

Alliums (bulb onions, salad onions and leeks)

Interpretation of leaf nutrient analysis

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Both crop yield and marketable quality of allium crops can be affected by nutrient deficiencies, with onions and leeks potentially susceptible to deficiencies of copper and manganese. If the nutritional status is below the 'critical level', visual symptoms will be present in the field. In the absence of visual symptoms, 'subclinical' deficiencies may be present which will reduce growth and subsequently yield. The ideal soil pH for growing onions and leeks to minimise potential nutrient deficiencies is 6.5 or above on mineral soils and 5.8 on peats.

This factsheet aims to:

- Assist with the diagnosis of the most common visual deficiency symptoms
- Provide guidance on sampling plants so that meaningful results are obtained
- Provide guidance on the interpretation of leaf tissue analysis results
- Provide information on the management of nutrient deficiencies

Visual symptoms

Visual diagnosis of nutrient disorders can be made where specific symptoms of deficiency and toxicity have been accurately described and documented. It is the quickest method for diagnosing the cause of poor crop performance due to

nutrient disorders. There are, however, several difficulties in relying solely on visual symptoms:

- Severe deficiencies are rare
- Crop disorders induced by non-nutritional factors such as drought, low temperatures, herbicides, pests

and diseases or even air pollutants may result in symptoms that can be mistaken for nutrient disorders

- More than one nutrient may be deficient causing different symptoms from those caused by a single nutrient.



1 Subclinical nutrient deficiencies may occur, even healthy looking crops

Nutrient deficiency symptoms

The diagnosis of a nutrient disorder in the field should follow clearly definable steps:

- 1 Realisation that something is wrong with the crop
- 2 Observation of abnormalities, noting if these are worse on older or younger leaves; chlorosis or interveinal yellowing; marginal scorch around leaf edges, necrosis of leaf tissue; pattern of distribution; deformities such as twisting and thickening
- 3 Relate a particular disorder to the field circumstances e.g. soil type or pH
- 4 Knowledge of susceptibility of onions or leeks to that disorder
- 5 Consider the possibility of symptoms having been caused by drought, waterlogging, etc
- 6 Identification by use of photographs illustrating nutrition deficiency
- 7 If doubt still remains, check diagnosis by means of leaf analysis

Description and photographs of nutrient deficiencies in Alliums

Note: Not all deficiencies produce clear field symptoms and this is particularly true for leeks where similar symptoms occur for several nutrient deficiencies.

Photographs are particularly helpful in providing a visual diagnosis. 'A colour illustrated guide to pests, diseases and disorders of vegetables'; a CD-ROM that contains further images and information on vegetable nutrient deficiencies is available from HDC. If in doubt, confirm diagnosis with leaf analysis.

Nitrogen (N)

Deficiency symptoms:

In onions, leaves turn yellow or greenish yellow and die back from leaf tips. Growth may be stunted. In leeks, leaves become erect and narrow with a uniformly pale green colour. Growth can be severely reduced and leaf tips can shrivel.

Occurrence:

Crops may become deficient under conditions of poor drainage, low temperature or in very wet seasons where applied nitrogen is leached below root access, especially when plant populations are high.

Similar symptoms:

Sulphur deficiency.



2 Nitrogen deficiency (left): growth dwarfed and thin, leaves pale green, tip die back. Phosphorus deficiency (right), growth dwarfed and thin, leaves dull green and tip die back



3 Healthy plant*



4 Same age of plant showing N deficiency; growth stunted and thin, foliage pale, older leaves turn yellow and die back from tips*

Phosphorus (P)

Deficiency symptoms:

Poor growth with leaves dull green: older leaves die back from tip and may show brown, yellow and green mottling. Occurrence of 'thick-necks' in onions is increased. In leeks,

growth is dwarfed and thin, with leaves showing a dull blue-green colour; leaf tips die back.

