Grower Summary

FV 370

Wild rocket: managing and reducing nitrate levels

Final Report 2010

Disclaimer

Whilst reports issued under the auspices of the HDC are prepared from the best available information, neither the authors nor the HDC can accept any responsibility for inaccuracy or liability for loss, damage or injury from the application of any concept or procedure discussed.

The results and conclusions in this report may be based on an investigation conducted over one year. Therefore, care must be taken with the interpretation of the results.

Use of pesticides

Only officially approved pesticides may be used in the UK. Approvals are normally granted only in relation to individual products and for specified uses. It is an offence to use non-approved products or to use approved products in a manner that does not comply with the statutory conditions of use, except where the crop or situation is the subject of an off-label extension of use.

Before using all pesticides check the approval status and conditions of use.

Read the label before use: use pesticides safely.

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

Headline

Around half of UK wild rocket crops had tissue nitrate concentrations above a proposed EU limit of 5000 mg NO_3/kg. Whilst levels were increased by dull weather in the week prior to harvest, there were only poor correlations with soil mineral nitrogen, rate of nitrogen fertiliser, or use of fleece as covers.

Background

Rocket is a leafy vegetable that is valued for its spicy flavour and is used increasingly in bagged salads. There has been a rapid growth in rocket sales in recent years. However, studies have shown that nitrate levels are higher in rocket than in any other vegetable which has raised concerns with legislators.

European legislation already exists to limit nitrate levels in lettuce and spinach, and the EC has announced for the first time the introduction of a maximum nitrate (NO_3) limit for rocket species of 5000 mg NO_3/kg. This is still pending, but new legislation is expected to come into force in 2011. Surveys have found average tissue nitrate concentrations (TNC) in rocket to be between 3000 and 4800 mg NO_3/kg, so many individual crops are likely to exceed the 5000 mg NO_3/kg limit specified for summer production. The proposed limits for nitrate currently relate specifically to salad rocket (*Eruca sativa*) but the Food Standards Agency (FSA) has indicated that they expect both garden rocket (*Eruca vesicaria*) and wall/wild rocket (*Diplotaxis tenuifolia*) to be included within annual surveillance sampling in the future. Eventually both species might be included in the limit, and the limit might be reduced.

There is a need for the industry to supply the FSA with good quality data on nitrate levels in rocket crops, to support their negotiations on behalf of the UK in Brussels. Although nitrate levels are expected to be relaxed for lettuce and spinach, the EC has confirmed that monitoring will still be required for some more years, so growers can expect continued scrutiny. There is therefore a requirement for continued vigilance and the industry as a whole needs to demonstrate to the FSA and the EC that it is endeavouring to reduce nitrate levels in rocket (both *Eruca* and *Diplotaxis*). Evidence of efforts by the industry to establish good agricultural practices in this area will reduce the risks of low limits being imposed, which would be a constraint on the UK industry.

There are currently no guidelines on appropriate levels of nitrogen fertiliser for rocket in the fertiliser recommendations. Very little work on nitrate in rocket has been done and despite

the fact that many of the larger growers are managing nitrogen use well, there is a need to understand the nitrogen requirements of rocket better and to spread best practice to the wider industry. Previous research with lettuce has shown that in addition to the effects of nitrogen supply, dull weather in the period up to a month prior to harvesting can increase nitrate levels. It is not clear how these critical periods compare to faster growing species such as rocket.

Before any surveillance or robust experimental work is done, there is a need to confirm whether the current sampling protocols for nitrate surveillance (applied from lettuce and spinach) are appropriate for rocket. The objectives of this project were (1) to determine optimum sample size for assessing nitrate levels in wild rocket and (2) to investigate the effects of factors such as spatial variability, between plant variation, soil type and fertiliser on nitrate levels in rocket.

Summary

Objective 1 – Determining optimum sample size

To determine optimum sample size for assessing nitrate levels in wild rocket, samples were collected from two commercial crops of wild rocket. At each site, 60 small quadrat samples were collected in a grid pattern, and individually assessed for sample fresh weight, dry matter content and Tissue Nitrate Concentration (TNC). These results allowed examination of the level of variation in TNC in commercial crops, and the scale of the variability.

The same data were also used to assess retrospectively the effectiveness of collecting a smaller number of quadrat samples in a range of different sampling patterns. At each site, the mean TNC values which would have been obtained from these sampling patterns were compared with the mean from the full set of 60 samples.

The results showed that patches of low or high TNC can be up to about 25 m long, and that adjacent beds can have significantly different nitrate concentrations. However, adequate samples for assessing mean tissue nitrate concentration could be obtained by collecting a bulked sample from 10 quadrats in a ‘W’ or ‘X’ pattern from a 40 m stretch of several beds. Each quadrat should be at least 25 cm x 25 cm to give a total sample of at least 1 kg, as specified by European legislation.

Objective 2 – Effects of soil type, location & SMN on nitrate levels

To investigate typical nitrate levels and the factors affecting them in commercial UK wild rocket crops, samples were collected from eight sites between mid-June and mid-August, the main UK harvest season. The sites were located in Dorset, Kent, Norfolk, Sussex and Wiltshire. At each site, ten quadrat samples of crop and twelve soil samples were collected in a 'W' pattern. The crop samples were individually assessed for sample fresh weight, dry matter content and TNC, and the soil samples for soil mineral nitrogen (SMN). Records were made of soil type, Nitrogen (N) fertiliser applications, rocket variety, sowing date, harvest date, and weather during the growing period.

Mean TNC at the eight sites ranged from 2446 to 7349 mg/kg, with four of the sites having mean TNC values above the proposed EU limit of 5000 mg/kg. There was a strong negative correlation between TNC and the average daily solar radiation over the 5 days prior to harvest (see Figure 1). The relationship became weaker if solar radiation was averaged over longer periods, suggesting that light levels in the week prior to harvest are key to determining crop TNC. A similar effect has been observed in other crops such as lettuce, and is thought to occur because high light increases the activity of the enzyme nitrate reductase, which converts nitrate within the crop to nitrite as part of the pathway for synthesising amino acids.

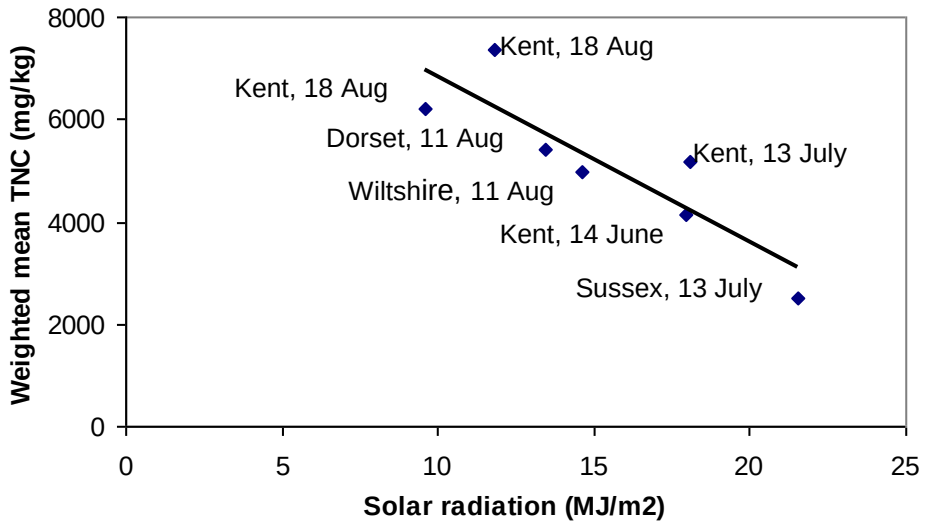

Figure 1. Relationship between solar radiation, averaged over the five days prior to sampling, and TNC at seven sites (radiation data were unavailable for one site). Fitted regression line $R^2 = 0.76$

There was some indication that TNC was higher at sites with high SMN (>300 kg N/ha), although the relationship was not significant. No effects of soil type, region, variety, crop covers or time of sampling were apparent from the data, although a survey including a greater number of sites would be necessary to confirm that these factors have no effect on TNC.

Financial Benefits

The UK market for rocket is worth *ca*. £45M at retail level, based on the annual volume of 3,340 tonnes of crop grown in 2009. Should the EC ultimately introduce a limit for TNC in rocket of 5000 mg NO_3/kg, this may result in the loss of home-grown rocket as a UK crop. The work reported here is therefore of strategic importance in protecting this market, by providing evidence to legislators that UK growers are supporting and following best practice.

Action Points

- Acceptable measures of TNC in rocket crops can be achieved from bulked samples of ten quadrats (measuring at least 25 cm x 25 cm) sampled in 'W' or 'X' shaped sampling patterns. Samples should be taken from distances of at least 25 m along several different beds.
- Crops grown during periods of dull weather (in August) had higher TNC than those grown during sunnier periods, probably due to reduced nitrate reductase activity, therefore growers should avoid harvesting wherever possible after such conditions.
- SMN appears to have some effect on TNC, with SMN levels of more than 300 kg N/ha being likely to raise crop TNC above the 5000 mg NO_3/kg limit.
- While crop N offtake appears to be balanced with respect to fertiliser N applications, it may be possible to make better use of available SMN.
- Taking into account SMN might offer opportunities to reduce growing costs through lower N inputs.
- Crop covers do not appear to raise crop TNC values, therefore growers can continue to use fleece to control flea beetles.
- No effects of soil type or region were detected in this survey, but it is possible that there could be small effects which would be detected by a more extensive survey.
- Further work may be justified on use of fertiliser products containing nitrification inhibitors.