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ORGANIC CARROT SEED PRODUCTION

Key points

- Research showed that optimal crop density for organic carrot seed production was 20 plants per m^2 with a row spacing of 60 cm.
- Fungal foliar pathogens were not controlled by the biological control agents tested but hot water treatment of carrot seed resulted in a 97% (67% percentage point) reduction in fungal infection after 30 minutes of treatment at 50°C.
- There may be potential for control of foliar pathogens using thermal treatment.
- Interrow weeds can be controlled mechanically but weeds within the row (intrarow) are usually hand weeded.
- Thermal weeders had limited success controlling intrarow weeds but the carrots were unaffected.
- To minimise weed problems, carrots can be transplanted in the spring rather than being direct sown in autumn.
- A direct-fired steam weeder was developed which is the first effective alternative to flame weeders.

Charles Merfield presented a summary of his findings from his PhD research on the organic production of carrot seed at the Canterbury Organic Growers demonstration day. Three areas of research were discussed: optimal crop density, control of foliar fungal pathogens (principally *Alternaria radicina*), and the control of intrarow weeds by thermal weeders.

1. Optimal crop density

The research showed that the crop density and spacing of 20 plants per m^2 which is currently used by conventional seed producers is suitable for organic production. Increasing seed density up to this level will increase seed quality because more seed will be produced by the primary umbels. (Seed from primary umbels produce higher quality seed.) Densities higher than this may increase pathogen infestation. An interrow spacing of 60 cm should be used to allow the use of interrow weeding machinery.

2. Control of fungal pathogens

Several biocontrol agents were tested for effectiveness against *A. radicina*. These were *Trichoderma Viride* 'Trichoflow'; *Trichoderma atroviride* 'Sentinel'; *Bacillus subtilis* 'Serenade', a bacteria which has broad spectrum anti-fungal properties; *Agrobacterium radiobacter* 'Dygall' and Effective Microorganisms (EM), a brew of microorganisms containing yeasts, bacteria and other microorganisms (see Organic Update 1).

None of the products tested showed potential for use as a bio-control against *A. radicina*. However on pot grown carrots thermal treatment using flame and steam weeders eliminated the pathogen which shows this technology may have potential for managing foliar fungal pathogens in the field.

Hot water treatment effective

Hot water treatment of carrot seed was effective in controlling seed borne disease. There was a 97% reduction in fungal infection after 30 minutes at 50°C. The carrot seed was unharmed.

3. Intrarow weed control

Weeds can be a serious problem in organic crops that are in the ground for a long time, such as carrots grown for seed. To help manage this problem, carrots can be transplanted as small plants ("stecklings") in the spring rather than being direct sown. Interrow cultivation successfully controls weeds between the rows, but weeds along the row (intrarow) cannot be mechanically weeded. Hand weeding is usually used to manage these weeds.

Thermal weeders – both flame and steam weeders – were trialled to see if the amount of hand weeding could be minimised. A direct fired steam weeder was developed which has advantages over a flame weeder of improved heat transfer, a lower fire risk, it uses diesel, bio-diesel or raw vegetable oil rather than LPG, and is unaffected by wind. However they have a higher capital cost and greater complexity.

The trials showed most weeds in the carrot crop that have grown through the autumn and winter are too large to be controlled by thermal means by springtime. Some weeds can be controlled, such as chickweed (*Stellaria media)* and field speedwell (*Veronica agrestis)* which have thin stems and small leaves.

There was a clear difference in the control of weeds at different growth stages for most species except ryegrass *Lolium perenne* (totally immune), *S. media* and *V. agrestis* (completely susceptible). Dock seedlings were killed when very young, but its contractile root allows plants as young as six true leaves to regrow after treatment.

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