Occurrence:

Very rare as most vegetable soils contain good levels of available

phosphate. May occur on alkaline soils that are poorly drained, but these soils are unlikely to be used for alliums.

Potassium (K)

Deficiency symptoms:

In onions, older leaves die back from tip without first becoming yellow. Plant leaves wilt due to loss of

turgidity and leaves take on a papery appearance. Bulbs may not store well and may be soft with thin skins. In leeks, die back of older leaf tips.

Occurrence:

Can occur as a result of leaching from sandy soils during periods of heavy rain.



5 Potassium deficiency; dying back of leaves from tips and dying off of older leaves



6 Onion potassium deficiency



7 Potassium deficiency; older leaves die back from tips without first becoming yellow. Loss of turgidity*

Magnesium (Mg)

Deficiency symptoms:

In onions, older leaves turn uniform yellow along entire length, without any die back. In leeks, older leaves turn yellowish-green, particularly near the base.

Occurrence:

Only occurs on soils which have low extractable Mg levels and occasionally on soils with very high extractable potassium/magnesium ratios particularly if soil compaction is present.

Similar symptoms:

Easily confused with N deficiency.



8 Magnesium deficiency; older leaves turn uniformly yellow along entire length without die back*

Sulphur (S)

Deficiency symptoms:

In onions, leaves become thick and deformed: with new leaves appearing yellow. In leeks, leaves may be pale in colour and become stiff and erect with early swelling of stem base.

With extreme deficiency, the new leaves are short, thickened and chlorotic.

Occurrence:

Can occur on sandy and shallow soils over chalk or limestone, in areas

with low levels of atmospheric deposition of sulphur.

Similar symptoms:

Nitrogen deficiency.

Calcium (Ca)

Deficiency symptoms:

In onions, appears as die back of young leaves without prior yellowing, or death of a short length of leaf causing the distal part to collapse and die. In leeks, leaves become very narrow and die back abruptly from tips without first yellowing.

Occurrence:

Extremely rare.

Similar symptoms:

Potassium deficiency.



9 Calcium deficiency; die back of young leaves without yellowing, or death of short length of leaf causing distal part to topple over and die*



10 Calcium deficiency; leek leaves chlorosis from tips followed by die back

Manganese (Mn)

Deficiency symptoms:

Onions show striped chlorosis of outer leaves, followed by necrosis with growth severely reduced. Also leaf curling, reduced bulbing and thick necks. Symptoms less obvious in leeks.

Occurrence:

Most severe on organic, peaty and marshland soils at pH values over 6.0 and on heathland soils at pH levels above 6.5. Symptoms are often transient and may disappear following rain. Low pH may cause Mn toxicity.

Similar symptoms:

Zinc deficiency.

Boron (B)

Deficiency symptoms:

Rarely occurs in onions, but when symptom appears, it produces a ladder-like transverse cracking of the upper surface of older leaves. In addition plants are stunted and distorted and their leaves appear grey-green to deep, blue-green. In leeks, transverse cracks appear on leaves.

Occurrence:

Extremely rare but may occur in areas of high rainfall particularly on light soils at pH over 6.5.



11 Boron deficiency; older leaves become chlorotic and die back. Regularly spaced faint yellow lines across leaves, which develop into leaf cracking*

Copper (Cu)

Deficiency symptoms:

In onions tips of youngest leaves become chlorotic, turn white and twist into spiral or bend at right angles to rest of plant. Bulb scales become soft, pale yellow and thin.

Occurrence:

Most likely on organic and peat soils in the Fens and also leached sandy soils, particularly reclaimed heathland.

Zinc (Zn)

Deficiency symptoms:

Leaves become striped yellow, twisted and stunted in onions.

Occurrence:

Associated with coarse sandy soils with a high pH. Extremely rare in the UK.

Similar symptoms:

Manganese deficiency.



12 Copper deficiency; bulb scales pale yellow and thin (right)

Why analyse leaf samples?

