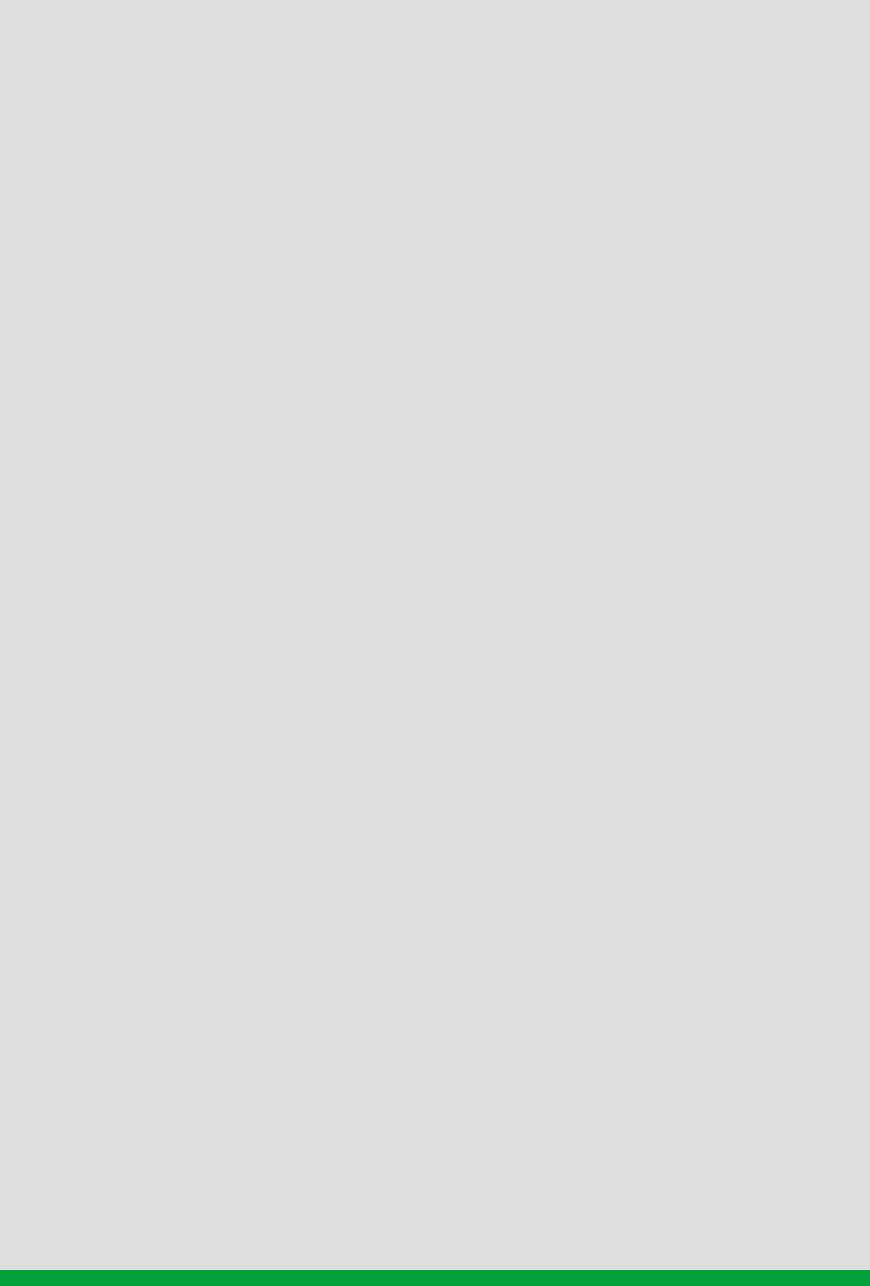




Crop Walkers' Guide

Field Vegetables

Asparagus



Introduction

Every year a significant proportion of the UK asparagus crop would be lost to pests and diseases if growers did not monitor their crops and employ effective crop protection strategies.

Asparagus is a perennial crop, therefore any losses due to pests and diseases in one season can result in reduced yields and crop vigour in subsequent seasons.

This Crop Walkers' Guide is aimed at assisting growers, supervisors and their staff in the vital task of monitoring the asparagus crop. It is designed for use in the field to help with the accurate identification of pests; their predators and parasitoids; and diseases within a crop. Images of key stages in the life cycles of pests, predators, parasitoids and diseases are included along with bullet point comments to help with identification.

A section of the guide has been dedicated to asparagus nutrition to help growers understand the nutrient needs of their crop.

It is impossible to show every symptom of every pest or disease therefore growers are advised to familiarise themselves with the range of symptoms that can be expressed and be aware of new problems that occasionally arise.

The guide does not offer any advice on the measures available for controlling pests or diseases as both chemical active ingredients and their approvals frequently change. However, having identified a particular pest or disease in their crop, growers should acquaint themselves with the currently available control measures.

Grace Choto

Horticultural Development Company

Contents

Section 1: Invertebrate pests

Asparagus beetle	1.1
Aphids	1.2
Slugs	1.3
Wireworms	1.4
Chafer grubs	1.5

Section 2: Predators & parasitoids

Nematodes	2.1
Aphid predators	2.2
Aphid parasitoids	2.3

Section 3: Diseases

<i>Stemphylium</i> purple spot	3.1
<i>Phytophthora</i> spear and crown rot	3.2
<i>Fusarium</i> rots	3.3
Rust	3.4
Grey mould	3.5
Viruses	3.6

Section 4: Asparagus nutrition

General information	4.1
Nutrient concentration ranges	4.2
Nitrogen (N)	4.3
Phosphorus (P)	4.4
Potassium (K)	4.5
Calcium (Ca)	4.6
Magnesium (Mg)	4.7

Iron (Fe)	4.8
Boron (B)	4.9
Copper (Cu)	4.10
Zinc (Zn)	4.11
Manganese (Mn)	4.12
Sulphur (S)	4.13
Molybdenum (Mo)	4.14

Section 5: Physiological disorders

Spear malformations – Surface cracking	5.1
Spear malformations – Faciation	5.2
Spear/Fern tip wilting	5.3
Tip rot	5.4
Open headed spears	5.5

