

A survey of pests and diseases in vegetable crops in UK gardens and allotments

Summary

In 2020, Garden Organic carried out a survey of pests and diseases in vegetable crops grown in gardens and allotments by its members. The aim was to:

- a) find out what pest and disease measures were employed
- b) find out which pests and diseases were most frequent and caused most damage
- c) find out which pests and diseases caused most damage in 2020.

As organic pest control is about a holistic, preventative approach, it is encouraging that the most popular measures taken were all proactive, not just replacing conventional sprays with organic equivalents. The three most popular measures were using mesh netting, hand picking and growing plants to attract beneficial creatures, which were used by over three quarters of participants regularly or every year.

There are some control measures that we would not recommend. Washing up liquid was used occasionally by around half of participants. Washing up liquid is a detergent and will often be applied in unknown doses so could damage plants and beneficial creatures, and persist in the environment.

We ranked pests and diseases by how frequently they occurred at people's sites and how much damage they caused. It will be no surprise that the slugs, cabbage white butterflies and pigeons were the top 3 most frequently occurring pests and were also likely to cause significant damage when they did occur.

However, when you started to work your way down the list, it was interesting that there were some sites that suffered very few problems from some key pests. Black bean aphid, carrot fly and brassica whiteflies were a problem for around half of participants, but conversely, for a third of participants, they were only an occasional problem. Similarly, flea beetle and cabbage aphids were a problem for a third of participants, but half suffered only occasional problems.

In 2020, black bean aphid was reported as a particularly bad problem causing crop loss at 30% of sites growing legumes. However, it was interesting that even in this bad year, there were still 41% of sites that suffered no damage at all.

It is encouraging that there was no damage from key pests at some sites, but it would be good to know the reasons why. Natural predators and parasitoids, plant nutrition and soil health are all thought to play a role. Unravelling some of these reasons, would help us greatly in improving our ability to manage pests and diseases without chemicals in our gardens.



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Background

Organic pest and disease management employs a multifaceted holistic approach with an emphasis on prevention rather than cure. This requires an understanding of which pests and diseases are likely to be a problem so that we can take cultural measures and modify our growing practices to prevent them.

Many pests and diseases exist at low levels making very little difference to yield. It is only once they increase above a 'damage threshold' that they start to become a problem. An ideal organic system will be in balance so that pests still exist but at low levels below this threshold. For example, aphids are necessary as a food source for many beneficial predators such as hoverfly larvae, which can keep pest levels down. If we obliterate everything with a pesticide, the controlling predator will be removed so the balance becomes tipped in favour of the aphid pests multiplying much more quickly.

The severity of pests and diseases varies both over the long term and with each season. They also vary with location. For example, the allium leaf miner was not much of a problem 15 years ago, but has gradually spread around the country from the Midlands, where it was first found. Insect pests tend to be much more a problem in drier years, whereas fungal diseases are more of a problem in wetter years.

Garden Organic has a membership of over 20,000 and a following of 80,000. We would like to tap into this network of gardeners to gather information as to which pests and diseases are most common and which cause most damage. To start, we will focus on the main diseases in the most commonly grown crops. There is the potential to add other pests and diseases and include others such as fruit crops in subsequent years.

The aim of this is to build up a long term picture of pests and diseases so that we can identify any trends over time and location. This is important for identifying new outbreaks and trends that may be a consequence of climate change.

Aims of this experiment

We wanted to build up a picture of

- What measures are taken to manage pests and diseases
- Which pests and diseases generally result in the greatest losses in vegetable crops
- Which pests and diseases resulted in the greatest losses in 2020

Methodology

Participants were sent a questionnaire that was divided into three sections.

1. General questions about methods of pest and disease control
2. General trends of pests and diseases in vegetables at the site. We wanted to know how often pests and diseases occurred and the severity of damage they caused. Pests and diseases were divided into Potatoes, Brassicas, Lettuces, Alliums, Carrots, Legumes
 - a. Frequency of pest or disease
 - Never
 - Occasionally (less than 1 in 5 years)
 - Sometimes (eg 1 in 3 years)
 - Regularly (most years)
 - Always (every year)

For the purposes of simplicity in this report, we use the term 'occurs regularly' to mean the latter two categories 'regularly' and 'always' grouped together.

- b. Damage caused when the pest or disease occurs
 - No damage at all
 - Small amount, not affecting yield
 - Causes loss but a crop is still produced
 - Virtually no useable crop

For the purposes of simplicity in this report, we use the term 'significant damage' to mean the latter two categories 'causes loss but a crop is still produced' and 'virtually no useable crop' grouped together.

3. Damage caused by pests in 2020:
 - No damage at all
 - Small amount, not affecting yield
 - Causes loss but a crop is still produced
 - Virtually no useable crop

Methods of pest control

Firstly, we wanted to get an idea of the most popular methods of pest control. As organic pest control is about a holistic, preventative approach, it is encouraging that the most popular measures taken were all proactive, not just replacing conventional sprays with organic equivalents.

Table 1. Pest control measures used by our members

% of participants who answered	Never	Occasionally	Sometimes	Always
Net or mesh barriers	3	9	29	59
Hand picking / removal	8	8	48	36
Growing plants to attract beneficials	8	13	28	51
Choice of variety	12	27	53	8
Timing of planting or harvesting	24	16	49	11
Habitat design (eg pond)	37	12	9	41
Iron phosphate slug pellets	45	19	16	20
Commercial biological controls (eg nematodes)	67	16	9	8
Homemade spray based on washing up liquid or soap	41	45	11	3
Commercial organic insecticide based on soap or plant oil	64	23	12	1
Other commercial slug deterrent (eg wool pellets)	65	23	12	0
Synthetic insecticide	89	9	1	0
Synthetic fungicide	99	1	0	0
Metaldehyde slug pellets	92	8	0	0

Preventative measures most popular

The three most popular measures were using mesh netting, hand picking and growing plants to attract beneficial creatures, which were used by over three quarters of participants regularly or every year. Mesh is still one of the most widely used control measures in organic growing, as it is the most effective protection from pests such as carrot fly, cabbage white butterflies and pigeons and its benefits can instantly be seen. Despite being made from plastic, if looked after, it can have a life span of up to 10 years, so its environmental impact is relatively small.

Varietal choice and timing of growing were also used regularly by around two thirds of participants. Often the varieties we see on supermarket shelves have been selected to grow under conditions with high inputs of sprays and show poor disease resistance, so it can make sense to look for alternatives. It is important to use up to date information on resistance as diseases can evolve quickly, so that varieties lose their protection. Timing of growing is a useful trick, as a gardener is not tied to supplying a market, so has the freedom to choose times that avoid pests and diseases. For example growing potatoes earlier will avoid the peak blight pressure, or growing salad brassicas later in the season will avoid attack from flea beetle.

Some contentious inputs being used

There are some control measures that we would not recommend. Washing up liquid was used occasionally by around half of participants. Washing up liquid is a detergent and will often be applied in unknown doses so could damage plants and beneficial creatures, and persist in the environment. Despite this, it was used by more participants than horticultural

soft soap spray. There may be a misconception that it is safer to be spraying a household product around the garden than a horticultural soft soap spray that has been tested for use in the garden.

Iron phosphate slug pellets were used occasionally or regularly by around half of participants. We would only consider using these as a last resort against slugs, as there has been work that shows that iron phosphate with the chelating agent used in slug pellets can damage the earthworm population (Edwards *et al*, 2009).

General trends in pests and diseases

We ranked pests and diseases by how frequently they occurred at people's sites and how much damage they caused. It will be no surprise that the slugs, cabbage white butterflies and pigeons were the top 3 most frequently occurring pests and were also likely to cause significant damage when they did occur.

Table 2. General trends in pests and diseases

Crop	Pest	% of sites where it regularly or always occurs	% of sites where it causes significant crop loss when it does occur
Lettuces	Slugs	86	83
Brassicas	Small white butterfly	72	58
Brassicas	Large white butterfly	69	56
Potatoes	Slug	67	49
Brassicas	Pigeon	66	72
Legumes	Black bean aphid	55	50
Carrots	Carrot fly	55	78
Brassicas	Whitefly	53	25
Brassicas	Fleabeetle	36	46
Brassicas	Cabbage Aphid	36	44
Potatoes	Blight	28	69
Alliums	White rot	26	76
Legumes	Rust	25	42
Potatoes	Wireworm	19	33
Legumes	Chocolate spot	16	24
Alliums	Leaf miner	16	70
Alliums	Neck rot	10	60
Lettuces	Lettuce aphids	9	24
Lettuces	Downy mildew	6	55
Lettuces	Sclerotinia	5	59
Alliums	Downy mildew	4	27
Brassicas	Blackspot	4	25
Brassicas	Clubroot	4	92
Potatoes	Blackleg	1	33

Carrots	Violet root rot	0	67
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However, when you started to work your way down the list, it was interesting that there were some sites that suffered very few problems from some key pests. Black bean aphid, carrot fly and brassica whiteflies were a regular problem for around half of participants, but conversely, for a third of participants, they were only an occasional problem. Similarly, flea beetle and cabbage aphids were a regular problem for a third of participants, but half suffered only occasional problems. This is discussed in the 2020 section.

There were also some pests and diseases which didn't occur frequently, but caused considerable damage when they did occur. Blight, white rot, allium leaf miner and clubroot all occurred regularly at less than a third of the sites, but, when they did occur, in two thirds of cases they caused significant loss to crops. All four of these pests and diseases are difficult to control once they occur so it is best to be aware of the conditions that cause them, and take preventative measures to reduce the chances of an outbreak in the first place. White rot and clubroot are diseases that will reside in the soil for a long time, once introduced, so it is especially important to ensure that you have a system with good rotational planning (leaving at least a 3 year gap between growing alliums or brassicas on the same plot) to lessen the chances of these diseases taking hold. Blight is very dependent on locality and weather conditions so in some areas it may be necessary to be more vigilant, taking measures such as growing blight resistant varieties, and harvesting early. Allium leaf miner does most damage to leeks, and can completely devastate a crop, but can be controlled by applying netting if it is a problem in the locality.

Most common pests and diseases in 2020

The most damaging pests and diseases in 2020 were slugs, black bean aphid, white rot and large cabbage white butterfly. In all these crops, more than 20% of people who reported growing these crops experienced significant losses due to these pests and diseases. Slugs were most prevalent in lettuce crops in June, July and August. This is consistent with the weather patterns, where April and May were very dry, but there was considerably more rainfall from June onwards.

Many people commented that 2020 was a very bad year for aphids, especially black bean aphid. Numbers increased during May then reached a peak during June and July at the time when broad bean plants were flowering. This pattern is broadly consistent with the general trend for the UK recorded in the AHDB pest bulletins (2020). For many aphids, populations are very dependent on the temperature conditions in late winter and early spring. A mild winter reduces winter kill of aphids, and warmer early season temperatures allow aphids populations to build up more quickly, so that they become more of a problem (Bell *et al.* 2015). The effects of climate change on insect pests are complex, as rising temperatures, rising CO₂ levels and changes in plant nutrient levels all interact with each other and have different effects on different pests (Bell *et al.*, 2015, Newman, 2004). Therefore climate change may result in increases in some pests and decreases in others.

Around 30% of sites that reported back experienced crop loss due to black bean aphid, but it is interesting that there were also 41% of sites growing legumes that had no problems at

all with the pest. It is not clear what the reasons are for this. Migration patterns and natural predation and parasitoids may account for some differences (Karley *et al.*, 2003, Mashanova *et al.*, 2008). There has also been work to show that the nutrient content of the plant leaves can have an important influence on aphid infestation, and although plants fertilised with higher levels of nitrogen tend to be more susceptible, the interaction of all the plant nutrients is complex and not always easy to predict (Noma *et al.*, 2010, Jansson and Ekbohm, 2002). There is the need for further work to examine the factors determining pest infestation in a garden setting.

White rot in alliums is a long term soil borne problem, so it is not good news that 29% of sites that reported in 2020 experienced significant losses due to this disease. Once a site is infected, there are few measures against this disease except for avoiding growing plants from the allium family in areas that are known to be infected, and taking measures to prevent it spreading to other areas of the garden, through transfer of soil on tools and boots.

The large cabbage white butterfly was sited from mid-June onwards, with peak numbers in July and August, but it was still present in September. It caused loss at 20% of sites that reported back. This pest can cause devastating loss in brassica crops, but is easily controlled using fine mesh netting, so is only likely to have been a problem in uncovered crops.

Table 3. Crop pests and diseases in 2020

Crop	PandD	No damage	Small amount, not affecting yield	Caused loss but a crop is still produced	Virtually no useable crop produced
Lettuce	Slugs	13	48	36	4
Legumes	Black bean aphid	41	30	30	0
Alliums	White rot	56	15	23	6
Potatoes	Slug	36	38	25	2
Carrots	Carrot fly	50	27	20	2
Brassicas	Large white butterfly	49	31	16	4
Brassicas	Cabbage aphid	57	26	16	1
Brassicas	Pigeon	59	24	17	0
Potatoes	Blight	68	18	14	0
Brassicas	Small white butterfly	50	36	13	1
Alliums	Neck rot	79	8	8	4
Brassicas	Flea Beetle	64	24	9	3
Legumes	Rust	72	17	9	2
Potatoes	Wireworm	77	13	9	2
Alliums	Allium leaf miner	79	10	6	4

Brassicas	Brassica whitefly	63	27	10	0
Brassicas	Clubroot	93	0	7	0
Lettuce	Sclerotinia	93	0	2	5
Legumes	Chocolate spot	81	13	4	2
Potatoes	Blackleg	95	2	4	0
Brassicas	Blackspot	94	3	1	1
Alliums	Downy Mildew	94	4	2	0
Lettuce	Downy mildew	96	2	2	0
Lettuce	Lettuce aphid	93	7	0	0
Carrots	Violet root rot	100	0	0	0

Key diseases in individual crops

Potatoes

Slugs were the most frequent pest in potatoes, being a regular problem at 76% of sites. When there was a slug infestation, it caused crop loss in 49% of the cases. It is mostly keel slugs that cause damage in potatoes, which eat away at underground structures. Blight was only a problem at 28% of the sites, but when it did occur, it caused losses in 69% of cases. The blight fungus is airborne and so spreads from infected plants in the region. As more plants become infected through the growing season, the risk of other plants in the region becoming infected increases. The risk of getting potato blight depends on the weather. When conditions are cool and damp, the leaf surface remains wet, so that any blight spores are likely to germinate (Harrison, 1995). The risk also depends on there being other infected potato crops in the region. As blight infection is difficult to control once plants are infected, growers will choose to take preventative action, depending on how much of a risk they consider it to be. Preventative action could be growing resistant varieties or harvesting crops early.

In 2020, most people reported seeing blight in July and August which is consistent with the frequent periods of rain and unsettled weather during that period.

Brassicas

Large and small cabbage white butterflies were the most frequently occurring pests in brassicas occurring frequently (69% and 72%) and causing significant damage in around half of the cases that it did occur. Fine netting is the only robust measure against this pest, as it can lay its eggs through wider mesh netting. Both types of cabbage white butterfly were around between June and September. Pigeons can also cause significant damage to uncovered crops, and were present throughout the season.

Brassica whitefly occurred regularly at just over half the sites, but only caused significant loss in 25% of cases. In most cases, brassica whitefly are considered unsightly, but the damage they do the crop is limited. The pressure of whitefly increased throughout the summer, reaching a peak in September, then declined.

Both cabbage aphids and flea beetle only occurred regularly (at 36% and 37% of sites respectively) causing damage in just under half (43% and 46% respectively) of cases. Cabbage aphids not only cause physical damage to plants but transmit viruses too. Cabbage aphids increased until June, declined in July, then reached a second peak in September. It is not known what causes this July crash in the aphid population. It has been suggested that a combination of natural enemies, declining nutrient content of the plants and migration may play a role (Karley *et al.*, 2003, Karley *et al.*, 2004, Mashanova *et al.*, 2008).

For commercial growers, flea beetle is most of a problem with direct sown brassicas, where it can kill the growing point of young emerging seedlings. However, as many gardeners tend to grow seedlings from plants sown indoors, they are most likely to notice the damage in brassica salad crops such as rocket and mizuna, where they cause lots of small holes in the leaves. Flea beetle is most of a problem in the early summer, and this was confirmed by a rapid increase in May, peaking in June and July, then a rapid decline in August. Clubroot only occurred regularly at 4% of sites growing brassicas, but it was highly damaging when it did occur, causing significant crop loss in 92% of cases. It is a soil-borne fungal disease that forms resting spores that can persist in the soil for at least 17 years even when no brassicas are growing (Wallenhammar, 1996). Rotating brassica crops is one of the key ways of ensuring that levels of infection remain below the threshold for causing damage.

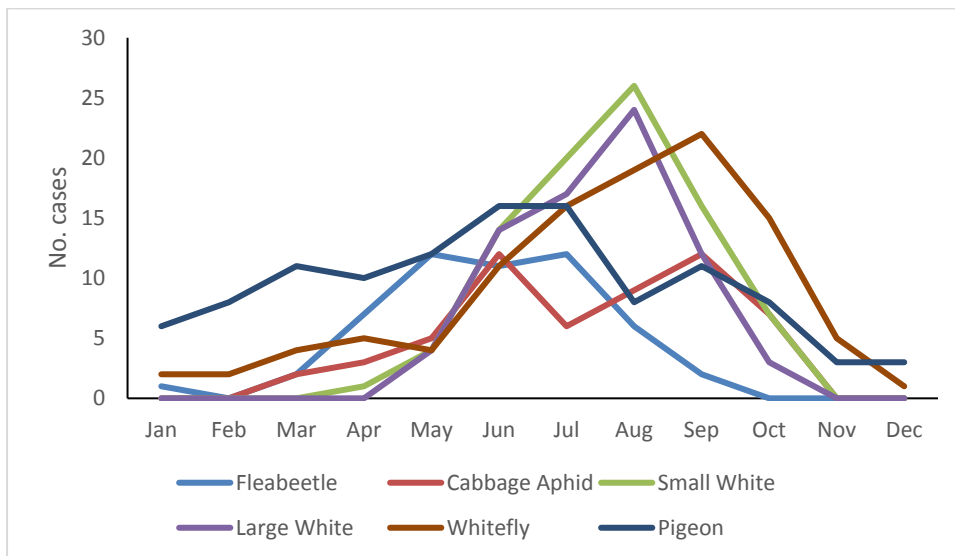


Figure 1 Pests of brassicas in 2020

Lettuce

Slugs were by far the most damaging pest of lettuces, occurring regularly at 86% of the sites and causing significant loss in 83% of cases, when it did occur. Most of the other pests and diseases such as downy mildew, sclerotinia and lettuce aphids only occurred at very low levels. Downy mildew can be damaging in commercial organic lettuce crops, but perhaps it is seen as less of a problem in home lettuce crops, where outer leaves tend to be

harvested regularly rather than trying to grow unblemished complete heads of lettuce for supermarkets.

Alliums

Alliums suffered less from pests and diseases than other crops. The main two pests: white rot and allium leaf miner, didn't occur frequently, but when they did occur, they caused significant loss. White rot only occurred regularly at 20% of sites, but when it did occur it caused significant loss at 86% of sites. White rot is a highly persistent soil fungal disease that can survive as resting spores in the soil for over 15 years even when no allium crop is grown (Coley-Smith, J. R., 1990). As with club root in brassicas, the problem can be kept at bay by rotating allium crops, to prevent infection levels building up in the soil.

Allium leaf miner only occurred at 16% of sites, but caused significant loss in 70% of cases. This pest mainly causes damage in leeks, and will often wipe out or render the crop inedible when it occurs. It is still specific to locations around the country, particularly around the Midlands and London, but is spreading rapidly. A recent survey done by Garden Organic (2017), showed that this pest was present at many growing sites but people were not aware that the damage in their crops was caused by this pest. If it is a problem in the area, it can be prevented by covering crops with fine mesh netting from September to November and in March to prevent the adult flies laying eggs in the crops.

Carrots

The main pest in carrots was carrot root fly. This occurred regularly at 54% of sites, and caused significant damage in 77% of cases. Covering with fine mesh seems to be the only robust method of protecting the crop, but damage can still be possible if the cover has been removed for a time for weeding. Other measures such as planting after the end of May to avoid the first generation of flies and harvesting before August to avoid the second generation will also avoid damage, but is not always reliable (RHS 2018).

Legumes

Black bean aphids were the most damaging pests in legumes, regularly occurring at 56% of sites, and causing crop loss in 70% of cases. They showed a peak in May and June when most people are growing broad bean crops. Other fungal diseases such as chocolate spot and rust only had a minor impact on crops.

Geographic location of pests and diseases

The locations of key pests and diseases were plotted on a map of the UK, using the participants' postcodes. The most marked trends were for black bean aphids and brassicas whiteflies with more problems in the south east and fewer problems towards the north and in Scotland. For many pests, warmer temperatures, especially in early spring result in higher and earlier levels of pest infestation, and this is directly related to latitude (Bell *et al*, 2015).

A study of over 26,000 pest records since 1960 suggest that on average, pests are moving north by a distance of 2.7 km per year (Barford, 2013). However, this is an average figure, and the effects of climate change will affect different pests in different ways.

Further recommendations

There are some instances where key pests are much less of a problem or even absent in some gardens. It would be useful to investigate some of the reasons for this, taking into account habitat, biodiversity, population of beneficial insects

Repeat the survey at regular intervals in subsequent years and open it out to a wider audience to observe trends. The survey may be too long and complex at present, so it could be simplified to include a number of key pests.

Pests and diseases are common for those growing top fruit and bush fruit, so a survey could be designed to cover these.

A simple survey of an easily identifiable pest (cabbage aphid) and a predator or parasitoid (eg *Aphidius colemani*) to raise awareness of pest and parasites in the gardens and the conditions under which they occur.

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