There are two reasons for recommending the use of leaf analysis in allium crops:

- To confirm a diagnosis based on the appearance of symptoms: in such cases the leaf nutrient concentrations will usually be well below the 'critical level' and there should therefore be little doubt about the diagnosis.
- To test for 'subclinical' deficiencies or toxicities which may be already limiting growth but which are not yet resulting in visible symptoms.

Guidance on methods of crop foliage sampling for nutrient analysis

It is essential to collect leaf samples that accurately reflect the nutritional status of the crop submitted for analysis. Therefore to adequately represent any field or smaller area of crop, the following sampling procedure should be followed:

- sample at the 4 leaf stage taking complete leaves
- if there is a clear differentiation between 'good' and 'poor' crop, collect a second sample of leaves from the 'good' crop for comparative analysis
- sample 25-30 plants following a 'W' pattern, collecting leaves at regular intervals
- avoid soil contamination
- ensure that the sample is representative of the crop/area
- include all relevant documentation and background information: sowing/planting date, variety, field name, soil type, fertiliser details, grower contact details, etc
- pack the sample, typically in a Jiffy Bag, so it arrives in the best possible condition
- do not post fresh material in an airtight container
- label each sample clearly
- avoid sending samples before weekends and bank holidays
- send by overnight courier or deliver directly to the analytical laboratory

Do not sample

- diseased or dead plant material
- plant tissue damaged by insects and mechanical equipment
- plant tissue which has been stressed by excesses of cold, heat or moisture
- plant tissue within 10 days of foliar application of nutrients, fungicides or herbicides

When sending samples to an analytical laboratory

- ensure there is sufficient plant material (250+ g)

Precise and meaningful analytical results are only possible when carefully selected plant material is submitted for analysis.

Interpretation of leaf tissue analysis results

Interpretation of laboratory results is possible by comparison with normal levels expected for the crop. The interpretations given here are based on the best information available.

Soil nutrition

Though soil nutrition is outside the scope of this factsheet, growers are advised to consult and act upon the nutrition requirements and fertiliser management for allium crops in *'Fertiliser Recommendations for Agricultural and Horticultural Crops (RB209)'*, PLANET Nutrient Management software or the appropriate crop protocols.

Interpretation of leaf tissue analysis

		Bulb Onions	Salad Onions	Leeks
Element	Unit	Normal range	Normal range	Normal range
Nitrogen	%	2.5 – 4.0	2.0 – 3.2	2.0 – 3.8
Phosphorus	%	0.25 – 0.4	0.25 – 0.41	0.27 – 0.41
Potassium	%	2.5 – 5.0	1.9 – 4.3	1.4 – 2.3
Magnesium	%	0.3 – 0.5	0.3 – 0.5	0.3 – 0.5
Sulphur	%	0.5 – 1.0	0.5 – 1.0	0.5 – 1.0
Calcium	%	1.0 – 2.5	1.0 – 2.5	1.0 – 2.5
Manganese	mg/kg	30 – 300	30 – 300	30 – 300
Boron	mg/kg	25 – 50	25 – 50	25 – 50
Copper	mg/kg	6 – 20	6 – 20	6 – 20
Zinc	mg/kg	25 – 100	25 – 100	25 – 100
Iron*	mg/kg	60 – 300	60 – 300	60 – 300

* of limited use as even the smallest amount of soil contamination invalidates the analysis and the deficiency may not be related to actual content

Strategy and specific action to rectify nutrient deficiencies

As deficiencies normally occur individually, specific treatments should be applied to the soil or crop foliage as appropriate to remedy a problem in a particular field.

All trace elements can be applied as simple salts or proprietary products, usually as foliar sprays, though soil treatments are preferable for boron and copper. The exception is iron but this is rarely a problem in alliums. These treatments are cost effective, although more than one spray may be needed for manganese.