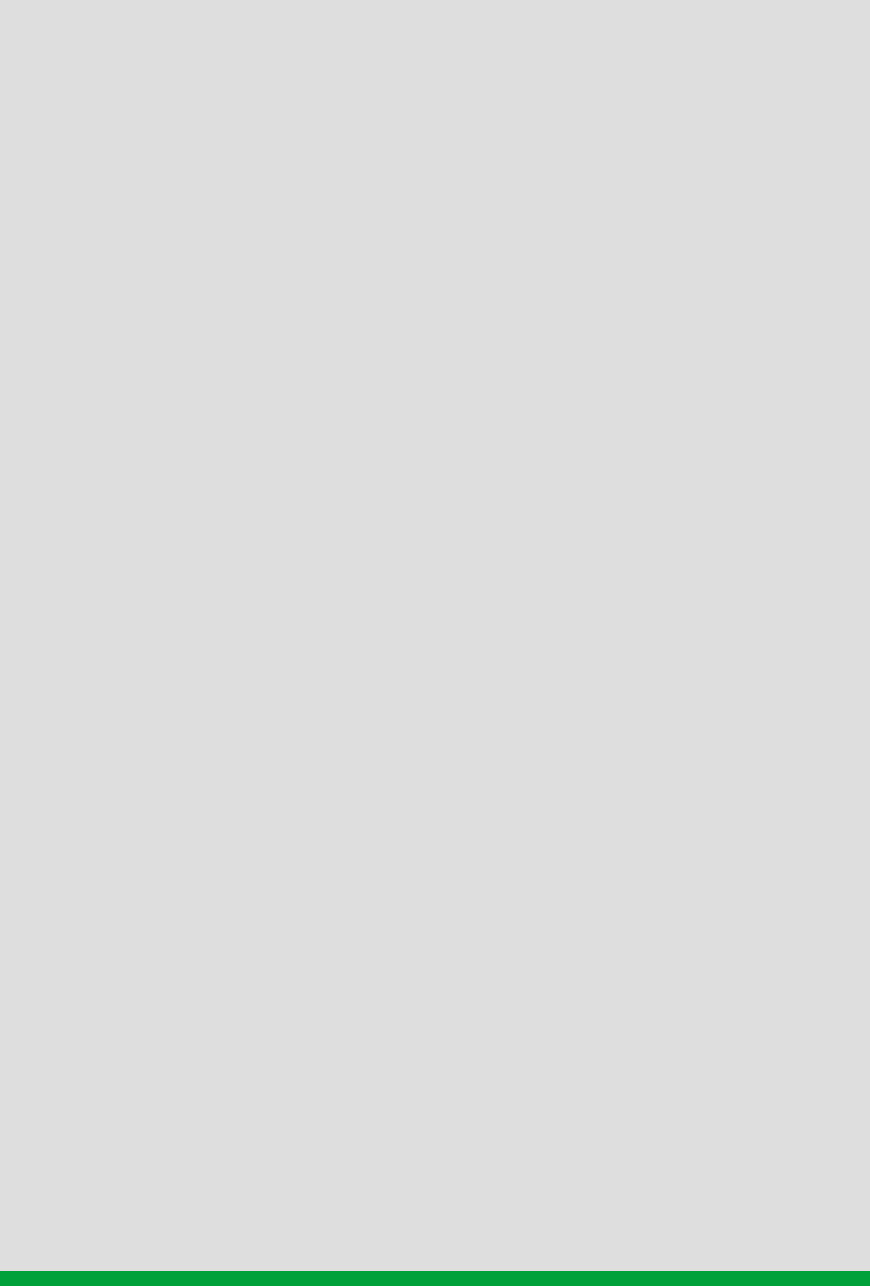
Section 6: Additional information

Acknowledgements	6.1
Photographic credits	6.2
References	6.3
Copyright	6.4

Section 1

Invertebrate pests





Asparagus beetle

(*Crioceris asparagi*)



- Adults overwinter in asparagus beds and become active in spring. They are approximately 6 mm long and easily recognised by their red bodies with black and cream markings.
- The brown eggs, 1-1.3 mm long are laid on their ends, in rows, on the young shoots. Larvae are pale yellowish-green with black shiny heads and three pairs of black legs.
- Adults and larvae graze the surface of fern and spears leading to reduced marketable yield and weakened crown growth.

Aphids

(e.g. *Aphis gossypii*, *Macrosiphum euphorbiae*)



- The potato aphid, *Macrosiphum euphorbiae* (right), can occur on spears. This is a large, green or pink, pear-shaped aphid, often with a darker stripe down the back.
- The melon-cotton aphid, *Aphis gossypii* (left), can occur in colonies on the fern. It is small, varying in colour from yellowish-green to olive green or black, sometimes with white powdery patches.
- The main aphid species that can transmit *Asparagus virus 1* (AV-1) is the peach-potato aphid, *Myzus persicae* which is not common on UK asparagus.

Slugs

(e.g. the field slug, *Deroceras reticulatum*)



- Slugs can feed on emerging spears. Grazing down one side of the spear causes crooked growth. The damage or presence of slugs on spears causes them to be unmarketable. Slugs can also graze on the base of stems, causing weakened growth.
- Slugs are a particular problem in damp soils, particularly on organic crops and on weedy sites, where large populations can build up.
- Clusters of eggs are laid in the soil, mainly in the spring and autumn.

Wireworms

(*Agriotes* spp.)



- Wireworms are the larvae of click beetles, usually *Agriotes* spp. Their normal habitat is grassland but wireworms live for 4-5 years and can damage crops following grass or in weedy fields.
- Click beetles are brown or black, up to 12 mm long and found in grass or on soil in April to July.
- Wireworms are golden brown, up to 25 mm long, cylindrical with three pairs of short legs.
- Wireworm root-feeding can affect establishment in new plantations.

Chafer grubs

(e.g. *Phyllopertha horticola*, *Hoplia philanthus*)

