Annual Report for: Food Standards Agency

Nitrate Surveillance Monitoring Programme

May 2020 – March 2021

Reference No: Contract Number FS513408

Issued by: Angela Huckle

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Period of Investigation:	01 April 2020 – 31 March 2021

Contents

SUMMARY

A total of 201 samples were collected between 01 April 2020 – 31 March 2021. While the onset of the covid-19 epidemic prevented sampling in the early season precluding the onset of collection until July, extra samples were collected in the later season to compensate.

There were 119 domestic lettuce samples, 26 spinach samples, 8 rocket samples and 48 “other leafy green vegetables”, described as Kale (7), Red Chard (5), Mizuna (5), Savoy Cabbage (4), Pointed Cabbage (4), Chinese Leaves (4), Bulls Blood (3), Spring Greens (3), Radicchio (2), Chard (2), Celery (2) and single samples described as Yellow Chard, Winter Greens, White Dutch Cabbage, Tatsoi, Romanesco, Cima di Rapa and Lamb’s Cress. Maximum nitrate limits are not in force for the ‘other leafy green vegetable’ samples. 1.96% of domestic samples (3 of 153 with reference) exceeded the Regulation limit in 2020, comprised of two spinach samples and a non-iceberg lettuce sample. This is only 43% of that reported in the 2018-19 season, returning to a decreasing trend seen in samples since 2002.

Within the main categories rocket had the greatest nitrate content (4258 mg kg^{-1}), reduced from 4590 mg kg^{-1} in 2019. On average iceberg lettuce had a higher nitrate content than in 2019 (2213 mg kg^{-1}, up from 1188 mg kg^{-1}). Spinach had the lowest nitrate content at 2027 mg kg^{-1}. In the “Other” category levels varied between <50 mg kg^{-1} (savoy cabbage) to 6073 mg kg^{-1} (Lamb’s Cress).

Consistent with previous years of this project, a positive correlation was found between nitrate concentration and date of sampling. While summer concentrations may be increased under dry conditions, relatively good summer weather in 2020 means that this is unlikely to have impacted nitrate concentrations. Indeed, the warm, bright summer is likely to have had a positive impact on nitrate concentrations, helping to keep levels low. Concentrations increased into the autumn and winter as day length and light inputs reduced, leading to greater accumulation due to reducing rates of nitrogen metabolism. This suggests that there may be scope to extend data collection and critically evaluate the links between tissue nitrate concentration, fertiliser input, crop husbandry and environmental factors with use of more detailed meteorological data to test the relationship between weather conditions, location and observed nitrate concentrations. Improved understanding would enable industry to refine their growing practices and further reduce the nitrate levels in UK grown leafy green vegetables.

PRINCIPAL WORKERS

Angela Huckle	Associate Director	ADAS Boxworth
Ewan Gage	Associate Director	ADAS Boxworth
Karen Wheeler	Senior Research Manager	ADAS Rosemaund
Sean Stevenson	General Manager	NRM Laboratories
Richard Weightman	Consultant Advisor	Home Based

Joseph Priest	Sample Officer	ADAS Gleadthorpe
Dennis Churchill	Sample Officer	ADAS Rosemaund
Geoff Bailey	Sample Officer	ADAS Starcross
Stephen Hamilton	Sample Officer	DAERA
Callum Burgess	Sample Officer	ADAS Boxworth
Diana Pooley	Sample Officer	ADAS Boxworth
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Andrew Moore	Sample Officer	ADAS Terrington
Guy Johnson	Sample Officer	ADAS Boxworth
Aldwyn Clarke	Sample Officer	ADAS home based

AUTHENTICATION

I declare that this work was done under my supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

Ewan Gage
(Project Manager)

Date: 27th June 2021

Angela Huckle
(Study Director)

Date: 28 June 2021

INTRODUCTION

Nitrates are chemicals that exist in plants, soils and water. The concentration of nitrate in plant tissues is variable but green leafy vegetables, when consumed raw can contain relatively high concentrations. Lettuce, spinach and rocket are important leafy vegetable crops in the UK and are the source plant material for this report.

Concerns regarding high concentrations of nitrate in the diet have led the European Commission (EC) to introduce maximum residue levels in lettuce, spinach and rocket.

Commission Regulation (EC) No 1258/2011 came into force in December 2011. This Regulation sets out new, permanent limits in green leafy vegetables; except the limits for rocket which applied specifically from 1 April 2012. It ends the previous temporary derogations which permitted the UK and some other EU countries to exceed maximum limits, without compromising consumer food safety, for fresh lettuce and spinach grown and intended for consumption on their own respective territories. Furthermore, the regulation now allows Member States to communicate results of the monitoring programme to the European Food Safety Authority (EFSA) on a regular basis, rather than the mandatory deadline of June 30 each year.

Every Member State is required to monitor and report levels of nitrate as part of a European Commission regulation. Whilst the UK is no longer part of the EU, monitoring activities have continued to be carried out by monitoring nitrate levels in lettuce, spinach and rocket by the UK Monitoring Programme (under GB retained law 1258/2011 since January 2021). This has been undertaken since May 1996 and reported in earlier MAFF (now Defra) /FSA Food Surveillance Information Sheets. Monitoring of UK grown lettuce, spinach and rocket is currently being led by RSK ADAS Ltd (ADAS) in partnership with NRM Laboratories.

QUALITY ASSURANCE

The study was conducted in compliance with the requirements of the Food Standards Agency, as set out in RRD27, February 2008. Sampling methodology conforms to the European Commission guidelines given in Commission Regulation EC/1882/2006 and with the quality assurance procedures adopted for the 2002-2018 surveys.

ADAS has its own in-house Quality Management System (QMS) developed to meet the requirements of externally accredited standards applied to parts of the business. ADAS QMS ensures that all work is controlled by documented plans, project management methodology, and carried out by properly trained staff, using suitable equipment and facilities. Business processes and routine procedures are documented in Standard Operating Procedures (SOPs) authorised by management and subject to periodic review. In-built process improvement ensures that ADAS QMS continues to improve and evolve to cover new areas of activity and to be responsive to the changing needs of customers. Compliance with QMS is monitored through formal audit by the operationally independent Quality Management Group. Audit schedules are designed to cover all key areas of activity. Study specific audits can also be carried out by prior agreement at contract stage. ISO 9001:2000 - ADAS is registered with Lloyd's Register Quality Assurance (LRQA) for: 'Provision of independent research, consultancy and contracting services, focused primarily on environmental management, regional development, agriculture, horticulture and the food supply chain, to Government, levy bodies and private sector companies'.

Chemical analysis carried out by NRM Ltd meets the requirements of the Joint Code of Practice for Quality Assurance in Research, complies with Commission Regulation (EC) No 1882/2006 and complies with the provisions of items 1 & 2 of Annex III to Regulations (EC) No 882/2004.

OBJECTIVES

1 To collect a total of 200 domestic samples of fresh produce (principally lettuce, rocket and spinach, but also including 'other leafy green veg').

2 To carry out the chemical determination of nitrate concentration in fresh tissue in accordance with the appropriate Directives.

3 To report results to the agency in an electronic format.

4 To ensure the grower has received a copy of the results relating to his/her sample.

METHODOLOGY

Site selection and grower representation

In April 2020 a sampling schedule was prepared by ADAS and agreed by the Food Standards Agency (FSA). The schedule ensured that the sampling of fresh produce complied with the European Commission guidelines given in Regulation EC/1882/2006 and met with the requirement to spread the sampling over representative geographical regions throughout the UK. The schedule also ensured that seasonal growing trends were adequately reflected whilst accommodating changes in response to the onset of the covid-19 epidemic which prevented sampling activities in the spring of 2020.

The sampling schedule covered the period from 22nd July 2020 to 29th March 2021 and involved the collection of lettuce, rocket, spinach and other leafy green vegetables from domestic sources. Geographic representation and seasonal growing trends were maintained and it was left to the discretion of the Sample Officer to ensure that appropriate numbers of samples from within each category were collected from a representative cross section of growers. During the sampling period, Sample Officers collected a total of 201 samples; 119 lettuce, 8 rocket, 26 spinach and 48 other leafy green vegetables.

Samplings of lettuce, spinach, rocket and other leafy green vegetables

Samples were collected by trained Sample Officers, in accordance with Standard Operating Procedure (SOP) 'Field sampling and transportation of lettuce and spinach samples for the UK Nitrate Monitoring Programme' (see Appendix 5) and Commission Regulation EC/1882/2006. Prior agreement was obtained from the grower before a sample was taken.

A minimum of 10 heads of lettuce or 1.0 kg of spinach, rocket and other leafy green vegetables was randomly collected from various points within the lot. Where samples were collected from the field or glasshouse the sample points were, as far as possible, evenly distributed across the area by walking a 'W' pattern back and forth. Lot size did not exceed 2.0 ha and samples were not taken from the field edges. Plants were not collected from patches within the lot which appeared unrepresentative and material that was obviously damaged or diseased was avoided.

Sample labelling and documentation

The sampling schedule assigned a unique identification number to each sample, along with details of the Sample Officer, month of collection and region. All samples were anonymised. A copy of the schedule was sent to each Sample Officer and the laboratory to ensure that all parties were fully informed and prepared. Pre-printed labels were provided by NRM and sent directly to the Sample Officers. Samples were sealed and labelled by the Sampling Officer, immediately following collection. The Project Manager held a master copy of the schedule and tracked sample collection, analysis and reporting of results throughout the year.

Transportation of samples to the laboratory

Each sample was carefully placed into a clean polythene bag which was subsequently placed into polystyrene insulated box, provided by NRM. Ice packs were placed in the base of the box, as appropriate, to ensure the sample remained below 10°C during transit. The containers

provided were inert and offered adequate protection for samples against water loss, deterioration, contamination, damage, heat and significant changes in nitrate content during transportation to the laboratory. Samples were dispatched to the laboratory to arrive before 10.30am on the day after harvest. Samples from Scotland and Northern Ireland were placed in sealed plastic bags and transported in insulated containers at <10°C, which arrived at the laboratory within two days of harvest.

Crop husbandry details

Details were collected by the Sample Officers to accompany each sample. Details included grower, date and time sample was collected, variety or type, location, lot size and fertiliser input.

Sample receipt

Samples were checked upon receipt to ensure they met the requirements of EC Regulation 1882/2006. Basic checks were carried out to ensure that the temperature upon arrival was below 10°C and that samples were intact and had not begun to degrade during transportation. Associated documentation was checked against the sample and each sample was assigned a unique NRM laboratory number, which was later reported alongside the unique identification number.

Sample preparation in the laboratory

Samples were prepared in accordance with the requirements of EC Regulation 1882/2006 and the quality assurance procedures meet the requirements of the Joint Code of Practice for Quality Assurance in Research and are in Compliance with the provisions of items 1&2 of Annex III to Regulations (EC) No 882/2004.

The whole sample was homogenised using a protocol developed by NRM Ltd which has been demonstrated to produce suitably homogenous samples. Four representative sub-samples were taken, (A, B, C and D). Sub-sample A was used immediately for analysis. Sub-sample B was kept refrigerated in case of a requirement for repeat analysis when exceedance occurred. Sub-samples C and D were frozen and will be kept in storage for 12 months following the reporting of results.