Multi-element sprays may not contain enough of a particular element to correct a deficiency, and where no deficiency exists, application can be wasteful. 'Insurance' treatments are not recommended where no deficiency has been identified, but

where deficiencies are known to occur prophylactic sprays may be used.

Nitrogen (N)

Leaf analysis is valuable for the confirmation of plant N status.

Treatment is usually by the addition of N fertiliser at the appropriate rate and time to the soil, with plant response to nitrate being very rapid except when the surface soil is very dry. Ammonium nitrate should be applied between the rows or 2% urea can be sprayed at high volumes to the foliage to address the deficiency.

Phosphorus (P)

Most soils have adequate P supplies and there should never be a need to apply supplementary phosphate if sufficient base P has been applied. Foliar feeding is not recommended because there is a high risk of leaf scorch.

Potassium (K)

Soil applications of potassium fertiliser according to crop

requirement, based on soil analysis, should mean that K deficiency is not seen in allium crops. Foliar feeding is not recommended because there is a high risk of leaf scorch.

Magnesium (Mg)

Symptoms of Mg deficiency can occur as a result of restricted root growth, commonly due to soil compaction or wetness and frequently associated with low temperatures in the spring. Foliar sprays of 20 kg/ha magnesium sulphate (Epsom salts) plus wetter in 500 l of water may accelerate recovery.

Sulphur (S)

Plant analysis is generally considered a more reliable tool for diagnosis of S deficiency than soil testing. Where reserves of sulphur are low and cannot be maintained, fertilisers containing sulphur should be used. Sulphur can be absorbed through leaves so foliar applications may be useful (but cannot be guaranteed to cure a problem). To date, sulphur

deficiency has been determined by using tests based on total S, sulphate – S or a N:S ratio. For example, plant material samples with an N:S ratio of >15:1 are deficient and likely to respond to a sulphur application. Plant material with an N:S ratio of between 15:1–13:1 may benefit from an insurance dressing, and a ratio of <13:1 is satisfactory and unlikely to suffer sulphur deficiency. Recently a new test based on malate:sulphate ratio has been developed and experience in cereals and oil seed rape shows it to be a better indicator of S deficiency.

Calcium (Ca)

Ca is a major nutrient and provided soil pH is satisfactory there should be always be a good supply. If Ca problems occur it is generally not an absolute deficiency but rather the lack of movement of the element within the plant, due to water stress, so it is the youngest tissues, which will suffer.

Foliar sprays of Ca have not been found to be useful but irrigation may be helpful.

Boron (B)

Soil analysis should be used to assess the boron need for crops grown on sandy soils. Plant analysis can be used to complement visual diagnosis but often by the time symptoms of deficiency are seen it is too late to apply a remedial treatment. Borax can be applied before sowing or suitable boron sprays used at an early growth stage.

Copper (Cu)

Deficiency has only been diagnosed in a few specific soils. Fields with a history of copper deficiency should be sprayed at full crop cover with 2 kg/ha copper oxychloride or cuprous oxide in at least 250 l of water. One application is usually sufficient although in cases of severe deficiency, a second spray will be

needed three weeks after the first. Preferably a soil application can be applied prior to planting.

Manganese (Mn)

Leaf analysis is a useful aid when there is doubt about visual symptoms. Avoid over-liming. Response to a foliar spray of manganese sulphate (or propriety materials) is rapid and reliable and the spray should be applied as soon as symptoms are diagnosed when sufficient leaf area is present. The normal rate is 8 kg/ha manganese sulphate plus wetter in at least 250 l of water. In severe cases additional sprays may be necessary as leaf area increases.

Zinc (Zn)

Leaf analysis is the most useful aid to diagnosis, but commercial incidence in allium crops is extremely rare.

Always check compatibility if mixing nutrients with agrochemicals

Analytical laboratories

It is not possible within this factsheet to list all the laboratories that offer a leaf tissue analysis service. Growers should discuss the options with their agronomist or crop protection consultant.

Acknowledgement

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Additional Information: