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Free-living nematodes associated with carrots and parsnips

Free-living nematodes (FLN) are microscopic soil-borne organisms that can cause significant crop damage by feeding on plant roots, leading to reduced yields and quality (Figure 1).

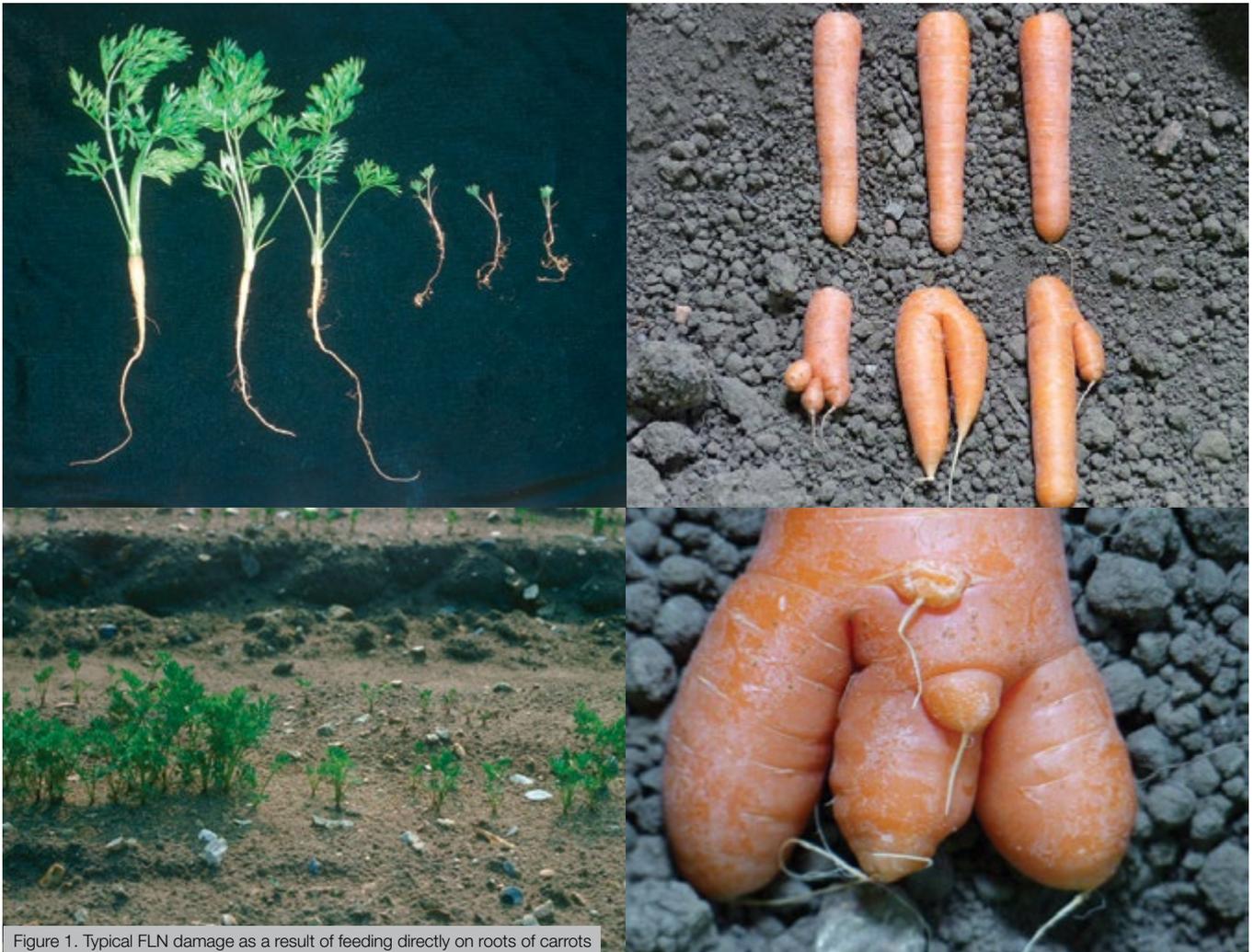


Figure 1. Typical FLN damage as a result of feeding directly on roots of carrots

Action points

To potentially achieve short-term benefits:

- Where possible, increase the length of rotation, even one additional year may be beneficial.
- Ensure that rotation crops include those that are poor hosts of FLN that impact carrot and parsnips. Thus limit, where possible, sugar beet, peas, beans and potatoes, which are known to increase damaging FLN.
- Where land is owned, rather than rented, consider inclusion of a cover crop within the standard rotation.
- Monitor FLN by pre-plant soil testing. Use of molecular diagnostics may minimise costs and improve specificity of testing (Table 1).
- Apply organic matter prior to planting.
- Be alert to the presence of root-knot nematode and take appropriate measures to minimise spread.

Why are FLN a problem now?

- Set-aside – undisturbed soil placed in long-term set-aside, with a diversity of plant species, significantly increased FLN populations that were a challenge to manage once the soil was brought back into agricultural production
- Potato cyst nematode (PCN) – a research focus within the UK on PCN
- Lack of monitoring or pre-plant testing – typically, fields are not tested for FLN before crop sowing/planting, thus no pre-crop knowledge is generated to inform management strategies
- Reduction in available land – over time, the area of land available for growing crops has significantly reduced
- Reduced rotations – a reduction in available land has driven reduced length of rotations leading to additional FLN pressure
- Inappropriate rotations – in the context of carrot and parsnip, frequently, rotation crops selected are excellent hosts of FLN, thus increasing their numbers
- Lack of full disclosure – landowners rarely disclose whether their soil has been tested for FLN, and if so, the results, passing responsibility onto the grower who wishes to rent the land
- Irrigation – poor timing of irrigation, in combination with rainfall events, may move FLN into the proximity of vulnerable seedlings
- EU legislation – driving a reduction in available active ingredients for the control of FLN.

Table 1. Main FLN species known to impact UK carrot and parsnip production

FLN species known to impact carrot	Present in UK	Molecular diagnostic	Microscopy
<i>Longidorus elongatus</i>	Yes	Yes	Yes
<i>Paratrichodorus anemones</i>	Yes	Yes	Yes
<i>Paratrichodorus pachydermus</i>	Yes	Yes	Yes
<i>Paratylenchus nanus</i>	Yes	No	Yes
<i>Paratylenchus bukowinensis</i>	Yes	No	Yes
<i>Pratylenchus penetrans</i>	Yes	Yes	Yes
<i>Pratylenchus neglectus</i>	Yes	Yes	Yes
<i>Trichodorus primitivus</i>	Yes	Yes	Yes
<i>Trichodorus similis</i>	Yes	Yes	Yes
<i>Tylenchorynchus dubius</i>	Yes	No	Yes
<i>Tylenchorynchus maximus</i>	Yes	No	Yes

Species in bold are known to have a widespread UK distribution. Molecular diagnostics provide presence/absence information, those in bold also provide quantification. Standard diagnostic is by microscopy based identification. Other FLN species that have been reported to affect carrot but have a restricted geographic distribution within the UK, are not listed here.



Potential alternative FLN management strategies

With the reduction in the number of active ingredients available, a range of alternative management strategies for FLN are being considered in the UK. A summary of available potential alternative FLN management strategies are listed below, noting availability of UK based data, potential for success and a potential deployment timeline.

Management strategy	UK data available	Potential for success	Deployable timeline
Breeding for resistance	No	Limited given grower concerns	Long term
Rotation	Yes	High	Immediate
Monitoring for FLN	Yes	High	Immediate
Biofumigation	Becoming available	Unknown – results to date inconsistent	Medium
Green manures and cover crops	No	Medium	Medium to long term
Tillage	Limited	Medium	Short term
Soil amendments	Limited	Good	Immediate to medium term, dependent upon the specific amendment
Biological control	Limited	Low to medium	Long term, with possible regulatory hurdles
Arbuscular mycorrhizal fungi	Yes	High	Medium

Sampling for FLN

Crop production decisions such as field selection, variety selection, rotation, crop selection and irrigation timing can be informed by pre-plant testing for FLN. While this incurs an economic cost for the farm unit, intensive sampling (a composite sample per hectare) would be valid for at least two rotations, as it is known that FLN persist in-field with minimal movement through cultivation. However, care should be taken when sampling, to ensure that collected soil is suitable for FLN analysis.

It is a myth that FLN are killed during transport. It is common practice for soil to be transported around the world for FLN studies. A well-packed cardboard box with soil samples in strong plastic bags is ideal for transporting soil samples for FLN analysis.

The following are important guidelines to appropriate soil sampling for FLN:

- Do not sample when the ground is frozen
- Do not sample during a continuous cold spell. If there has been a prolonged spell of cold weather and soil temperatures were close to 0°C but not frozen for five days or more, do not sample
- Do not sample during the heat of the summer. If there has been a prolonged spell of warm/hot weather, resulting in soil temperatures around 20°C, coupled with low rainfall for 3–5 days, do not sample
- Optimal sampling time is spring and autumn when the soil is moist. However, sampling can continue through mild winter months if the soil temperature does not reach freezing. Similarly, unseasonal warm/hot spring/autumn weather with low rainfall could halt FLN sampling

- The top 10–15cm soil should be sampled, as this is the depth that the majority of FLN are known to inhabit
- Soil samples should be composite, taken per hectare, and comprise at least 50 cores, resulting in a soil sample weighing at least 500g
- Current research indicates that optimum sampling for FLN should be at random distances along a W-shape. This can change in future if new research indicates improved sampling strategies
- The sampling tool used should have at least a 25mm (1 inch) aperture
- Do not use an auger, as a screwing action can damage FLN
- Use a strong plastic bag to ensure that the soil does not escape during transport and contaminate other samples
- Provide a clear, permanent and legible label on each sample.

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