Analytical analysis

Analysis commenced immediately after preparation and initial analysis of all samples was completed within five days of sampling. Analysis was undertaken using a UKAS accredited method which fully meets the requirements of EC Regulation 1882/2006. The method is accredited to BS EN ISO 17025: 2005 and has been since 2000. The method uses an extraction procedure which has been shown to be reliable and robust and involves freezing in liquid nitrogen prior to homogenisation. Detection is based on flow injection colorimetry and is currently used by NRM Ltd for analysis of all commercial samples.

The determination of nitrate-N is based on the formation of a diazo compound between nitrite and sulphanilamide. This compound is then coupled with N-1-Napthylethylenediamine dihydrochloride to produce a red azo dye. The colour is measured at a light wavelength of 540 nm in a spectrophotometer. Nitrate is reduced quantitatively to nitrite by cadmium metal in the

form of an open tubular cadmium reactor (OTCR). The nitrate content of the sample was calculated from the analysed nitrate-N value.

Nitrite-N was monitored and was quantified if it was present. The measurement of Nitrite was not part of the accredited Nitrate method and was dealt with, when required, outside of the accredited system.

If any value was ≥ 90% of the maximum Nitrate level (Table 1) for a particular product then this triggered a requirement for a repeat extraction and analysis of refrigerated Sample B to confirm the high value. This repeat confirmatory analysis was carried out within two days of the initial analysis and both results were reported on the same day.

Table 1. Maximum permitted concentrations of nitrates in lettuce, spinach and rocket.

Product	**Maximum permitted levels (NO_3 mg kg^{-1})**	
Fresh spinach		3500
Preserved, deep-frozen or frozen spinach		2000
Fresh lettuce Non-iceberg type	*Harvested 01 October to 31 March:* Lettuce grown under cover Lettuce grown in the open air	 5000 4000
	Harvested 01 April to 30 September: Lettuce grown under cover Lettuce grown in the open air	 4000 3000
Fresh lettuce Iceberg type	Lettuce grown under cover Lettuce grown in the open air	2500 2000
Rocket	*Harvested 01 October to 31 March* *Harvested 01 April to 30 September*	7000 6000
Other leafy green vegetables		n/a

Quality control

All quality control (QC) information was recorded on the laboratory worksheets. Routinely an in-house reference material is included with every batch of samples at a frequency of at least one QC sample in every batch of twenty samples. A spiked sample may also be included at the same frequency if required. A reagent blank is prepared with each batch of samples. A mid-range standard is included at the end of each batch to ensure any drift over the run is within acceptable limits (+/- 5%). All QC results are plotted on Shewart Charts and monitored to ensure they conform to NRM's policy on Quality Control (i.e. precision, accuracy, 9 point bias, ascending or descending trends etc).

In-house reference materials are routinely used. These are prepared in-house from material obtained from growers or retailers. These materials are typical of produce entering the retail chain and therefore contain nitrate levels typical of those encountered in the marketplace. New materials are run alongside existing materials to obtain reference values for the new material.

The value obtained for the reagent blank must be less than 0.2 mg/l NO_3-N. This equates to 8.9 mg kg^{-1}. One QC value at ± 2 standard deviations = Warning. Two consecutive QC values at ± 2 standard deviations = Action. One QC value at ± 3 standard deviations = Action.

A QC Failure Record is generated when an Internal QC falls outside the required criteria. This initiates a documented investigation into the cause of the failure under NRM's Non-Conforming Work policy. This typically results in the retained sample being re-extracted and re-analysed from the start.

New in-house reference materials and standard solutions are crossed over against the current reference material or standard solution prior to use. Documented evidence of this cross-over is retained. Control materials are included in every batch at a frequency of at least one QC sample in every batch of twenty samples (5%). LOQ = 50 mg kg-1, LOD = 6 mg kg^{-1}, Blanks = generally less than 2 mg kg^{-1}. Precision values over the relevant concentration range expressed as relative standard deviations; 4.4% at approx. 2000 mg kg^{-1}, 8.9% at approx. 450 mg kg^{-1}, 11.3% at approx. 100 mg kg^{-1}. IHRM: Currently Spinach, mean = 314 mg kg^{-1}, SD = 15.6 mg kg^{-1}, RSD = 5%.

Recovery was determined on five batches of triplicate samples spiked at three levels. Approx. 2000 mg kg^{-1} average recovery = 98%, range = 94% - 105%, approx. 450 mg kg^{-1} average recovery = 102%, range = 85% – 114%, approx. 100 mg kg^{-1} average recovery = 104%, range = 80% - 117%. Reporting limit = 50 mg kg^{-1}. Recovery: acceptable between 90% and 110%. Measurement uncertainty is estimated using precision and bias data.

Reporting of results

Analysis commenced immediately after preparation and initial analysis of all samples was completed within five days of sampling. Where nitrate levels exceeded the limits specified by the Commission the frozen sub-sample was re-analysed within two days of the initial analysis, in all cases. Results were received by ADAS within five days of sample receipt. Nitrate concentrations are expressed in milligrams of nitrate per kilogram of sample fresh weight (mg kg^{-1}).

Communication of results to FSA

Results were reported to the FSA on a monthly basis. Individual data were reported in an Excel spreadsheet and filters were added to the column headings to enable the FSA to search for and group results, as appropriate. Monthly mean values and running totals of maximum, minimum and mean nitrate levels, grouped according to category, were tabulated (Appendix 1 and Appendix 2).

Communication of results to growers and wholesalers

A template letter was produced by the FSA and forwarded to ADAS for use when reporting results (Appendix 3). When the nitrate level of a sample was within the maximum permitted level, as described in Commission Regulation (EC) No 1881/2006 or Commission Regulation (EC) No 1258/2011 (from 02 December 2011 onwards) and as retained as GB law, ADAS reported the results directly to the grower/wholesaler. A copy of the letter was also sent to the FSA. If the nitrate level in a sample exceeded the maximum permitted limit then, following confirmation of the result by NRM, ADAS informed the responsible person at the Agency before reporting the result to the grower/wholesaler (Appendix 4).

Long term sample storage in case of dispute

Sub-samples 'C' and 'D' (see above) from each sample have been frozen and will be stored by NRM for a period of 12 months after the reporting of results.

RESULTS

Sample overview by region

A total of 201 domestic samples were collected during July 2020 – March 2021 and grouped by region (**Figure 1**).

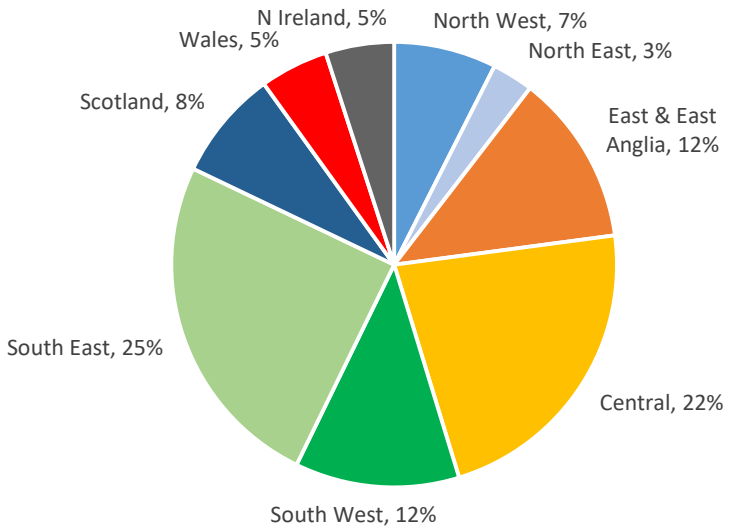

Figure 1. Pie chart showing the percentage of samples collected from each region July 2020 – March 2021 (total 201 samples).

Differences in the mean nitrate concentration were observed between the regions with the highest domestic mean concentration (3230 mg kg^{-1}) in Wales compared with 2443 mg kg^{-1} reported in the South East region in 2018/19. The lowest mean concentration (896 mg kg^{-1}) was reported for Scotland compared with 1580 mg kg^{-1} in the East and East Anglia in 2018/19 (Table 2). But this may be reflected as changes in samples numbers (e.g. increased number of Kale samples) which may change in subsequent years as a result of varying products of differing lineages (e.g. salad vs. brassica leaf). Only three samples exceeded the maximum nitrate level taken from central and south east England, and Wales, compared with seven samples in the 2018/19 season. An additional four samples had nitrate concentrations that fell within 10% of the maximum permitted level.

Table 2. Nitrate levels shown by region for UK grown samples.

Region	No. samples collected	Min. NO_3 content (mg kg^{-1})	Max. NO_3 content (mg kg^{-1})	Mean NO_3 content (mg kg^{-1})	No. samples within 10% of max. level (inc. those exceeding limit)	No. samples exceeding max. level following retest
North West	15	701.1	4831	2605	0	0
North East	6	279	4217	1596	0	0
East & East Anglia	25	129.9	4700	2494	0	0
Central	45	265.5	6073	2319	1	1
South West	24	50	5562	1362	0	0
South East	50	217.7	4758	2477	2	1
Scotland	16	62.2	2117	896	0	0
Wales	10	2329.3	4947	3230	1	1
Total	201					

Sample overview by category

A total of 201 samples were collected between July 2020 and March 2021 (Figure 2). Lettuce samples were sub-divided into iceberg (17 samples) and non-iceberg (102 samples) categories. Non-iceberg samples were further divided into open air summer (01 April – 30 September) (42 samples), open air winter (01 October – 31 March) (6), protected summer (6) and protected winter (48) categories. All iceberg lettuce samples were collected from the field and none were grown in a protected environment. All but two of the rocket (8) samples were collected from the field during the summer period. 48 samples fell into the 'other leafy green vegetables' category, described as Cima di rapa (1), lambs cress (1), Romanesco (1), Tatsoi (1), white dutch/processing cabbage (1), winter greens (1), Yellow chard (1), celery (2), Chard (2), Radicchio (2), Spring greens (3), Bulls blood (3), Chinese leaves (4), pointed cabbage (4), savoy cabbage (4), Mizuna (5), Red chard (5), kale (7).

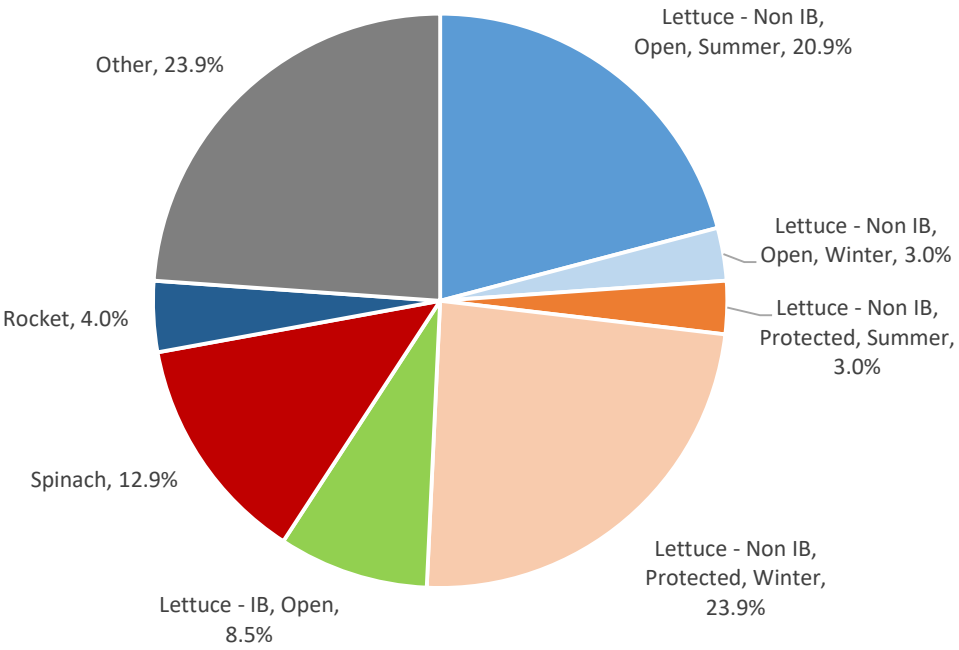

Figure 2. Pie chart showing the percentage of samples collected for each category, May 2020 – March 2021 (total 201 samples). IB – Iceberg; Non IB – Non Iceberg.

Overview of Nitrate Concentration

Nitrate concentrations in UK grown lettuce, spinach and rocket were influenced by the season with nitrate levels tending to increase as the season progressed from mid-summer to winter (Figure 3a, 3b and 3c).

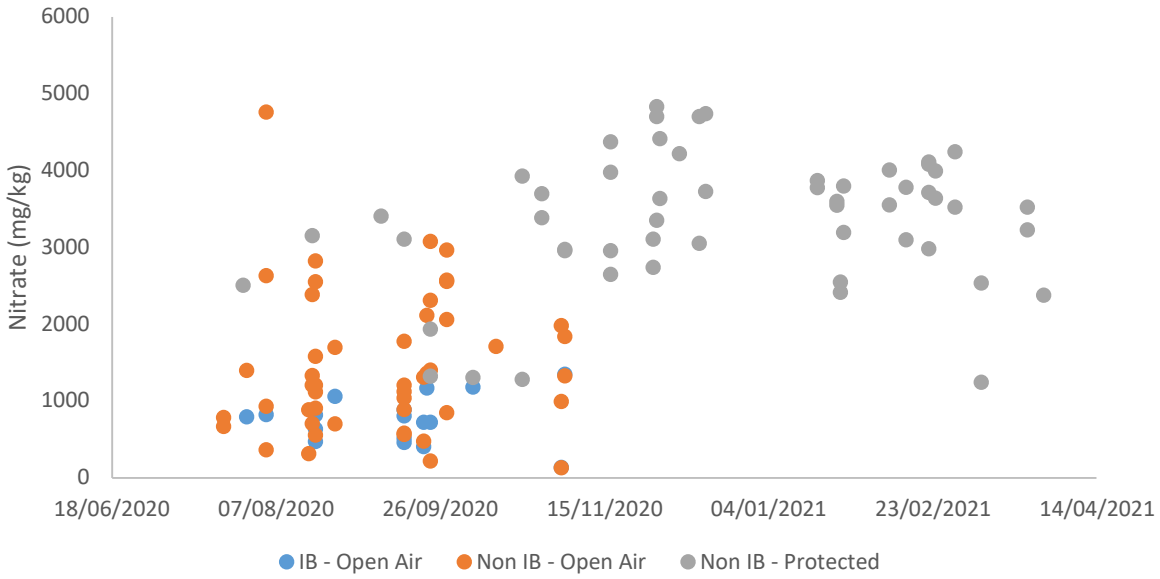

Figure 3a. Graph of nitrate levels in UK grown lettuce during 2020-2021. The trend shows an increase in nitrate concentration during the winter months. IB – Iceberg, Non IB – Non Iceberg.

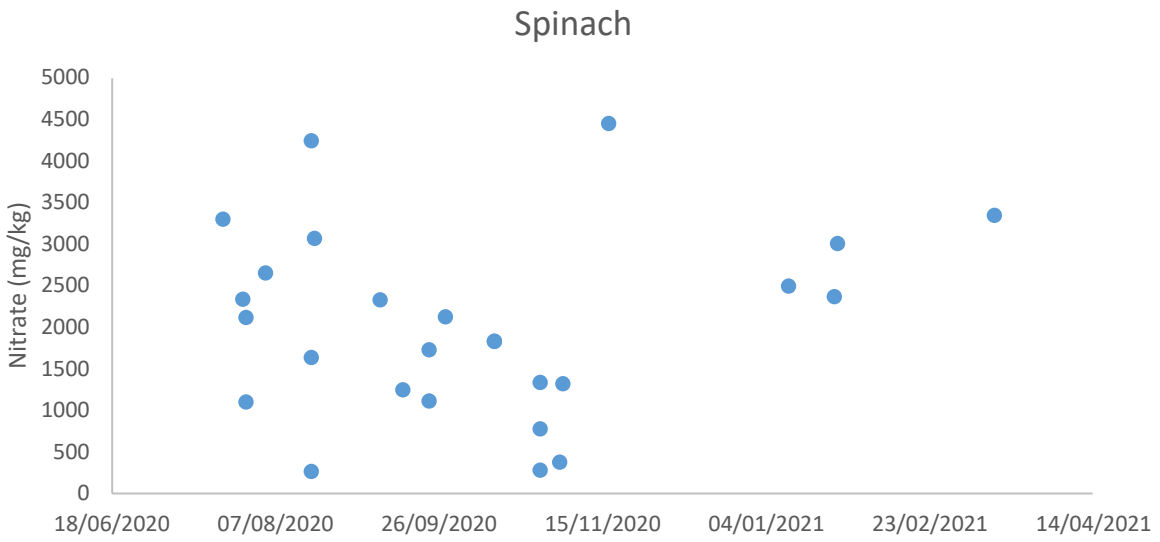

Figure 3b. Graph of nitrate levels in UK grown spinach during 2020-2021. Nitrate levels tend to increase as the season progresses.

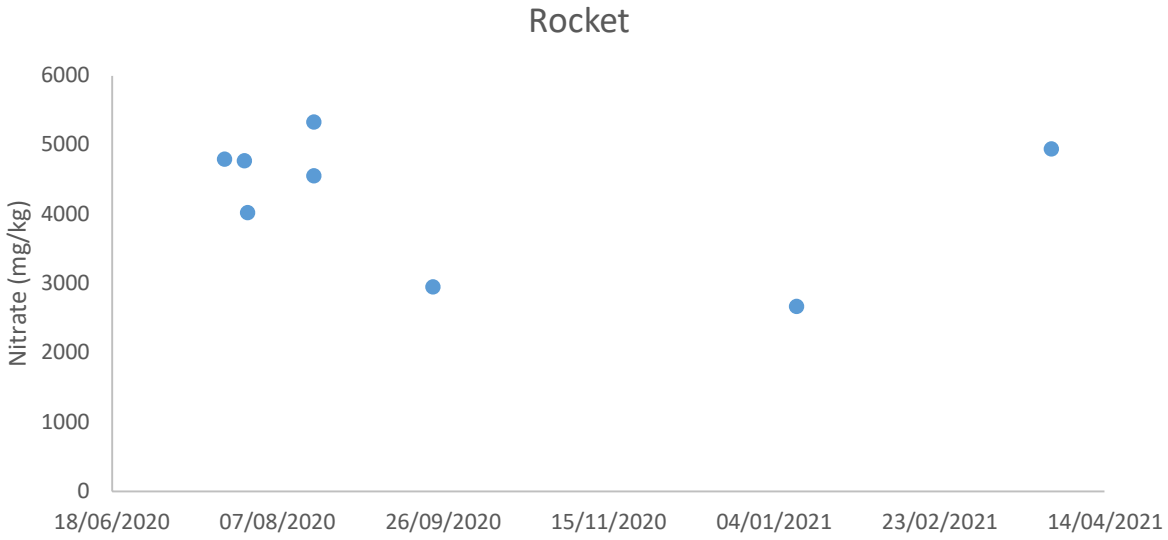

Figure 3c. Graph of nitrate levels in UK grown rocket during 2020-2021. The trend shows an increase in nitrate concentration as the season progresses.

Results by Category

Spinach

Fresh spinach samples (26 in total) were collected between July 2020 and March 2021. Nitrate concentrations ranged from 265 to 4454 mg kg^{-1}, averaging 2026 mg kg^{-1}. Two spinach samples exceeded the maximum threshold of 3500 mg kg^{-1} in samples harvested in August and November 2020 (4162 and 4583 mg kg^{-1} respectively). Two further samples were within 10% of the maximum threshold – 3301 and 3346 mg kg^{-1} harvested in July and March 2020 respectively.

Rocket

Eight samples of rocket were collected between September 2020 and April 2021. Summer concentrations varied between 2950 – 5335 mg kg^{-1} (4406 mg kg^{-1} on average from 6 samples) with winter concentrations varying between 2672 – 4947 mg kg^{-1}, or 3809 mg kg^{-1} on average from 2 samples. No samples exceeded either the permitted limit of 6000 mg kg^{-1} (summer) or 7000 mg kg^{-1} (winter), nor approached the 10% threshold.

Iceberg type lettuce

17 samples of open air-grown iceberg-type lettuce were samples between July and November 2020. Nitrate concentrations varied between 133 – 1345 mg kg^{-1}, with an average of 761 mg kg^{-1}. No samples exceeded either the permitted limit of 2000 mg kg^{-1}, nor approached the 10% threshold.

Non-iceberg type lettuce grown in a protective environment

54 samples of non-iceberg type lettuce grown under protection – 48 between October 2020 and April 2021, and 6 between July and September 2020. Winter levels varied between 1245 – 4831 mg kg^{-1}, with an average of 3439 mg kg^{-1}. Four samples were within 10% of the maximum permitted level, although none exceeded the maximum level following retest. Of the winter samples concentrations varied between 1324 – 3405 mg kg^{-1}, with an average of 2571 mg kg^{-1}. No winter samples approached within 10% of the permitted threshold.

Non-iceberg type lettuce grown in the open air

For non-iceberg type lettuce grown in the open air 48 samples were collected – 42 samples between July and September 2020, and 6 samples between October and November 2020. Summer concentrations varied between 217 – 4758 mg kg^{-1}, averaging 1475 mg kg^{-1}. Winter samples varied between 130 – 1981 mg kg^{-1}, averaging 1330 mg kg^{-1}. Three samples approached the 10% threshold of 3000 mg kg^{-1}, and one sample exceeded this limit after retest in the summer samples. No samples approached the 10% threshold in the winter.

Summary figures for all samples tested are given in **Table 4** below.

Table 4. Nitrate levels shown by category for 2020-21 UK grown samples.

UK grown samples		Max. permitted (mg NO_3/kg)	No. samples	Min. NO_3 (mg kg^{-1})	Max. NO_3 (mg kg^{-1})	Mean NO_3 (mg kg^{-1})	No. samples within 10% of max. level (inc. those exceeding limit)	No. samples exceeding max. level following retest
Lettuce non-iceberg type	*Harvested 01 October - 31 March*							
	Lettuce grown under cover	5000	48	1245	4831	3439	4	0
	Lettuce grown in the open air	4000	6	129.9	1981	1330	0	0
	Harvested 01 April - 30 September							
	Lettuce grown under cover	4000	6	1324.2	3405	2571	0	0
	Lettuce grown in the open air	3000	42	217.7	4758	1475	3	1
Iceberg type lettuce	Lettuce grown in the open air	2000	17	133.2	1345	761	0	0
Spinach	*Fresh*	3500	26	265.5	4454	2027	4	2
Rocket	*Harvested 01 October - 31 March*	7000	2	2672.1	4947	3809	0	0
	Harvested 01 April - 30 September	6000	6	2950.6	5335	4407	0	0
Other leafy green veg		n/a	48	<50	6073	1842	n/a	n/a
		Total	201				11	3

Comparison of 2020/21 data with long term average data

Mean nitrate concentration

Data from 2014 – 2021 were used to calculate a long term mean (LTM) nitrate concentration for each category and data from 2020/21 were compared with the LTM values on a calendar-year basis (Figure 4). Figures are not presented for other leafy vegetables as the relative proportions of different cultivars vary between years precluding long-term mean calculation.

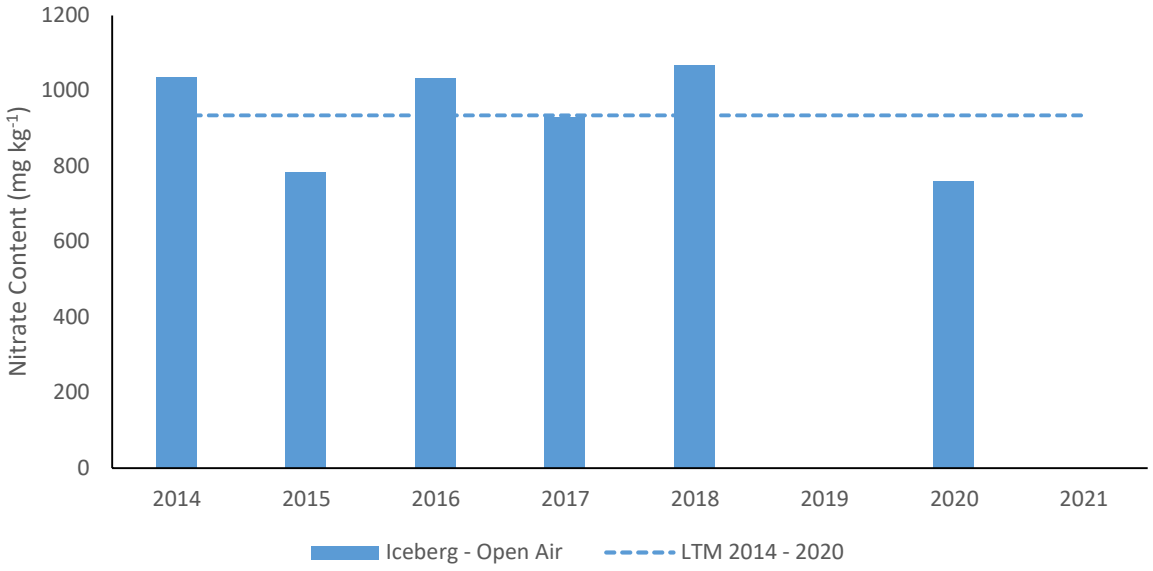

Figure 4a. Comparison of annual average nitrate concentrations for outdoor iceberg-type lettuce compared with the LTM.

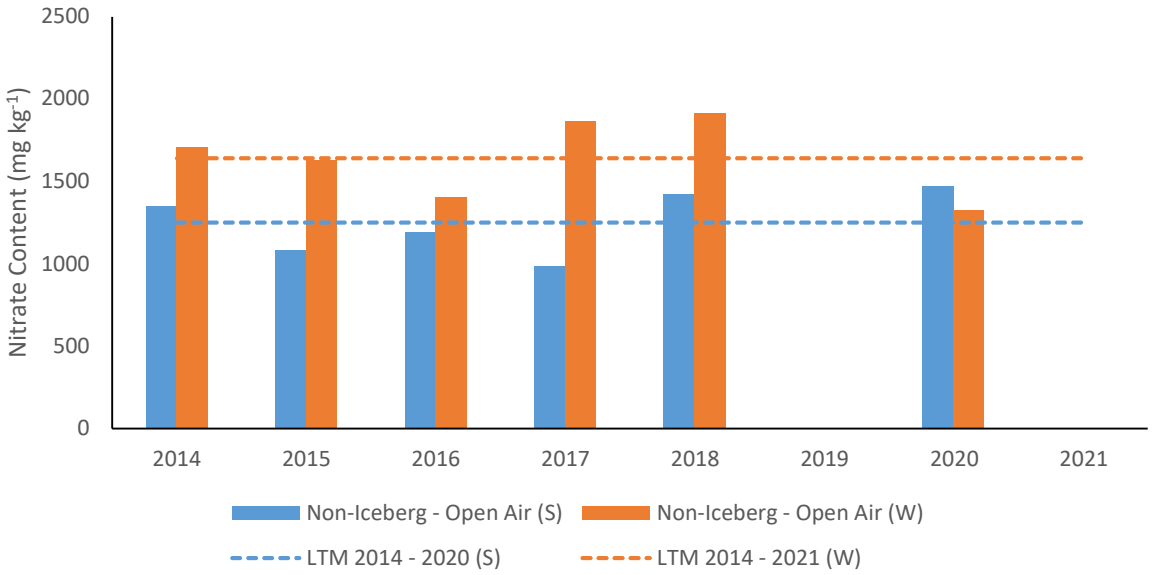

Figure 4b. Comparison of annual average nitrate concentrations for open air non-iceberg type lettuce grown in the summer (S) and winter (W) compared with the LTM.

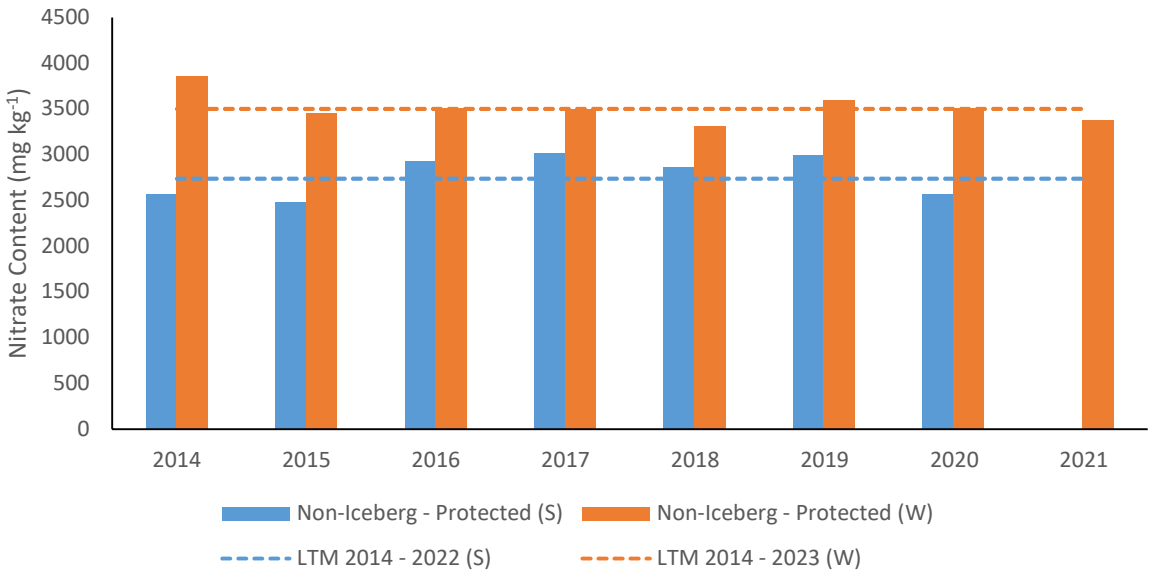

Figure 4c. Comparison of annual average nitrate concentrations for protected non-iceberg type lettuce grown in the summer (S) and winter (W) compared with the LTM.

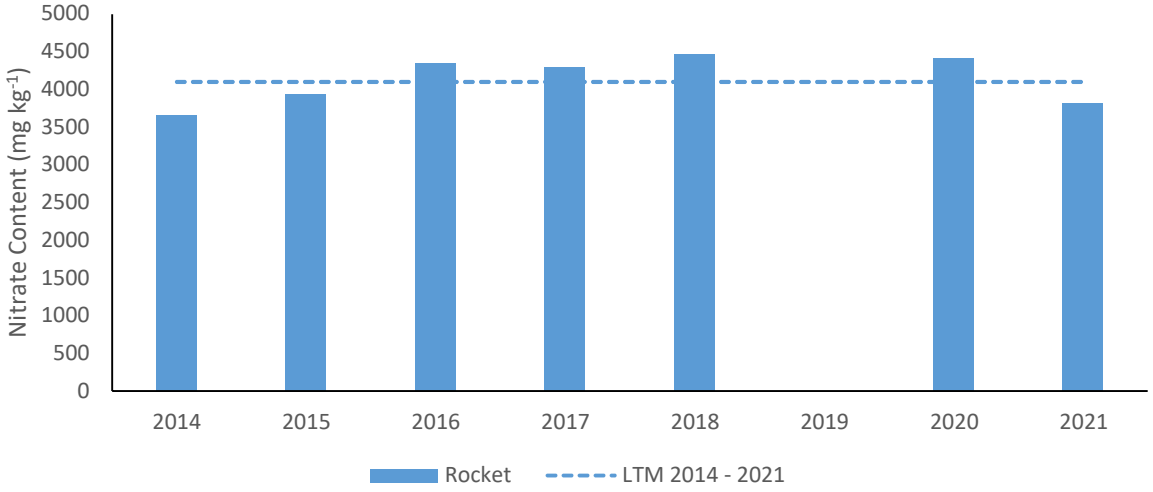

Figure 4d. Comparison of annual average nitrate concentrations for rocket compared with the LTM.

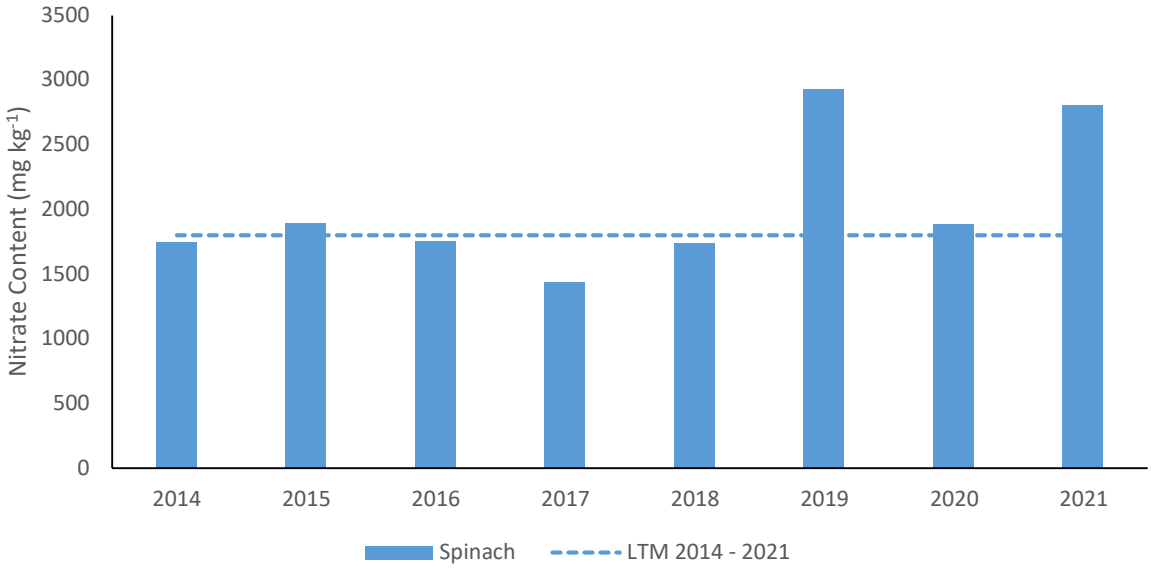

Figure 4e. Comparison of annual average nitrate concentrations for spinach compared with the LTM.

The 2020 mean nitrate content for iceberg grown in the open air (935 mg kg^{-1}) was significantly lower than the LTM (935 mg kg^{-1}), and is the lowest recorded in the past five years. Winter grown non-iceberg types grown in the open air were also below the LTM (1330 vs. 1642 mg kg^{-1}), and were also at the lowest level recorded over the last five years. However, summer grown open air non-iceberg types exceeded the LTM (1475 vs. 1252 mg kg^{-1}) although levels were relatively comparable to those recorded in 2018. Conversely, summer grown protected non-iceberg types were below the LTM (2571 vs. 2738 mg kg^{-1}) whilst winter grown protected non-iceberg types marginally exceeded the LTM (3508 vs. 3501 mg kg^{-1}). Variation between summer and winter grown non-iceberg types was significantly greater in the protected samples compared with those grown in the open air – open air-grown samples showed the closest mean nitrate content than that recorded since 2014. Nitrate levels in winter-grown protected non-iceberg lettuce show relatively consistency over the past five years, unlike those grown in other conditions, most likely as a result of more consistent growing environments under protection. Although nitrate levels in spinach in 2021 significantly exceed that of the LTM this is likely to be due to sampling bias – only three samples have been collected in January 2021 at the time of writing, and it is anticipated that average levels will be lower for when compared across the entirety of 2021. Similarly, the average for 2019 is based on a single sample collected in February rather samples taken across the duration of the year.

The proportion of domestic samples exceeding the maximum permitted nitrate concentration

The percentage of domestic samples exceeding the Regulation limit has shown a decreasing trend over the last decade, and samples collected in 2020 continue this trend (Figure 5). The overall proportion of UK grown samples that exceeded the Regulation limit in 2020 was 1.96%, reduced from 4.5% in 2018. This was due to one sample of open air non-iceberg lettuce, and two samples of spinach from a total of 153 samples (excluding other leafy green veg for which no limits are set). A further 11 samples had nitrate concentrations which were within 10% of the maximum permitted level.

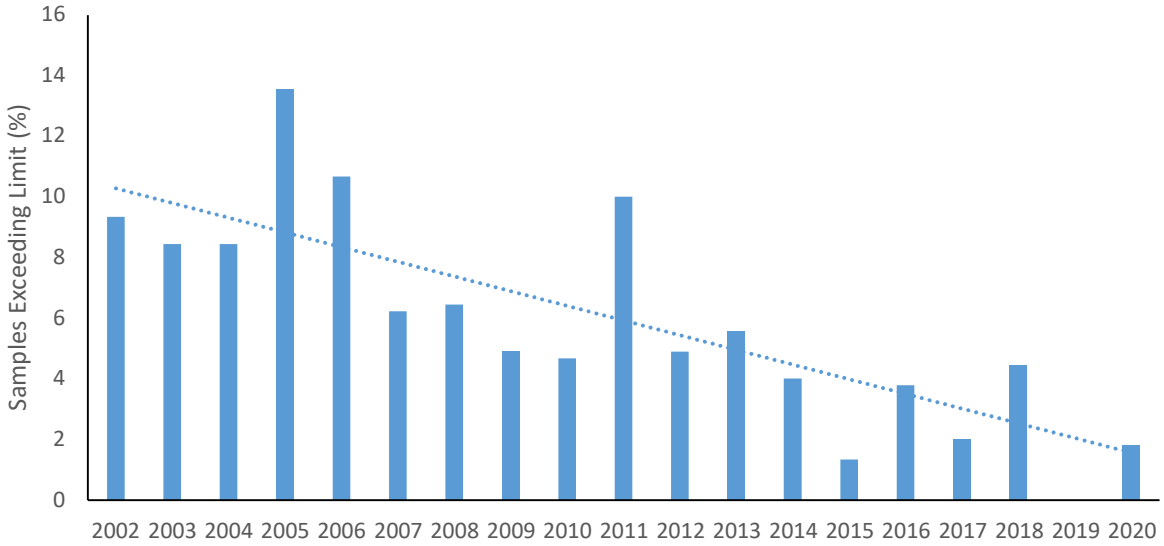

Figure 5. Graph showing the percentage of UK grown samples collected each year from 2002 – 2020 which exceed the Regulation limit.

For the fifth year (excluding 2019), no iceberg lettuce samples exceed the permitted maximum nitrate concentration, and there were no samples approaching the 10% maximum threshold.

Only 18 samples out of the 895 collected since 2014 have exceeded the necessary limits for lettuce, rocket, and spinach (Figure 6). The majority of these samples (5 each) were in non-iceberg types grown under protection in the summer, rocket and spinach. Over this period only a single open-air non-iceberg lettuce exceeded the threshold collected in 2020.

For lettuce grown under protection less than 5% of samples collected exceeded the limit since 2014, except for 2017 were 11.5% of summer-grown samples exceeded the thresholds. However, only six samples were collected for summer grown protected non-iceberg lettuce in 2020, compared with 18 samples per year on average since 2014.

While there have been no samples of rocket exceeding the threshold since 2017, three samples of spinach have exceeded the limit since 2018.

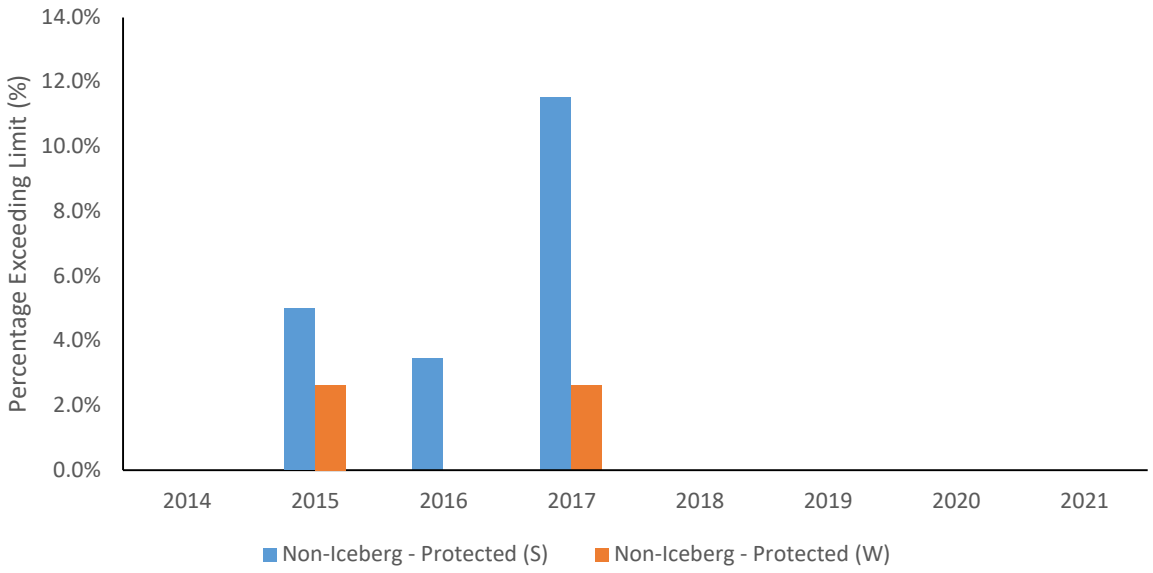

Figure 6a. Graph showing the percentage of samples collected each year (2014 – 2021) that exceeded the maximum limit for protected non-iceberg lettuce grown in the summer (S) or winter (W).

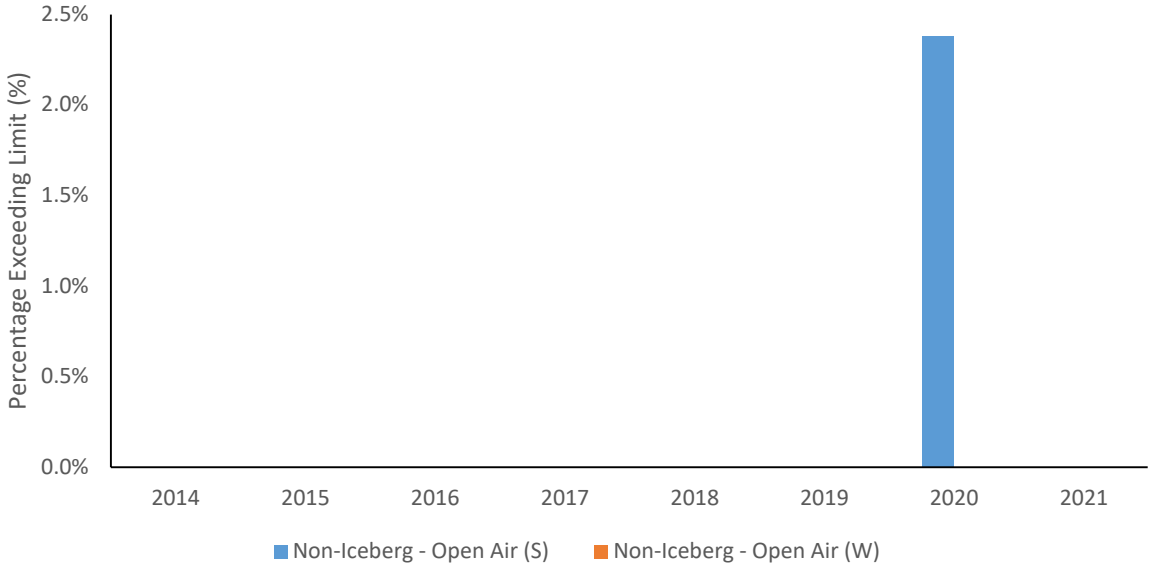

Figure 6b. Graph showing the percentage of samples collected each year (2014 – 2021) that exceeded the maximum limit for open air non-iceberg lettuce grown in the summer (S) or winter (W).

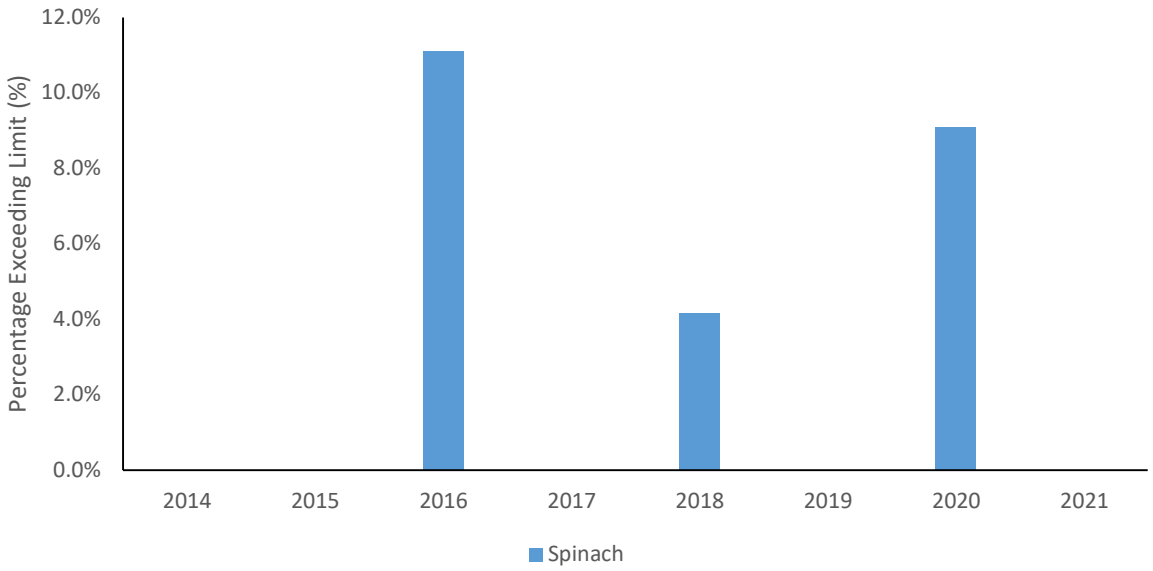

Figure 6c. Graph showing the percentage of samples collected each year (2014 – 2021) that exceeded the maximum limit for spinach.

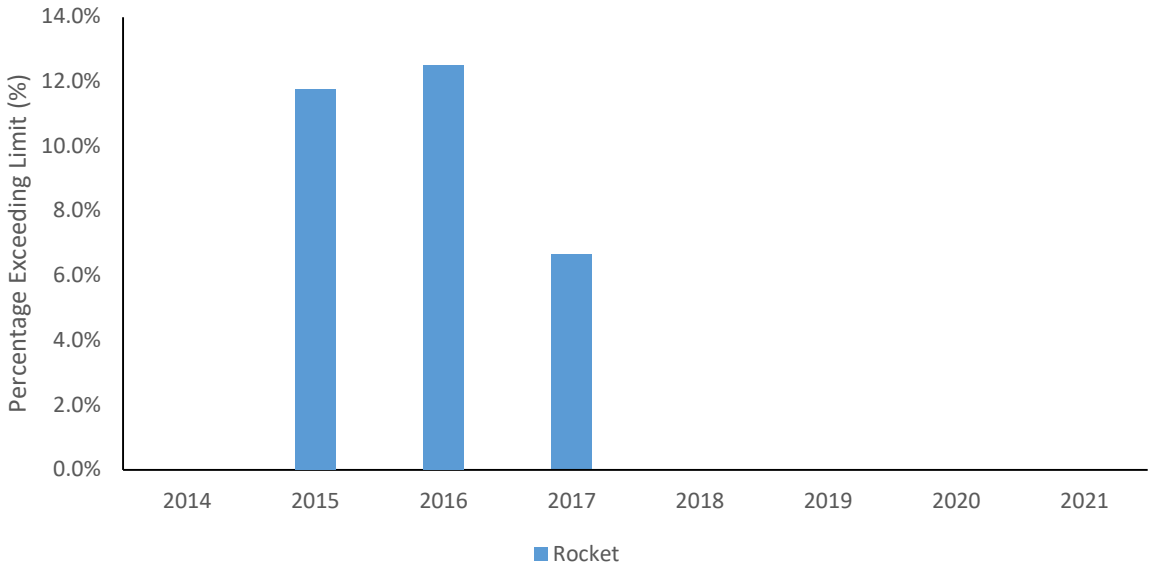

Figure 6d. Graph showing the percentage of samples collected each year (2014 – 2021) that exceeded the maximum limit for rocket.

Discussion

For sample types which are subject to Commission Regulation (EC) No. 1258/2011, the percentage of UK grown samples exceeding the permitted maximum nitrate concentration for their respective sample types has remained below 10% since 2007 with a decreasing trend observable (Figure 5). The introduction of Commission Regulation (EC) No. 1258/2011 and the associated increase in the maximum permitted nitrate concentration for fresh spinach could be partially responsible for decrease of sample failures.

Iceberg lettuces and open-air, winter non-iceberg lettuces have the lowest frequency of samples exceeding their permitted maximum nitrate concentrations whilst spinach and rocket samples exceed their respective permitted maximum nitrate concentrations most frequently.

Some evidence of an increase in nitrate concentration across all domestic crops throughout the summer is observable in Figure 3. Early summer crops (May - June) appear to have lower nitrate levels than those harvested later in the season. As discussed in previous annual reports, this is likely because as the season progresses, samples are being collected from second and third crops which are sown on top of previous crop residues and their associated fertiliser inputs. This causes soil mineral nitrogen to accumulate through the season and if fertiliser input is not reduced accordingly then nitrate levels are likely to increase.

For period of 2002 – 2021, ADAS has been involved with the collection of lettuce and spinach samples; data has been collected from rocket samples across seven seasons. During this time we have compiled a unique dataset and it is unlikely that a comparable data set exists elsewhere in the UK but detailed statistical analysis of the data is beyond the scope of this study.

Research project CO3030 ‘Sampling for nitrate in lettuce and spinach’ concluded that short-term fluctuations in light level (shading 24-48h before harvest) had little effect on nitrate levels compared with the large difference known to occur following dull periods 10-14 days before harvest (Weightman *et al*., 2006). This supports findings by Burns (2000), who showed that it was the 7-10 day period prior to harvest that was important in terms of influencing nitrate level. HDC-funded work in 2010 (Roques and Weightman, 2010) showed that there was a correlation between light levels in the 5 days prior to harvest and total nitrate concentration.

Early 2020 saw extremely wet weather followed by a dry spring into April and May which delayed planting of salad crops and poor seed bed establishment, particularly on heavy soils. Weather conditions were more favourable from the end of May, and while hotter spells in July and August increased irrigation pressure in some areas, frequent showers generally favoured salad production. Notably, heavy rainfall at the end of May badly impacted lettuce crops in Lancashire. Rainfall may impact leaf nitrate content – heavy rainfall will promote leaching of soil nitrate as well as diluting nitrate concentrations limiting uptake, whilst dry soils will show increased nitrate concentrations leading to greater uptake (Huang *et al*., 2010) although generally good conditions in 2020 means that water availability is unlikely to have had a significant impact on nitrate concentrations.

Open air iceberg types showed little variation in nitrate levels over a relatively narrow growing season, but sufficient soil moisture and warm summer conditions are likely to have kept nitrate levels low. Greater nitrate concentrations in non-iceberg types were seen throughout the season, reaching a peak from August to September. Higher levels in protected salads, especially in the later season, are likely to be reflective of lower light levels leading to increased accumulation in the leaf. Reduced summer nitrate content may also be due to an increase in average daytime temperature and daylength, with reports summer grown lettuce may have three times lower nitrate content in the summer period (Van Eysinga, 1984) compared with the winter. Greater temperatures and increased light interception in the summer may boost plant development and downstream biochemistry to prevent accumulation of high concentrations of nitrates. This corresponds with assessments that lower concentrations may be seen in produce grown in southern Europe due to warmer conditions (Weightman *et al*., 2006). Unbalanced applications of nitrogenous fertilisers, and that the use of sulphates or amino acid products as part of the fertiliser regimen may reduce content.

Relevant meteorological data could be purchased from Meteorological Office loggers which are located throughout the UK or alternatively could be obtained from the peer reviewed Irriguide Model and used in conjunction with data collected during the surveillance studies. If funding was available the data could be explored to further our understanding of interactions between nitrate concentration, lettuce type, crop husbandry, agricultural practices, fertiliser input, edaphic factors and environmental factors including climate change scenarios. The outcome of such a study would enable industry to refine their growing practices and would serve as supporting data for the Food Standards Agency.

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APPENDIX 1. UK domestic sample monthly summaries

			Sampling Month						Running Total						
July 2020		Max. permitted (mg NO_3/kg)	No. samples	Min. NO_3 (mg kg^{-1})	Max. NO_3 (mg kg^{-1})	Mean NO_3 (mg kg^{-1})	max. level	No. samples exceeding max. level	No. samples	Min. NO_3 (mg kg^{-1})	Max. NO_3 (mg kg^{-1})	Mean NO_3 (mg kg^{-1})	No. samples of max.	No. samples
Lettuce non-iceberg type	*Harvested 01 October - 31 March*													
	Lettuce grown under cover	5000												
	Lettuce grown in the open air	4000												
	Harvested 01 April - 30 September													
	Lettuce grown under cover	4000	1	2507.1	2507	2507.1								
	Lettuce grown in the open air	3000	3	669.9	1398	950.3667								
Iceberg type lettuce	Lettuce grown in the open air	2000	1	792.7	793	792.7								
Spinach	*Fresh*	3500	4	1100.7	3302	2214.075	1							
Rocket	*Harvested 01 October - 31 March*	7000												
	Harvested 01 April - 30 September	6000	3	4025.3	4796	4532.533								
Other leafy green veg		n/a	2	449.9	3150	1799.75								
		Total	14				1							

August 2020		Max. permitted (mg NO_3/kg)	Sampling Month						Running Total					
			No. samples	Min. NO_3 (mg kg^{-1})	Max. NO_3 (mg kg^{-1})	Mean NO_3 (mg kg^{-1})	max. level	No. samples exceeding max. level	No. samples	Min. NO_3 (mg kg^{-1})	Max. NO_3 (mg kg^{-1})	Mean NO_3 (mg kg^{-1})		samples
Lettuce non-iceberg type	*Harvested 01 October - 31 March*													
	Lettuce grown under cover	5000												
	Lettuce grown in the open air	4000												
	Harvested 01 April - 30 September													
	Lettuce grown under cover	4000	1	3152.1	3152	3152.1			2	2507.1	3152.1	2829.6		
	Lettuce grown in the open air	3000	19	315.3	4758	1508.205	1	1	22	315.3	4758.1	1432.136	1	1
Iceberg type lettuce	Lettuce grown in the open air	2000	5	472.6	1058	761.16			6	472.6	1057.7	766.4167		
Spinach	*Fresh*	3500	5	265.5	4246	2374.02	1	1	9	265.5	4245.9	2302.933	1	1
Rocket	*Harvested 01 October - 31 March*	7000												
	Harvested 01 April - 30 September	6000	2	4558.2	5335	4946.7			5	4025.3	5335.2	4698.2		
Other leafy green veg		n/a	15	62.2	6073	2384.393			17	62.2	6073.1	2315.612		
		Total	47				2	2	61				2	2

			Sampling Month						Running Total					
September 2020		Max. permitted (mg NO_3/kg)	No. samples	Min. NO_3 (mg kg^{-1})	Max. NO_3 (mg kg^{-1})	Mean NO_3 (mg kg^{-1})	nax. level	No. samples exceeding max. level	No. samples	Min. NO_3 (mg kg^{-1})	Max. NO_3 (mg kg^{-1})	Mean NO_3 (mg kg^{-1})		samples
Lettuce non-iceberg type	*Harvested 01 October - 31 March*													
	Lettuce grown under cover	5000												
	Lettuce grown in the open air	4000												
	Harvested 01 April - 30 September													
	Lettuce grown under cover	4000	4	1324.2	3405	2442.175			6	1324.2	3405	2571.317		
	Lettuce grown in the open air	3000	20	217.7	3075.2	1521.88			42	217.7	4758.1	1474.871	1	1
Iceberg type lettuce	Lettuce grown in the open air	2000	8	403.9	1166.8	709.1125			14	403.9	1166.8	733.6714		
Spinach	*Fresh*	3500	5	1111.3	2329.3	1708.6			14	265.5	4245.9	2090.671	1	1
Rocket	*Harvested 01 October - 31 March*	7000												
	Harvested 01 April - 30 September	6000	1	2950.6	2950.6	2950.6			6	2950.6	5335.2	4406.933		
Other leafy green veg		n/a	11	50	2117.4	961.0455			28	50	6073.1	1783.461		
		Total	49						110				2	2

October 2020		Max. permitted (mg NO_3/kg)	Sampling Month						Running Total					
			No. samples	Min. NO_3 (mg kg^{-1})	Max. NO_3 (mg kg^{-1})	Mean NO_3 (mg kg^{-1})	nax. level	No. samples exceeding max. level	No. samples	Min. NO_3 (mg kg^{-1})	Max. NO_3 (mg kg^{-1})	Mean NO_3 (mg kg^{-1})		samples
Lettuce non-iceberg type	*Harvested 01 October - 31 March*													
	Lettuce grown under cover	5000	5	1282.3	3926.8	2719.42			5	1282.3	3926.8	2719.42		
	Lettuce grown in the open air	4000	1	1708.5	1708.5	1708.5			1	1708.5	1708.5	1708.5		
	Harvested 01 April - 30 September													
	Lettuce grown under cover	4000							6	1324.2	3405	2571.317		
	Lettuce grown in the open air	3000							42	217.7	4758.1	1474.871	1	1
Iceberg type lettuce	Lettuce grown in the open air	2000	1	1180	1180	1180			15	403.9	1180	763.4267		
Spinach	*Fresh*	3500	5	278.5	1834	1211.14			19	265.5	4245.9	1859.216	1	1
Rocket	*Harvested 01 October - 31 March*	7000												
	Harvested 01 April - 30 September	6000							6	2950.6	5335.2	4406.933		
Other leafy green veg		n/a	10	50	4967.1	2123.84			38	50	6073.1	1873.034		
		Total	22						132				2	2

November 2020		Max. permitted (mg NO_3/kg)	No. samples	Min. NO_3 (mg kg^{-1})	Max. NO_3 (mg kg^{-1})	Mean NO_3 (mg kg^{-1})	nax. level	No. samples exceeding max. level	No. samples	Min. NO_3 (mg kg^{-1})	Max. NO_3 (mg kg^{-1})	Mean NO_3 (mg kg^{-1})		samples
Lettuce non-iceberg type	*Harvested 01 October - 31 March*													
	Lettuce grown under cover	5000	8	2646.4	4371.7	3215.25			13	1282.3	4371.7	3024.546		
	Lettuce grown in the open air	4000	5	129.9	1980.8	1253.74			6	129.9	1980.8	1329.533		
	Harvested 01 April - 30 September													
	Lettuce grown under cover	4000							6	1324.2	3405	2571.317		
	Lettuce grown in the open air	3000							42	217.7	4758.1	1474.871	1	1
Iceberg type lettuce	Lettuce grown in the open air	2000	2	133.2	1345.1	739.15			17	133.2	1345.1	760.5706		
Spinach	*Fresh*	3500	3	375.1	4454.4	2049.967	1	1	22	265.5	4454.4	1885.227	2	2
Rocket	*Harvested 01 October - 31 March*	7000												
	Harvested 01 April - 30 September	6000							6	2950.6	5335.2	4406.933		
Other leafy green veg		n/a	2	50	279	164.5			40	50	6073.1	1787.608		
		Total	20				1	1	152				3	3

December 2020		Max. permitted (mg NO_3/kg)	Sampling Month						Running Total					
			No. samples	Min. NO_3 (mg kg^{-1})	Max. NO_3 (mg kg^{-1})	Mean NO_3 (mg kg^{-1})	max. level	No. samples exceeding max. level	No. samples	Min. NO_3 (mg kg^{-1})	Max. NO_3 (mg kg^{-1})	Mean NO_3 (mg kg^{-1})		samples
Lettuce non-iceberg type	*Harvested 01 October - 31 March*													
	Lettuce grown under cover	5000	10	3053.5	4831	4137.53			23	1282.3	4831	3508.452		
	Lettuce grown in the open air	4000							6	129.9	1980.8	1329.533		
	Harvested 01 April - 30 September													
	Lettuce grown under cover	4000							6	1324.2	3405	2571.317		
	Lettuce grown in the open air	3000							42	217.7	4758.1	1474.871	1	1
Iceberg type lettuce	Lettuce grown in the open air	2000							17	133.2	1345.1	760.5706		
Spinach	*Fresh*	3500							22	265.5	4454.4	1885.227	2	2
Rocket	*Harvested 01 October - 31 March*	7000												
	Harvested 01 April - 30 September	6000							6	2950.6	5335.2	4406.933		
Other leafy green veg		n/a	3	58.9	1897.1	679.3667			43	50	6073.1	1710.288		
		Total	13						165				3	3

			Sampling Month						Running Total					
January 2021		Max. permitted (mg NO_3/kg)	No. samples	Min. NO_3 (mg kg^{-1})	Max. NO_3 (mg kg^{-1})	Mean NO_3 (mg kg^{-1})	nax. level	No. samples exceeding max. level	No. samples	Min. NO_3 (mg kg^{-1})	Max. NO_3 (mg kg^{-1})	Mean NO_3 (mg kg^{-1})		samples
Lettuce non-iceberg type	*Harvested 01 October - 31 March*													
	Lettuce grown under cover	5000	8	2415.8	3868.3	3343.125			31	1282.3	4831	3465.787		
	Lettuce grown in the open air	4000							6	129.9	1980.8	1329.533		
	Harvested 01 April - 30 September													
	Lettuce grown under cover	4000							6	1324.2	3405	2571.317		
	Lettuce grown in the open air	3000							42	217.7	4758.1	1474.871	1	1
Iceberg type lettuce	Lettuce grown in the open air	2000							17	133.2	1345.1	760.5706		
Spinach	*Fresh*	3500	3	2368	3008.1	2623.833			25	265.5	4454.4	1973.86	2	2
Rocket	*Harvested 01 October - 31 March*	7000	1	2672.1	2672.1	2672.1			1	2672.1	2672.1	2672.1		
	Harvested 01 April - 30 September	6000							6	2950.6	5335.2	4406.933		
Other leafy green veg		n/a	1	5450.9	5450.9	5450.9			44	50	6073.1	1795.302		
		Total	13						178				3	3

February 2021		Max. permitted (mg NO_3/kg)	Sampling Month						Running Total					
			No. samples	Min. NO_3 (mg kg^{-1})	Max. NO_3 (mg kg^{-1})	Mean NO_3 (mg kg^{-1})	nax. level	No. samples exceeding max. level	No. samples	Min. NO_3 (mg kg^{-1})	Max. NO_3 (mg kg^{-1})	Mean NO_3 (mg kg^{-1})		samples
Lettuce non-iceberg type	*Harvested 01 October - 31 March*													
	Lettuce grown under cover	5000	10	2981.5	4111.7	3695.43			41	1282.3	4831	3521.798		
	Lettuce grown in the open air	4000							6	129.9	1980.8	1329.533		
	Harvested 01 April - 30 September													
	Lettuce grown under cover	4000							6	1324.2	3405	2571.317		
	Lettuce grown in the open air	3000							42	217.7	4758.1	1474.871	1	1
Iceberg type lettuce	Lettuce grown in the open air	2000							17	133.2	1345.1	760.5706		
Spinach	*Fresh*	3500							25	265.5	4454.4	1973.86	2	2
Rocket	*Harvested 01 October - 31 March*	7000							1	2672.1	2672.1	2672.1		
	Harvested 01 April - 30 September	6000							6	2950.6	5335.2	4406.933		
Other leafy green veg		n/a	2	50	859.3	454.65			46	50	6073.1	1737.013		
		Total	12						190				3	3

March 2021		Max. permitted (mg NO_3/kg)	Sampling Month: No. samples	Min. NO_3 (mg kg^{-1})	Max. NO_3 (mg kg^{-1})	Mean NO_3 (mg kg^{-1})	max. level	No. samples exceeding max. level	Running Total: No. samples	Min. NO_3 (mg kg^{-1})	Max. NO_3 (mg kg^{-1})	Mean NO_3 (mg kg^{-1})		samples
Lettuce non-iceberg type	*Harvested 01 October - 31 March*													
	Lettuce grown under cover	5000	7	1245	4245.4	2953.657			48	1245	4831	3438.944		
	Lettuce grown in the open air	4000							6	129.9	1980.8	1329.533		
	Harvested 01 April - 30 September													
	Lettuce grown under cover	4000							6	1324.2	3405	2571.317		
	Lettuce grown in the open air	3000							42	217.7	4758.1	1474.871	1	1
Iceberg type lettuce	Lettuce grown in the open air	2000							17	133.2	1345.1	760.5706		
Spinach	*Fresh*	3500	1	3346	3346	3346			26	265.5	4454.4	2026.635	2	2
Rocket	*Harvested 01 October - 31 March*	7000	1	4946.8	4946.8	4946.8			2	2672.1	4946.8	3809.45		
	Harvested 01 April - 30 September	6000							6	2950.6	5335.2	4406.933		
Other leafy green veg		n/a	2	3950.9	4556.7	4253.8			48	50	6073.1	1841.879		
		Total	11						201				3	3

APPENDIX 2. Letter sent by ADAS to communicate results

Date

xxxx

Dear Sir/Madam,

Re: UK Nitrate Monitoring Programme

Thank you for your continued support of the UK Nitrate Monitoring Programme by allowing RSK ADAS Ltd to collect field samples of your product, for analysis of nitrate content.

As you may be aware, a new Commission Regulation (EC) No 1258/2011 came into force in December 2011. This new Regulation amends Commission Regulation (EC) No 1881/2006 which sets maximum limits for nitrate levels in lettuce and spinach, together with a statutory requirement for an annual monitoring programme of nitrate levels in certain vegetables.

Commission Regulation (EC) No 1258/2011 has applied in the UK since 23 December 2011 and sets out new, permanent limits in green leafy vegetables; except the limits for rocket which applied specifically from 1 April 2012. It ends the previous temporary derogations which permitted the UK and some other EU countries to exceed maximum limits, without compromising consumer food safety, for fresh lettuce and spinach grown and intended for consumption on their own respective territories. Limits have also been included for rocket for the first time under this new Regulation. Furthermore, the regulation now allows Member States to communicate results of the monitoring programme to the European Food Safety Authority (EFSA) on a regular basis, rather than the mandatory deadline of June 30 each year. This change will, however, not affect the programme. I have attached details of the permitted maximum nitrate limits in Appendix 1.

I am pleased to provide you with the analytical results for recent sample(s) of your product, collected as part of the monitoring programme, in Table 1. Data collected will be collated, anonymised and submitted by the Food Standards Agency to EFSA, for statutory monitoring purposes.

Although the information we have provided is simply for your information, if you do find any analytical results for nitrate in produce from your farm that are above the limits specified in Commission Regulation 1258/2011, then you may wish to verify your application of the Code of Good Agricultural Practice and the controls you have in place. It is, therefore, expected that any potential breaches of limits would be addressed through voluntary review of agronomic practices. Other action(s) could be considered in the event of a breach that presents a food safety concern. In this case the FSA would take appropriate action in the interest of consumer safety.

Any additional data on nitrate in leafy vegetables you may have as part of your own monitoring would be most useful and such information can be submitted to the Food Standards Agency directly or via a Trade Association and will be treated in confidence.

If you have any queries about your results please feel free to contact me at the above address, or for more general queries about the monitoring programme, please contact Mr Ian Smith at the Food Standards Agency (Tel 020 7276 8375).

Yours sincerely

Angela Huckle
Associate Director
ADAS Horticulture
RSK ADAS Ltd

cc: Ian Smith, Food Standards Agency
Encs

Letter used from January 2021 for samples collected in GB

Date

xxxx

Dear Sir/Madam,

Re: UK Nitrate Monitoring Programme

Thank you for your continued support of the UK Nitrate Monitoring Programme by allowing ADAS to collect field samples of your product, for analysis of nitrate content.

As you may be aware, GB retained law 1258/2011 came into force in December 2011. This Regulation amends GB retained law 1881/2006 which sets maximum limits for nitrate levels in lettuce and spinach, together with a statutory requirement for Member States to monitor nitrate levels in certain vegetables.

The GB retained law 1258/2011 has applied in the UK since 23 December 2011 and sets out new, permanent limits in green leafy vegetables; except the limits for rocket which applied specifically from 1 April 2012. It ends the previous temporary derogations which permitted the UK and some other EU countries to exceed maximum limits, without compromising consumer food safety, for fresh lettuce and spinach grown and intended for consumption on their own respective territories. Limits have also been included for rocket for the first time under this new Regulation. Furthermore, the regulation now allows Member States to communicate results of the monitoring programme to the European Food Safety Authority (EFSA) on a regular basis, rather than the mandatory deadline of June 30 each year. This change will, however, not affect the programme. I have attached details of the permitted maximum nitrate limits in Appendix 1.

I am pleased to provide you with the analytical results for recent sample(s) of your product, collected as part of the monitoring programme, in Table 1. Data collected will be collated, anonymised and published by the Food Standards Agency.

Although the information we have provided is simply for your information, if you do find any analytical results for nitrate in produce from your farm that are above the maximum limits , then you may wish to verify your application of the Code of Good Agricultural Practice and the controls you have in place. It is, therefore, expected that any potential breaches of limits would be addressed through voluntary review of agronomic practices. Other action(s) could be considered in the event of a breach that presents a food safety concern. In this case the FSA would take appropriate action in the interest of consumer safety.

Any additional data on nitrate in leafy vegetables you may have as part of your own monitoring would be most useful and such information can be submitted to the Food Standards Agency directly or via a Trade Association and will be treated in confidence.

If you have any queries about your results please feel free to contact me at the above address, or for more general queries about the monitoring programme, please contact Mr Ian Smith at the Food Standards Agency (Tel 020 7276 8375).

Yours sincerely

Angela Huckle
Associate Director
ADAS Horticulture
RSK ADAS Ltd

cc: Ian Smith, Food Standards Agency
Encs

APPENDIX 3. Letter sent on behalf of the FSA to communicate results

Name Reference:
Address

Date
Dear

RE: UK NITRATE MONITORING PROGRAMME

Thank you for your continued support of the UK Nitrate Monitoring Programme by allowing RSK ADAS Ltd to collect field samples of your product, for analysis of nitrate content.

As you may be aware, a new Commission Regulation (EC) No 1258/2011 came into force in December 2011. This new Regulation amends Commission Regulation (EC) No 1881/2006 which sets maximum limits for nitrate levels in lettuce and spinach, together with a statutory requirement for an annual monitoring programme of nitrate levels in certain vegetables.

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The sample has been re-tested to confirm that the level is above the maximum limit. Both results are shown in Table 1 for your information. The Food Standards Agency does not intend to take any further action on this occasion. It is, however, expected that breaches of limits would be addressed through voluntary review of agronomic practices and regulatory action considered only after persistent breaches that threaten consumer safety. You may wish to be aware, though, that the data collected will be collated, anonymised and submitted by the Agency to the Commission, for statutory monitoring purposes.

Although the information we have provided is simply for your information, if you do find any analytical results for nitrate in produce from your farm that are above the limits specified in Commission Regulation (EC) No1258/2011, then you may wish to verify your application of the Code of Good Agricultural Practice and the controls you have in place.

Any additional data on nitrate in leafy vegetables you may have as part of your own monitoring would be most useful and such information can be submitted to the Food Standards Agency directly or via a Trade Association and will be treated in confidence.

If you have any queries about your results please feel free to contact me at the above address, or for more general queries about the monitoring programme, please contact Mr Ian Smith at the Food Standards Agency (Tel 020 7276 8375).

Yours sincerely

Angela Huckle
Associate Director
ADAS Horticulture
RSK ADAS Ltd

cc: Ian Smith, Food Standards Agency
Encs

Table 1

Results of samples taken

Grower	Sampler	Sample Date	Sample ID	Sample type	Variety	Nitrate (mg NO3/kg)	Re-test Nitrate (mg NO3/kg)

APPENDIX 1

Maximum permitted levels of nitrates in fresh spinach and lettuce (under Commission Regulation (EU) No 1258/2011)

Products	**Maximum permitted levels (mg NO_3/kg)**	
Fresh spinach		3500
Preserved, deep-frozen or frozen spinach		2000
Fresh lettuce	Harvested 1 October to 31 March: Lettuce grown under cover Lettuce grown in the open air Harvested 1 April to 30 September: Lettuce grown under cover	 5000 4000 4000

	Lettuce grown in the open air	3000
Iceberg-type lettuce	Lettuce grown under cover Lettuce grown in the open air	2500 2000

Letter used from January 2021 for samples collected in GB

Date

xxxx

Dear Sir/Madam,

Re: UK Nitrate Monitoring Programme

Thank you for your continued support of the UK Nitrate Monitoring Programme by allowing RSK ADAS Ltd to collect field samples of your product, for analysis of nitrate content.

As you may be aware, GB retained law 1258/2011 came into force in December 2011. This Regulation amends GB retained law 1881/2006 which sets maximum limits for nitrate levels in lettuce and spinach, together with a statutory requirement for Member States to monitor nitrate levels in certain vegetables.

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The sample has been re-tested to confirm that the level is above the maximum limit. Both results are shown in Table 1 for your information. The Food Standards Agency does not intend to take any further action on this occasion. It is, however, expected that breaches of limits would be addressed through voluntary review of agronomic practices and regulatory action considered only after persistent breaches that threaten consumer safety. You may wish to be aware, though, that the data collected will be collated, anonymised and published by the FSA.

Although the information we have provided is simply for your information, if you do find any analytical results for nitrate in produce from your farm that are above the maximum limits, then

you may wish to verify your application of the Code of Good Agricultural Practice and the controls you have in place.

Any additional data on nitrate in leafy vegetables you may have as part of your own monitoring would be most useful and such information can be submitted to the Food Standards Agency directly or via a Trade Association and will be treated in confidence.

If you have any queries about your results please feel free to contact me at the above address, or for more general queries about the monitoring programme, please contact Mr Ian Smith at the Food Standards Agency (Tel 020 7276 8375).

Yours sincerely

Angela Huckle
Associate Director
ADAS Horticulture
RSK ADAS Ltd

cc: Ian Smith, Food Standards Agency
Encs

APPENDIX 5. Standard Operating Procedure for collecting samples

Field sampling and transportation of lettuce and spinach samples for the UK Nitrate Monitoring Programme.

INTRODUCTION

EC Regulation No. 1881/2006 requires Member States to monitor nitrate levels in lettuce and spinach. This document specifies the procedure to be followed for taking and transporting samples of lettuce and spinach to the laboratory in connection with the UK Monitoring Programme for nitrate.

Principle: Representative sampling of lettuce, or spinach, from the field in accordance with Commission Directive 1882/2006/EC. Transfer to suitable containers and transport to the laboratory under appropriate conditions. Complete and despatch the sample pro-forma to the laboratory.

REFERENCE DOCUMENTS

Commission Directive 1882/2006/EC of 20 Dec 2006 establishing Community methods of sampling for the official control of nitrate in lettuce. Official Journal of the European Communities. No. L364/25.

MATERIALS AND EQUIPMENT

Vegetable knife.
Suitable insulated box for sample transportation.
Ice packs.
Sampling record pro-forma.

PROCEDURES

1. Sampling and data logging.

As far as possible samples should be taken at various places distributed throughout the lot. Avoid taking samples that are extensively spoiled. Also avoid taking samples from areas which appear to be unrepresentative of the field, and avoid taking samples from the extreme edges of the field.

Take samples from a pattern similar to that on a "5-spot" die, or by walking a "W" pattern across the field, collecting a minimum of 10 heads of lettuce (or 10 spinach samples) to give a combined total minimum weight of 1 kg. Plants must be cut at ground level. Trim off outer leaves to ensure the lettuce plant resembles a marketable product. Samples must not be cut or broken to produce the laboratory samples.

Complete the "Sampling Record - UK Produce" pro-forma (Annex 1) and transfer this to a plastic bag to prevent damage in transit.

2. Transportation to the laboratory.

Place each set of (minimum) 10 vegetables in a clean, inert container offering adequate protection from contamination and damage in transit. Ensure that suitable ice packs are included with the sample to ensure that the sample temperature is maintained below 10 ^{0}C during transportation to the laboratory. Include the completed pro-forma. Arrange despatch to the laboratory without delay.

Transportation should ensure that samples arrive at the laboratory before 10.30am on the day after harvest.