biological or physical factors within certain growing media components.

GSLs and their hydrolysis products (isothiocyanates, ITCs) are responsible for the distinctive pungent smell and hot taste of cabbages, mustards and other brassicas and are known to have toxic effects against plants, root knot nematodes and fungal species; brassicas are successfully used in bio-fumigation of soils against weeds and diseases. GSLs could potentially be used to control weeds in container grown crops; however each brassica variety has a distinctive profile of one or more glucosinolates, each of which could have a different effect on liverwort.

Year 1 of this project was comprised of two trials investigating the effect of five brassica oil seeds (*Brassica carinata, Sinapis alba, Camelina sativa* and two different *Brassica napus* - oilseed rape samples), and five growing media amendments (Melcourt Sylvafibre®, Melcourt Growbark®, Perlite, Vital Earth Green Compost and sterilised loam) on liverwort establishment and growth. The seed meal trial found that *Sinapis alba*, *Brassica napus* '00'

and *Camelina sativa* significantly reduced liverwort establishment, whilst the growing media amendment trial found that amendment with Sylvafibre® and sterilised loam significantly reduced liverwort establishment, although neither reduced liverwort levels to what would be commercially acceptable levels.

The expected deliverables from this work include the development of an effective novel control for liverwort infestation based on:

- Growing media amendment with seed meal or a combination of seed meals to reduce liverwort establishment (either through herbicidal effect and/or natural barrier effect).

- Growing media amendment with materials to provide natural microbial suppression of liverwort in addition to any physical effect.

Summary of the project and main conclusions

Two trials were carried out during 2010/11, the first investigated the effect of application method and dose rate of *Sinapis alba* seed meal on liverwort establishment and growth, and the second examined the fate of the glucosinolate content of the seed meal. Both trials were carried out under protection.

Seed meal suppressive effect

This trial focused on the use of *Sinapis alba* 'Braco' seed meal (containing glucosinolates) to control liverwort (Figure GS 1) when applied as pellets (mulch), ground seed meal (mulch), ground seed meal plus bark (mulch), ground seed meal incorporated into the growing media and a managed treatment (ground seed meal applied as a mulch on two separate occasions), identifying the most effective application method, determining effective application rates and any effects on crop growth and quality. For the managed treatment, two applications of ground seed meal were made, with the second being applied when liverwort infestation first started to appear in the trial (three weeks after the initial treatment). For the control, no seed meal was applied. Application rates used were 3, 6 and 9g per pot for each treatment. *Clematis* 'Ernest Markham' was used throughout this trial to test any beneficial or adverse effects on plant growth as it is known to be sensitive to herbicides (e.g. isoxaben the active ingredient in Flexidor 125). The growth habit of the plant also minimises

shading of the growing media surface which increases the likelihood of liverwort establishment.

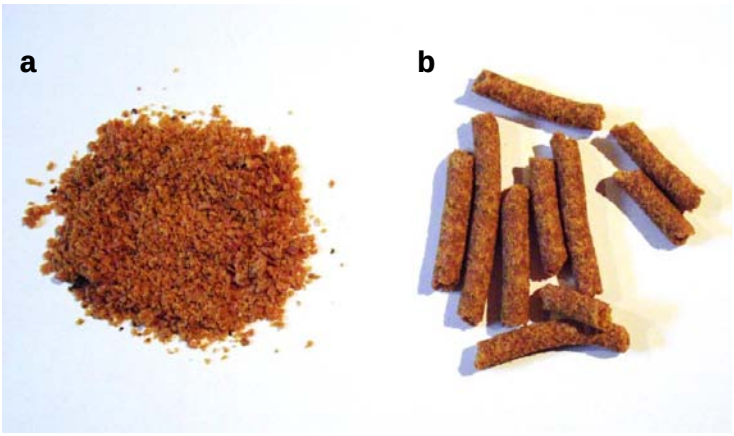

Figure GS1. Seed meal treatments: a) ground seed meal b) seed meal reformed as pellets

The seed meal was processed to a fine meal and analysed for glucosinolate content. Plots consisted of 10 x 9cm pots, each planted with a plug of *Clematis* 'Ernest Markham'. A peat growing medium and overhead irrigation regime was adopted to provide conditions favourable to liverwort growth. Liverwort inoculum was provided by a 'spreader' pot (one pot per plot) containing liverwort.

The trial was set up on 19 August 2010 and the treatments applied on 2 September 2010. The dose rate of each of the seed meal treatments was easily distinguished once applied, with the 9g ground seed meal and all the seed meal with bark treatments completely covering the surface of the growing media. The pots were well watered after the treatments were applied, and this resulted in the seed meal swelling and covering a greater proportion of the growing media surface (Figure GS2).

Ground **Pelleted**

Figure GS2. Treatments: ground and pelleted seed meal (9g dose) post watering.

Liverwort cover

Throughout the trial the least amount of liverwort established in the managed and seed meal with bark treatments (Figure GS3). The managed application of seed meal and the seed meal with bark treatments covered most of the growing media surface and this physical capping may have helped to reduce liverwort establishment in these treatments (i.e. it was difficult to separate chemical control from physical control with these treatments). At 26 weeks after treatment (WAT) there was evidence of a small amount of liverwort establishment around the edge of some pots with these treatments.

In general, liverwort cover increased over time, except for the incorporated treatments. With these treatments the greatest amount of liverwort establishment was noted around 8 to 12 WAT. At later assessment dates the level of liverwort had substantially declined.

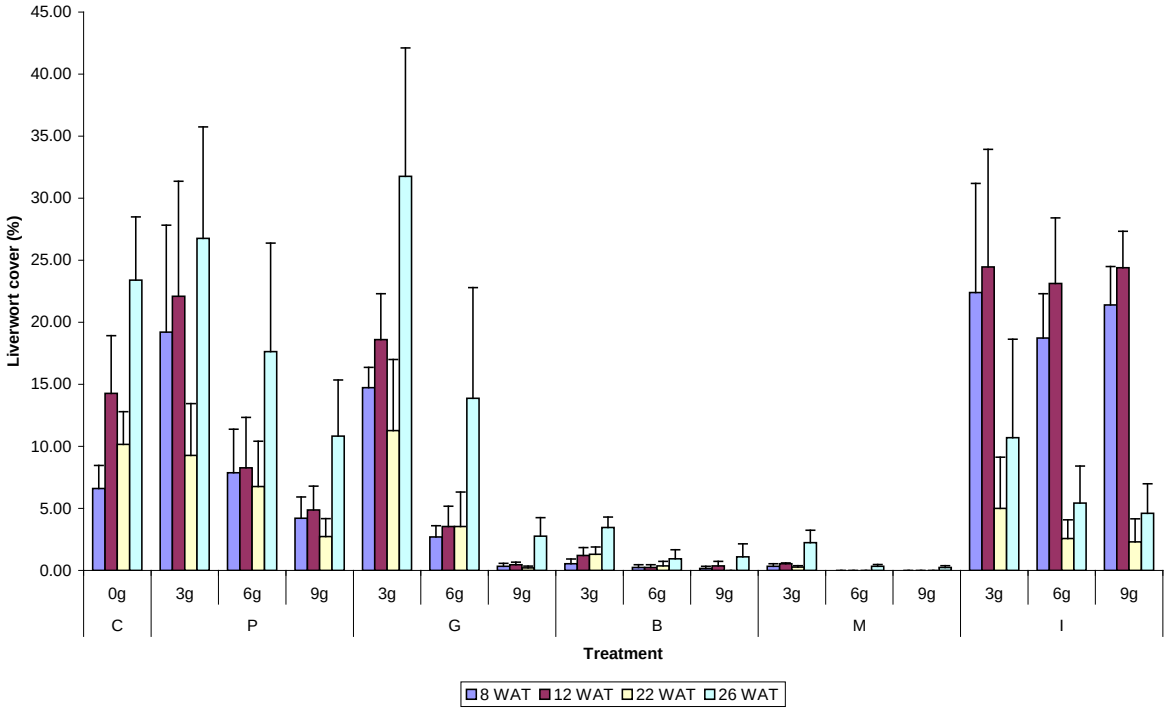

Figure GS3. Liverwort cover (%) (WAT = weeks after treatment).

C = no seed meal applied. P = pelleted seed meal, G = ground seed meal, B = seed meal combined with bark, M = managed treatment and I = seed meal incorporated into growing media.

At 22 WAT it was observed that some of the liverwort had died back, relative to that recorded 12 and 26 WAT in the majority of treatments (Figure GS3). This was possibly either the result of the drier conditions experienced at this time, as the irrigation system was disconnected during the winter and plants were hand watered, or due to the extreme cold conditions.

Plant height

Plant height was recorded 8 WAT. The data collected suggested greater height of the *Clematis* at the 6g dose rate across all treatments except for the incorporated treatment where plant height was reduced. Least growth was recorded in the incorporated seed meal treatment (all dose rates) and the seed meal with bark treatment at the 9g dose rate. Plant height at the 6g dose rate in the pelleted seed meal and seed meal with bark treatments were both greater than in the control.

Phytotoxicity

By 15 September 2010 (2 WAT) phytotoxicity was noted on all plots where seed meal was incorporated. Most damage was found in the 9g treatments where the leaves were completely scorched on up to 50% of the plants, and marginal leaf scorch was observed on some of the remaining plants. Some scorching was also evident on the leaf margins of new growth. Within the 6g treatments leaf margin scorch was noted on 50-70% of plants, affecting older leaves. There was also reduced vigour and some marginal leaf scorch noted on new leaves. Marginal leaf scorch was noted on up to 25% of the plants in the 3g treatments.

Symptoms were typically greater at 8 WAT than 12 WAT suggesting that the phytotoxic effect of the treatments reduced over time.

Root development

Root development was assessed 26 WAT. Root development was compared with the control and graded on a scale of 1-5, ranging from no roots to root development comparable with those found in the control plots. There was a clear adverse effect of the seed meal on root development in the incorporated treatment, with root development decreasing with increased seed meal dose rate. The general trend in response to dose rate was for greater root development at the lower dose rates (ground seed meal, seed meal with bark and

incorporated seed meal). However, root development was greater at the 6g dose rate for the managed treatment and at the 9g dose rate in the pelleted seed meal treatment.

Glucosinolate fate

A trial was designed to investigate the fate of the glucosinolate content of *Sinapis alba* 'Braco' seed meal via sample analysis (NIAB), determining the residual glucosinolate content of the seed meal. Fresh *Sinapis alba* seed was sourced for the 2010 trials due to the low residual glucosinolate found in seed meal used in the 2009 trials.

10 g of seed meal was placed on the surface of 100 x 9 cm pots containing growing media and arranged in a single block of 100 pots. *Sinapis alba* 'Braco' seed meal samples were analysed for glucosinolate content before the trial, and then a total of 100 g was removed from the pots weekly until the threshold dropped below a measurable quantity.

Glucosinolate concentration in the seed meal decreased rapidly and was present in quantities too small to measure two weeks after treatment.

Overall, the *Sinapis alba* managed treatments and the seed meal with bark treatments were the most promising. Incorporating seed meal into growing media was the least successful in terms of phytotoxicity and reduced root development compared to the other treatments.

Financial benefits

There are currently no herbicides approved for use over plants under protection that will control liverwort. The cost of moss, liverwort and weed control at dispatch is estimated at 4% of the total annual production costs, equating to over £1,700 per hectare based on 2008-9 figures. Consequently, the development of a novel control method will prove particularly beneficial for use within protected environments.

A cost-benefit analysis for the novel control method will be carried out in the final project year.

Action points for growers

Further investigation of the effect of seed meal on liverwort and any associated phytotoxic effects on crop plants is required before any specific recommendations can be made for growers.

Growers could consider including a proportion of Sylvafibre® or sterilised loam in potting mixes as an aid to limiting liverwort development, particularly in short term crops (refer to the Year 1 Annual Report for further details).