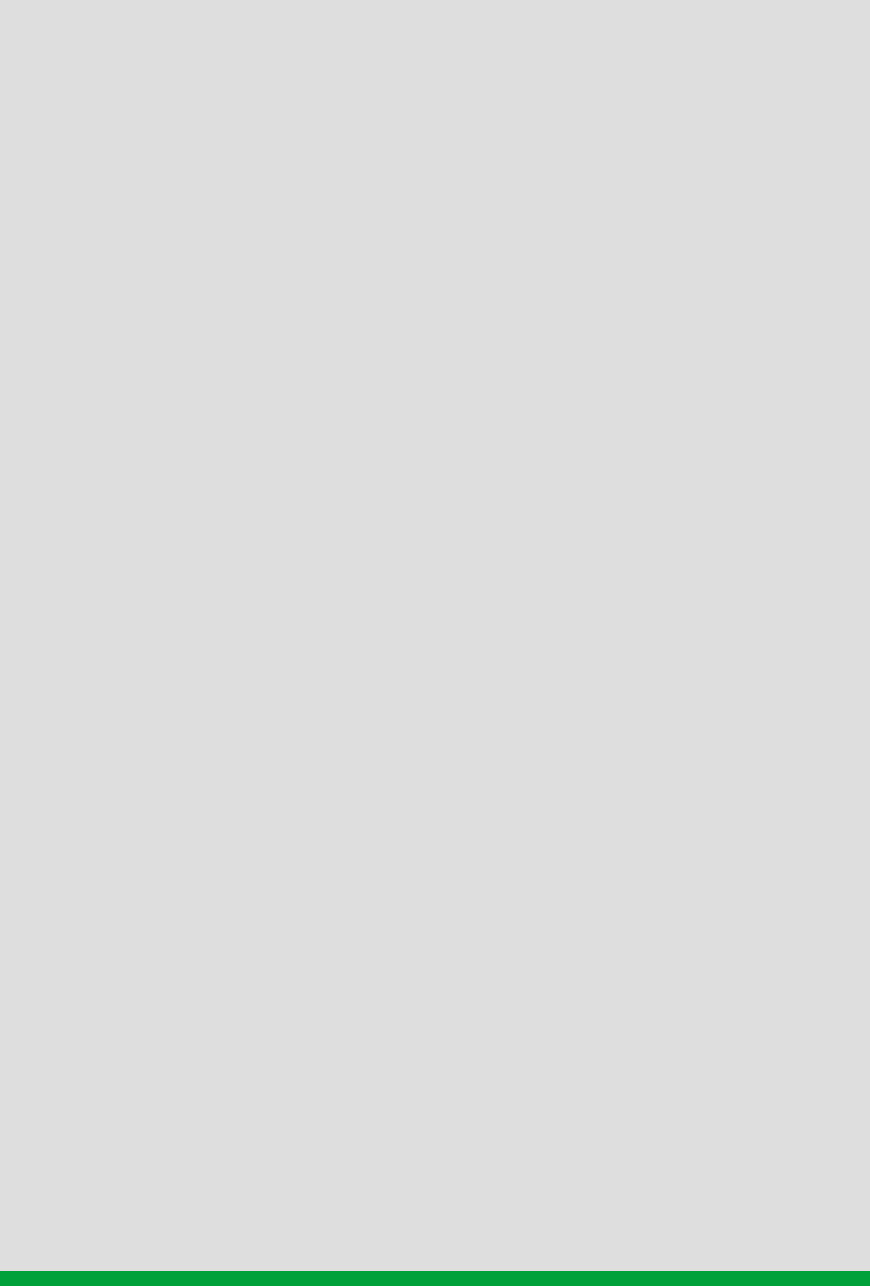


- Chafer grubs are larvae of chafer beetles, the most common being the garden chafer, *Phyllopertha horticola* and the Welsh chafer, *Hoplia philanthus*.
- Adults of these two species are 7-9 mm long with reddish-brown wing cases. The grubs often lie in a C-shape, and are whitish with brown heads and three pairs of legs.
- Crops following grass or near woodland may be at risk.
- Feeding underground by grubs in spring/autumn causes root damage which can affect establishment of new crops.

Section 2

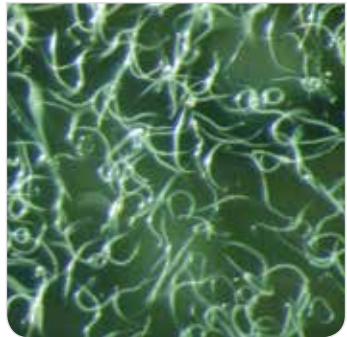
Predators & parasitoids





Nematodes

(*Steinernema*, *Heterorhabditis* and *Phasmarhabditis* spp.)



- Microscopic worm-like nematodes, supplied in a gel-like carrier in plastic trays.
- *Steinernema feltiae* has been used experimentally in Holland as foliar sprays for the control of asparagus beetle.
- *Phasmarhabditis hermaphrodita* and *Heterorhabditis* spp. are available as soil drenches for the control of slugs and chafer grubs respectively.
- The nematodes enter the pest's body and release lethal bacteria. The nematodes multiply inside the cadaver and are released into the soil when the pest dies.

Naturally occurring aphid predators

(e.g. ladybirds, lacewings, hoverflies)



- Both ladybird adults and larvae (bottom left) eat aphids. Ladybird larvae have three pairs of legs and are dark grey with yellow, orange or red spots depending on species.
- Lacewing larvae (top) are 2-10 mm long, pale brown with darker markings, three pairs of legs and large jaws. They eat aphids and other small prey.
- Hoverfly larvae (bottom right) are maggots, with no legs, up to 10 mm long and creamish. They are voracious aphid predators.

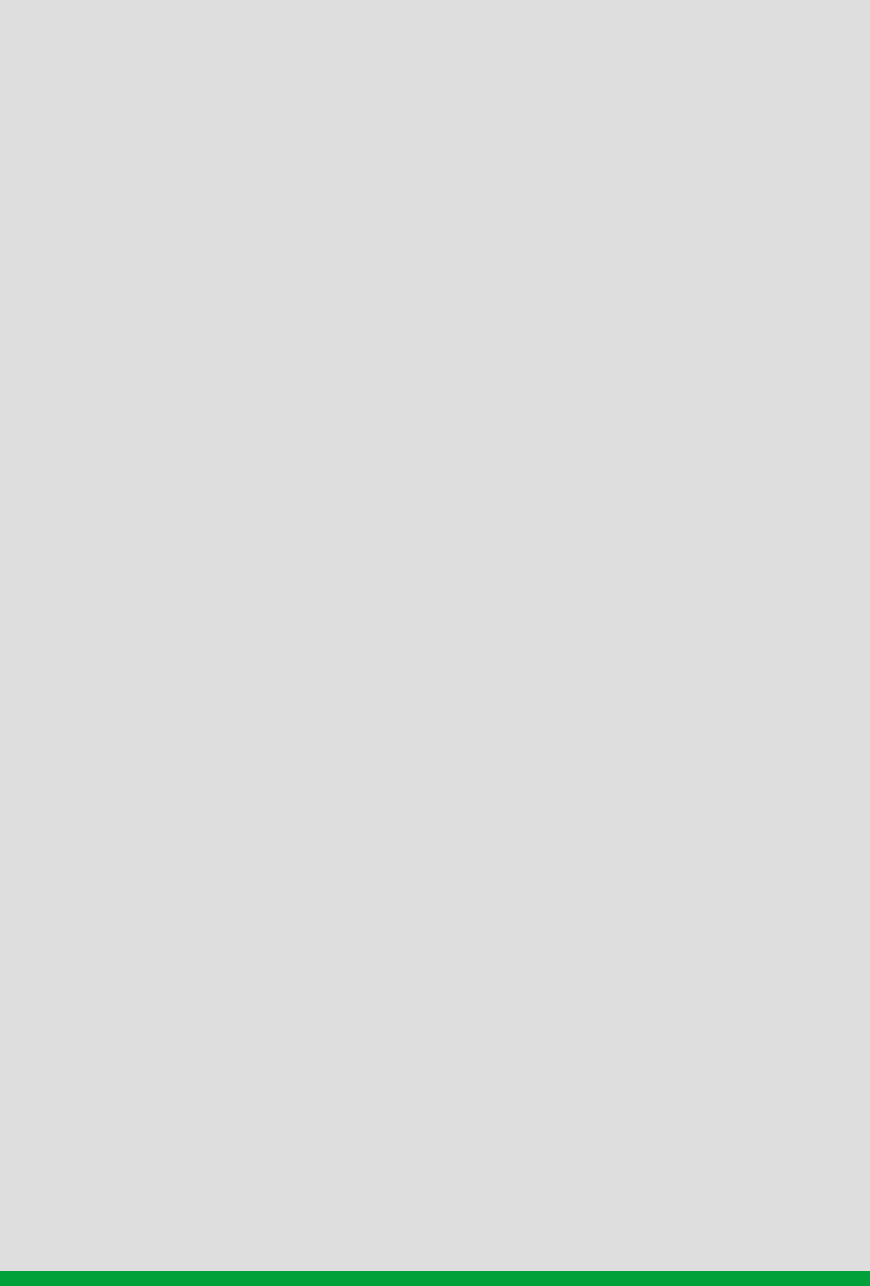
Naturally occurring aphid parasitoids



- Aphid parasitoids are small dark parasitic wasps that lay eggs inside aphids. Different parasitoids attack different aphid species e.g. *Aphidius ervi* attacks the potato aphid and *A. colemani* attacks the melon-cotton aphid.
- The young parasitoid develops inside the aphid, turning it into a pale brown, black or white 'mummy', depending on species (*Aphidius* spp. mummies are pale brown). The adult wasp emerges from a hole cut into the top of the mummy.

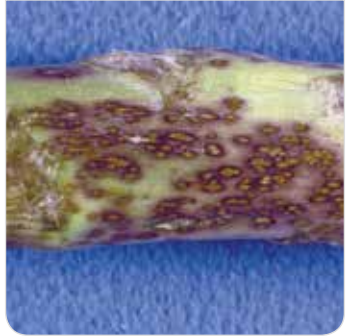
Section 3

Diseases



Stemphylium purple spot

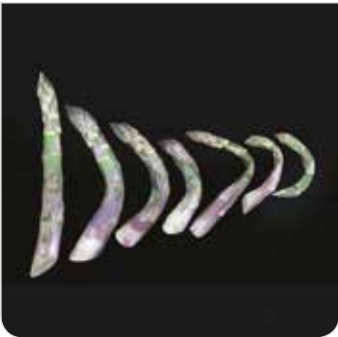
Stemphylium vesicarium (= *Pleospora herbarum*)



- In spring, black overwintering structures on fern debris release spores.
- Elliptical lesions develop on spears, fern and needles, initially pale then dark red / purple with light centres. Avoid confusion with hail damage.
- Severe infection results in fern yellowing, premature fern death and lower yields in subsequent years.
- Disease develops when fern remains wet for long periods.

Phytophthora spear and crown rot

Phytophthora asparagi



- Slightly sunken water-soaked lesions develop on emerging spears.
- When wet, lesions become slimy from bacterial infection. When dry, affected spears become brown and shrivelled.
- Spears bend around the lesion to give a 'crook' shape (avoid confusion with slug or wind damage).
- Roots become translucent then brown and hollow; crowns develop water-soaked, brown, fibrous tissue.
- The pathogen is soil-borne and spear symptoms follow heavy rain.

Fusarium rots

E.g. *Fusarium oxysporum* f. sp. *asparagi* and *F. culmorum*



- Fern becomes yellow, wilts, turns brown and dies.
- Red-brown oval lesions develop on lower stems and roots.
- Infection by *F. culmorum* results in red discolouration of stem and crown vascular tissue.
- Plant growth is weakened, and severely affected plants die; the disease contributes to asparagus 'decline' (premature yield loss).
- *Fusarium* pathogens of asparagus are soil-borne and some are also carried in seed and crowns.

Rust

Puccinia asparagi



- Red to dark-brown pustules develop on infected stems and needles of new fern.
- Later in the season, the pustules turn black as another spore type develops.
- Severe infection results in premature fern death, and lower yields in following seasons.
- Serious outbreaks occur occasionally in the UK, and are favoured by hot days (>25°C) and cool nights with dew formation.

Grey mould or *Botrytis*

Botrytis cinerea



- Develops on injured or ageing fern, resulting in browning of the lower fern canopy.
- Individual lesions are tan with dark brown borders, often surrounded by a yellow halo. Grey fuzzy fungal growth indicates spore production.
- *Botrytis* spores are spread by wind and rain within dense fern canopy. Disease progress is rapid during warm, humid weather when the fern does not dry properly.
- Currently a minor problem on UK asparagus.

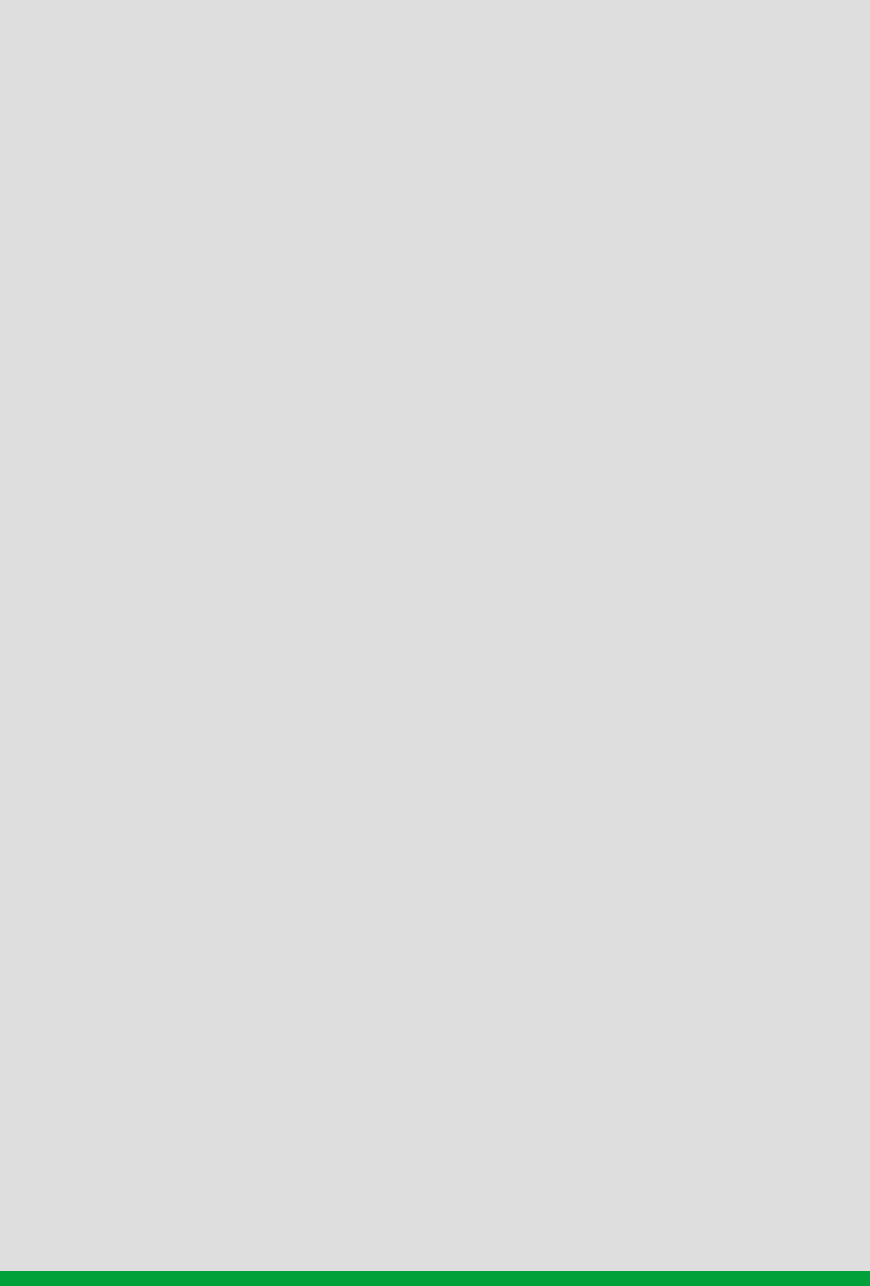
Asparagus viruses

- *Asparagus virus I* (AV I, Potyvirus) and *Asparagus virus II* (AV II, Ilarvirus) have been detected in UK asparagus crops. They produce no obvious symptoms.
- Literature suggests that where both are present in the same plant, survival and plant vigour can be substantially reduced, particularly in young plants.
- It has also been reported that when plants are infected with both viruses, they become more susceptible to infection by other pathogens.
- AV II is transmitted through seed and may be transmitted in pollen from male plants to seed produced by female plants. AV II may also be transmitted mechanically on harvest knife blades, mowers, cultivation equipment, or any other activity that moves plant sap from one plant to another.

Section 4

Asparagus nutrition





- It is unusual to see nutritional deficiency symptoms in mature asparagus because the crop has a very large fleshy root system (rhizome) which is capable of storing large quantities of nutrients.
- Deficiencies are often noted in young newly planted crops as they do not have large reserves of nutrients. Early identification of nutrient related shortages followed by corrective measures ensures that the long-term development of the crop is not impacted.
- Where doubt exists, tissue testing is by far the most precise method to determine the current fertility status of the plants as it directly measures nutrients that plants have taken up.
- A soil pH of 6.5 to 7.5 is optimal for nutrient availability and asparagus grows well where soil pH is between 6.0 and 7.5. Liming for pH adjustment also supplies calcium to the crop.
- See D2 for the major nutrients removed by an asparagus crop yielding 5 tonnes per hectare and nutrient ranges in the top 30 cm of healthy asparagus fern 6-11 weeks after the end of harvesting.
- For detailed information on asparagus nutrient management, refer to HDC Factsheet 14/13.

Nutrient concentration ranges

in healthy asparagus

Major nutrients removed by an asparagus crop yielding 5 tonnes per hectare

Nutrient	Kg/ha
Nitrogen	25
Potassium	20
Phosphorus	4
Sulphur	2
Magnesium	1
Calcium	1

Nutrient concentration ranges in the top 30 cms of healthy asparagus fern 6-11 weeks after the end of harvesting

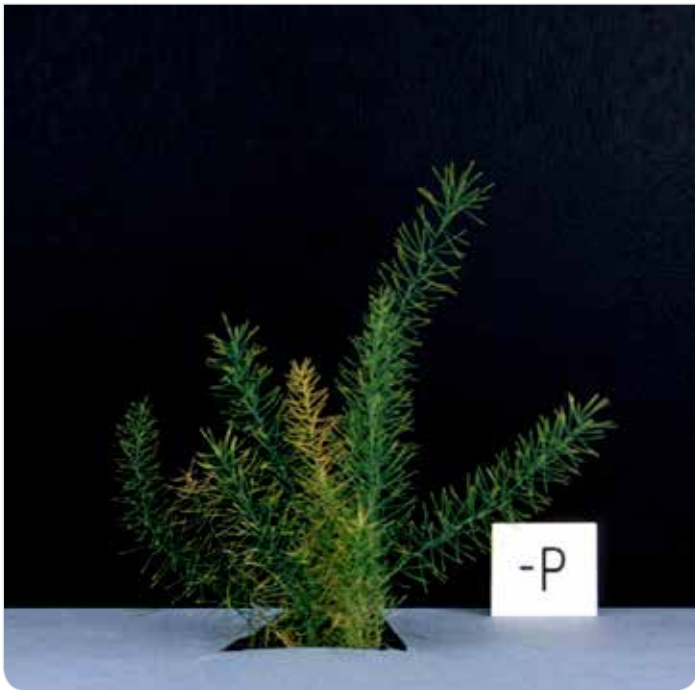
Nutrient	Common Range
Nitrogen (N%)	2.50 - 4.00
Phosphorus (P%)	0.20 - 4.00
Potassium (K%)	1.90 - 3.50
Calcium (Ca%)	0.60 - 1.50
Magnesium (Mg%)	0.14 - 0.45
Sulphur (S%)	0.30 - 0.45
Trace Elements - parts per million (ppm)	Common Range
Manganese (Mn)	30 - 160
Zinc (Zn)	20 - 60
Copper (Cu)	5 - 15
Iron (Fe)	50 - 150
Boron (B)	30 - 150
Molybdenum (Mo)	0.08 - 0.40



- Needles light green with open airy appearance. More mature fern has a pale green colouration (although this can also result from low temperatures or a lack of water).
- Asparagus has high N requirements in the first few seasons as it establishes an extensive root system to store nutrients. The root system is fully developed at the end of the fourth year.
- N is mobilised for re-growth in each year, so growers can replenish nitrate levels each year. Beware of oversupply which may lead to leaching, particularly in Nitrate Vulnerable Zones (NVZs).

Phosphorus

(P)



- Needles have yellow discoloration on tips and needles progressively change to brown. Main stalks are often dark green and of shorter stature.
- Phosphorus should be incorporated in the field prior to planting crowns as P is very immobile in soils.
- Additional applications of phosphorus should be made to maintain adequate soil levels of the nutrient.



- Needles light yellow-green along entire length particularly in younger fern. Older fern shows chlorosis mainly in the tips.
- Potassium is often available in adequate amounts in the soil.
- Where soils are deficient, applications of potassium should be made to maintain levels of the nutrient.

Calcium

(Ca)



- Complete dieback of fern tips particularly on new fern. Side branch growth off main stem can be restricted.
- Calcium deficiency is often seen in fields with low pH. Ca rich lime additions can help reduce deficiency problems.



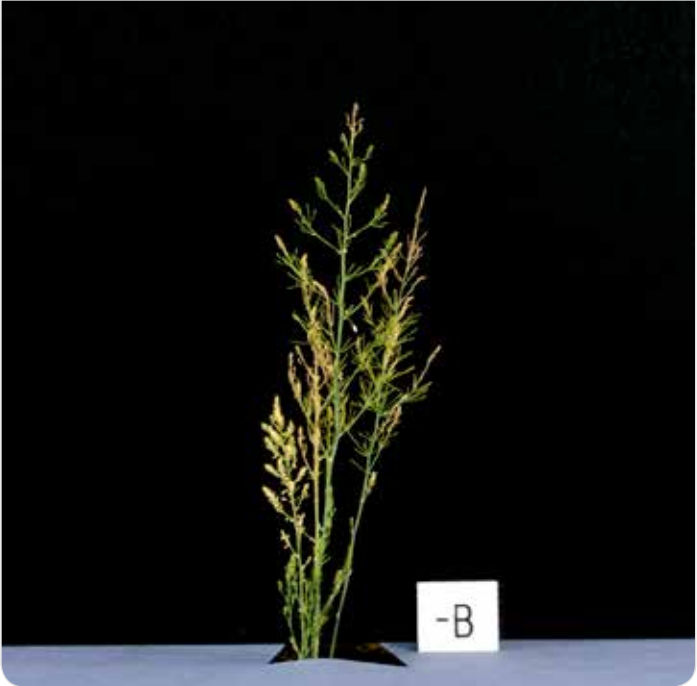
- Deficiency is apparent on oldest fern first, which eventually dies. Needles show increasing yellowing from mid-fern area to terminal branches. Entire portions of fern become chlorotic and then dieback.
- Deficiency symptoms can occur even where there are adequate amounts of the element in the soil as drought stress limits the plant's ability to take up available Mg.
- Mg deficiency also occurs in very hot conditions when growth is rapid, despite adequate levels of Mg in the soil.
- Plant tissue analysis is recommended.

Iron

(Fe)



- Terminal of fern shows extreme chlorosis (white tips). Some needles may have a reddish tint. Needles and fern tips eventually dieback. Fern is quite stunted.
- Soils that have high lime content often show iron deficiency (lime-induced chlorosis).
- Low, wet areas or fields with drainage problems often exhibit iron chlorosis.



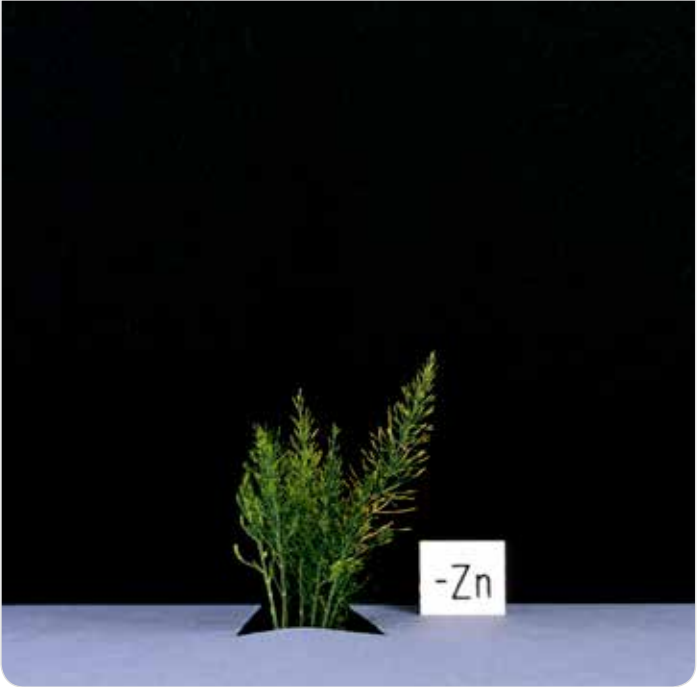
- Fern have very few needles. Most needles are chlorotic over entire length and terminal portions of branches dieback. Plant growth is stunted (fewer fern and small root system).
- Hollow spears and horizontal cracking on surface of spears may be related to boron deficiency.
- Boron deficiency is rarely seen in the field. High pH soils tend to fix B while leaching can occur in low pH soils.

Copper

(Cu)



- Sporadic dieback of primary stems on youngest fern. Plants produce additional (secondary) branching of primary stems which also dieback.



- Plant growth very stunted and fern are short and compact. Side branch development inhibited.
- Needles tightly clustered (resetting) and may have yellow tips. Fewer and smaller buds form on rhizome.
- Fields with very high phosphorus levels or that have high pH may express zinc deficiencies.

Manganese

(Mn)



- Needle chlorosis in discrete areas near terminal of fern.
- Can be confused with calcium deficiency as symptoms are similar.
- Plant tissue analysis is recommended to determine deficiency.



- Needle bunches light yellow in sporadic areas on terminal portions of fern.
- May be limiting on sandy soils with low organic matter. Soil tests are not a reliable method for predicting S deficiency in a growing crop.
- The best approach is to determine if there is a history of S deficiency in the area. If confirmed then apply adequate levels of S prior to planting.

Molybdenum

(Mo)

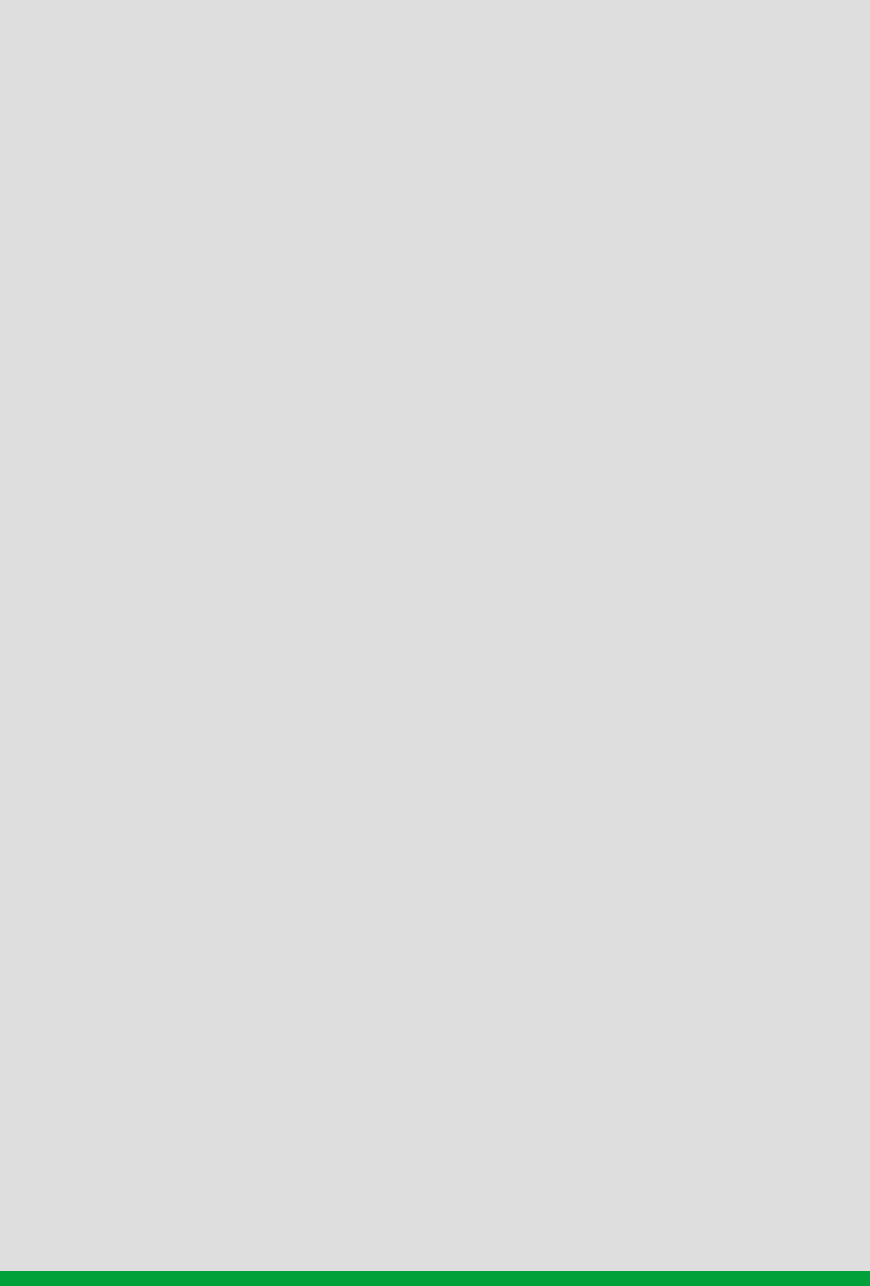


- Scattered regions of needle chlorosis or dieback on old and new fern.
- Initial symptoms can be confused with nitrogen deficiency. As severity increases, the problem can be confused with Mg or Fe deficiencies.
- Plant tissue analysis is recommended.

Section 5

Physiological disorders





Spear malformations

Surface cracking



- Surface cracking can occur when hot temperatures accelerate spear growth. As spear temperature rises, pressure increases in the spear causing the skin to rupture.
- Soil moisture content also influences cracking. In low soil moisture conditions, spear growth is slow and spears are less likely to crack. Rapid changes in moisture that typically occur after irrigation or rain may cause some spears to crack or have a rough feel.

Spear malformations

Faciation



- Faciation is the fusion or flattening of many stems that gives the spear a distorted appearance.
- Faciated spears occur when the bud or buds have been damaged by cold, insects, bacteria or viruses, chemicals or mechanical injury.
- Plants that grow faciated spears generally do not produce them every year and their appearance is unpredictable.
- In some plant species, genetic mutations result in year-to-year expression of the symptoms but this is uncommon in asparagus.

Spear/Fern tip wilting



- Fern tip wilting occurs during periods of rapid growth and high temperatures. Water loss near the fern tip is greater than supply even when soil moisture levels are adequate.
- Fern wilts during the day and recovers overnight resulting in “S-crooked” appearance. When soil moisture levels are very low, spears may wilt and recover resulting in bent spears while in fern, the tips may die out and dieback.
- Localised Ca deficiency in growing tips may be responsible for fern wilting because Ca is immobile in plants.

Tip rot



- Tip rot is strongly related to high growth rates of spears during warm growing conditions. Harvesting triggers a sequence of biochemical responses which results in the disorder.
- Early signs are the collapse of bud tips. This is followed by the collapse of vegetative buds and stem tissue with subsequent secondary bacterial infection which leads to unpleasant odours during marketing and storage.
- Shorter harvest intervals and harvesting shorter stems is reported to reduce the problem.

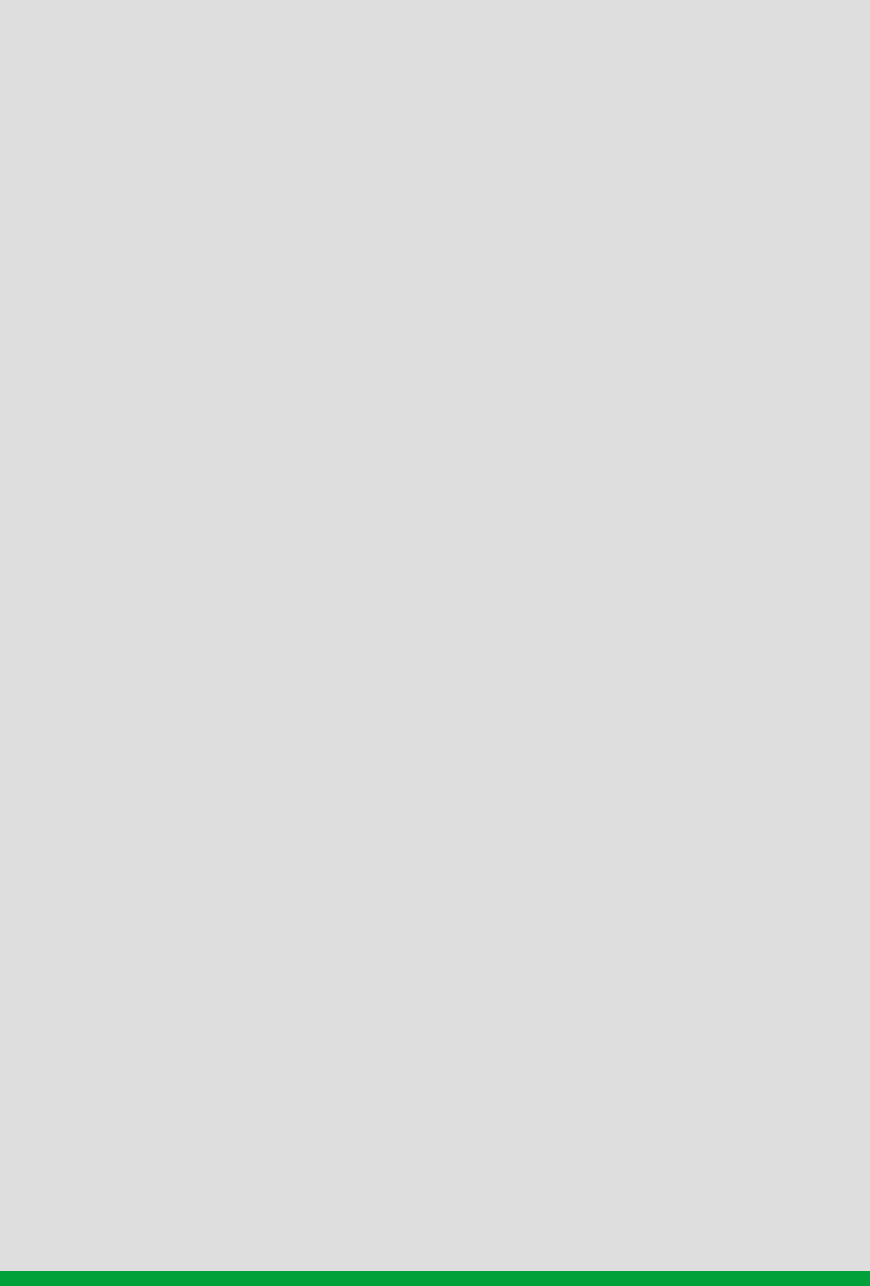


- This refers to the excessive opening of the spear head. It is more common if the crop experiences a hot growing period. It is often most noticeable during late season harvesting. It may result from overharvesting.
- Some varieties maintain tight heads even when the crop is grown under warm conditions.

Section 6

Additional information





The HDC is grateful to the following authors for writing the different sections of the guide:

- 'Pests' and 'Predators' - Jude Bennison (ADAS)
- 'Diseases' – Kim Parker
- 'Asparagus nutrition' and 'Physiological Disorders' – Dan Drost (Utah State University)

Our gratitude also goes to asparagus consultants: Claire Donkin, Peter Knight and Wilson Dyer for providing comments and additions to the '*Asparagus Nutrition*' and the '*Physiological Disorders*' sections of the guide.

And finally, our thanks go to the Asparagus Growers' Association for supporting the production of this publication – we very much hope that it proves a helpful aid to your businesses.

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- Brückner, B; Geyer, M; Ziegler, J. (2008) *Spargelanbau: Grundlagen für eine erfolgreiche Produktion und Vermarktung*. Eugen Ulmer KG, Stuttgart.
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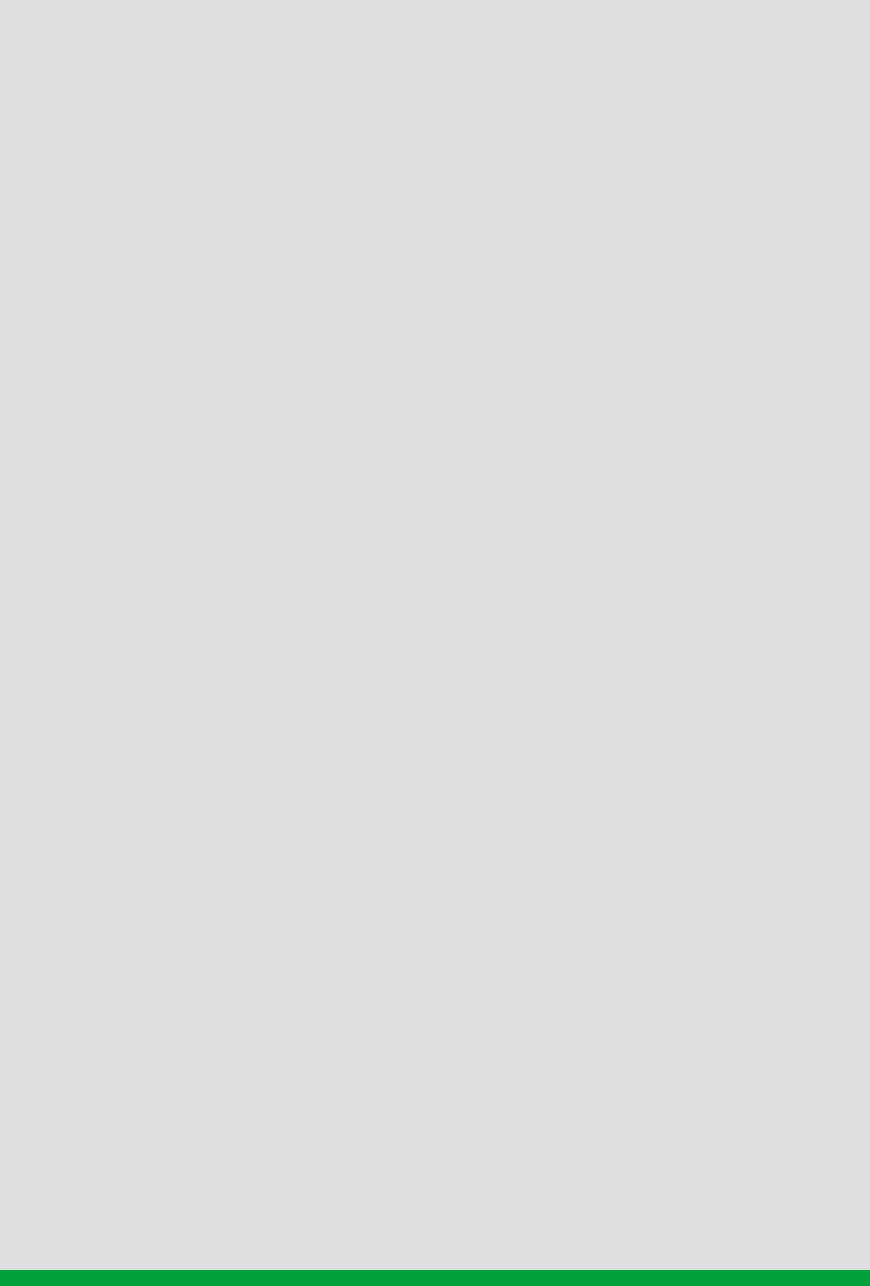
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