A Guide to Vegetable Growing

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Agriculture and Food Development Authority

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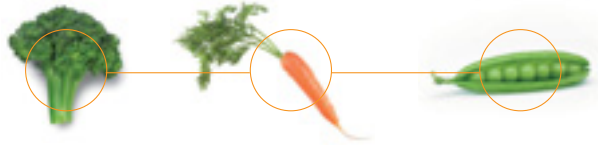


Vegetable Growing

The selection of fresh vegetables now available in shops and supermarkets is probably greater than ever before. But there's a huge amount of satisfaction to be had from growing part of the food we eat. A well managed garden or allotment is an asset to any family and vegetable growing can rapidly develop into an absorbing hobby.

The quantities of vegetables to grow will naturally depend on circumstances. It can be as simple as growing a pot of parsley on your back doorstep or you can make it as big and fancy as you like. If there's only a small area available preference should be given to items where freshness is especially valuable such as lettuce, herbs, spinach, parsley, peas and beans. If there's more ground add brassicas, onions, carrots, beetroot, rhubarb and early potatoes to the mix. It will also add interest to try out some new or unfamiliar kinds each year.

Helpful Hints

(1) Vegetables can be grown on most soils (light, medium or heavy) provided they are well drained. Choose an open though not exposed site, where plants can receive maximum sunlight.

(2) Crops are grown on the flat, in drills (ridges) or on raised beds (also known as deep beds). Choose the system that suits you best. Or maybe a combination of all three.

(3) Site perennial vegetables, such as asparagus, rhubarb, seakale, horse radish and other crops which remain in one place for a number of years to one side so that they do not interfere with the cultivation of annual crops.

(4) Grow the early maturing crops together so that when they are harvested the ground may be planted with late crops. For example, early potatoes, scallions, lettuce, spinach and radish could be followed by savoy cabbage, winter cauliflower or late celery.

(5) Vegetables are normally either sown directly where they are to mature (known as direct drilling) or else the seed is sown into a nursery bed or modules (multi-celled tray) and later on the young plants (transplants) are planted out into their final quarters. Carrots, parsnips, scallions, beetroot,

swedes, spinach, radish, peas and beans are usually direct drilled, while most brassicas, lettuce, celery and courgettes are transplanted. Leeks, onions and sweetcorn are examples of crops that can either be drilled or planted.

(6) A common mistake is to sow seed too thickly. As the seeds germinate and the young plants come through they should not crowd each other. When thinning out plants to their final distance this should be done when they are still quite small. The depth to which seed should be sown will vary depending on the size of the seed. See Table 2 in the Appendix for details.

(7) Transplanted crops are usually sown under protection (plastic tunnel, glasshouse or garden frame) into a container of some sort. These containers could be a seed tray, small pot or a multi-celled tray called a module. Some of the brassicas and leeks can also be direct drilled into a seed bed outdoors and later on transplanted out as bare root plants.

(8) A garden frame (or cold frame) is a marvellous addition to any vegetable garden. It's a simple box like structure with a plastic or glass top that allows you to warm the soil in early spring. If you don't possess a glasshouse you can use frames to propagate transplants or to grow early season crops.

(9) As there are few effective insecticides available it's essential to physically protect your crops from pest attack using fleece, nets or barriers.

(10) Keeping annual records outlining the crops grown, planting distances, varieties, dates of sowing, transplanting or harvesting etc. will add to the owner's store of information year on year.

(11) Vegetable growing can get confusing due to the large number of different types of vegetable that are available and the many different ways of growing them. If you are a beginner you're better off to start small and grow something easy like cabbage, onion sets or beetroot. Look after them well and you'll get a harvest.

Cultivation of the Soil

Thorough drainage of the soil is one of the first requisites for success in vegetable growing. The soil must be well drained so that all surface water may drain quickly into the subsoil within a few hours of falling. As crops are frequently harvested right through the winter growers will often grow their crops on drills or on raised (deep) beds to improve drainage.

Building up soil fertility and maintaining a healthy soil structure is also important. In a well cropped vegetable garden, two and sometimes three crops a year are taken off the same piece of ground and not only the weight of the produce but its table quality depends on the quantity of plant food available in the soil. The texture of very light or very heavy soil can be improved by adding garden compost or farmyard manure to the top layers. Crops that traditionally get additions of organic matter include potatoes, celery and leeks but if your ground is lacking in organic matter it can be applied to any crop.

All ground which falls vacant in autumn or winter, should be dug when the weather permits. A good rule of thumb is that if clay sticks to your spade or boots then the ground is too wet. Ordinary digging should always be done to the full depth of the spade, turning the soil over and burying any trash or small weeds. Lumps should not be broken during this digging, and the surface soil can be left quite rough in order to expose it to the influence of the frost.

If you have underlying compaction problems and you're feeling energetic you should cultivate the ground to two spits deep – also known as double digging. This involves digging out a trench one spit (spade dept) deep, taking the soil to the end of the plot and forking over the bottom of the trench before turning over the soil from the adjacent spit. In double digging, opportunity should be taken to add to the subsoil such substances as vegetable refuse, old leaves and as much manure as can be spared. On no account should the subsoil be brought to the surface.

The formation of a fine seed bed is of great importance, especially for the smaller seeds such as onions. Provided we get sufficient frost, ground which has been dug in autumn or early winter will break down to a fine tilth more easily

than that which has been left un-dug until spring. To form a seed bed fork over the ground to a depth of about 10 cm carefully breaking all lumps, and then rake it smooth, removing stones and unbroken lumps. The forking down should be done only when the ground is dry, and it may be advisable to wait a day or two between the forking and raking, to allow the soil to dry still further.

Summer cultivation consists principally in the frequent use of a hoe. It is impossible to overestimate the benefits which plants derive from having the soil around them shallowly stirred. Not only are weeds destroyed, but hoeing conserves moisture in the soil and it entails less labour to destroy weeds in the seeding stage by hoeing than to resort to hand pulling when they are mature. The action of a hoe will also aerate the soil, thereby encouraging bugs to release nitrogen and growth is stimulated.

Plant Nutrition

Vegetables require a number of things to grow: light, temperature, CO_2, water and nutrients. The nutrients consist of major and minor elements. Those nutrients that a plant uses a lot of are called major elements. These are nitrogen (N), phosphorus (P), potash (K), sulphur (S), calcium (Ca) and magnesium (Mg). Minor or trace elements are also essential for plant growth but are only required in tiny amounts. These include boron (B), manganese (Mn), molybdenum (Mo), copper (Cu), zinc (Zn), iron (Fe), chlorine (Cl) and nickel (Ni).

Harvesting vegetable crops removes considerable quantities of nutrients from the soil and hence we have to replace them to maintain good yields. A certain amount of replenishment comes naturally from weathering of minerals and breakdown of organic matter but the bulk of the replacement has to come from the compost, manure or fertiliser that we add to supplement what's naturally available. But how do we know how much to add? To work that out we need to know what's in the soil to start with and marry that with the crop to be grown. Normally we only concern ourselves with the three major elements that are used is large quantities by crops: nitrogen, phosphorus and potash.

The only accurate way to find out what nutrients are in your soil is to take a soil sample and post it off to a laboratory for analysis (see Table 3 in the Appendix). It's also possible to purchase 'do it yourself' kits from garden centres which will give you a rough guide to the fertility of your soil. A sample must be representative of the area you're testing so take about 20 sub samples, mix them up and select about 450g for the test sample. Do not take a sample within three months of applying fertiliser. A basic test will tell you the pH of the soil, how much lime to add if needed, plus the phosphorus (P) and potash (K) level. Nitrogen is not normally tested for as the amount in the soil is very variable – its natural availability depends on biological processes and is also prone to leaching.

The results of the test are expressed in mg per litre (mg/l) of soil which is equal to parts per million. To keep things simple from an advice point of view the results are put into a 1-4 index system where Index 1 = very small amounts of the nutrient and Index 4 = very large amounts of the nutrient. The general idea is to get your soil into Index 3 – this is the recommended level for optimum

nutrition of vegetable crops. This is equivalent to 6-10 mg/l for P and 100-150 mg/l for K; the optimum pH is around 6.5-6.8. You don't have to sample annually – once every 4-5 years is recommended.

The table below sets out the Index levels for P, K and Mg.

Index	Index description	P mg/l	K mg/l	Mg mg/l	Response to fertiliser
1	Very Low	0.0-3.0	0-50	0-25	Definite
2	Low	3.1-6.0	51-100	26-50	Likely
3	Medium	6.1-10.0	101-150	51-100	Unlikely
4	Excess	> 10	> 150	> 100	None

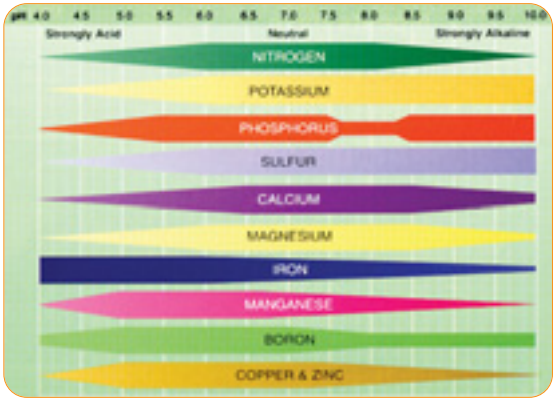
The laboratory will usually make a recommendation based on the results and what crop is to be grown. At Index 1 and 2 relatively large amounts of nutrients are advised to bring the soil up to Index 3. At Index 3 only maintenance amounts are required to replace what's taken out and at Index 4 usually nothing is advised as the levels are excessive and need to be allowed to drop back to Index 3.

Soil sample results frequently show excessive fertiliser use by vegetable gardeners so use fertiliser sensibly and take into account that use of organic matter will also add N, P and K to your soil.

Soil pH

The pH of a soil is a key component of soil fertility and relates to whether a soil is acid or alkaline. It's measured using a pH scale of 0-14 the mid-point being 7 (neutral), with any reading below indicating acidity and above denoting alkaline conditions. Whilst most vegetables are reasonably tolerant of variations in pH (5-8) we ideally try to keep our soil slightly acidic between 6 and 7 to ensure maximum availability of nutrients (see chart). If your soil is very acidic you can get lock-up of certain nutrients like molybdenum whilst other elements such as aluminium and manganese become overly available to the extent of being toxic. At the other end of the scale very alkaline soils can reduce

availability of elements like iron, boron and manganese. To check what pH suits what crop see Table 1 in the Appendix.



The natural pH of a soil will depend on the underlying rock formation e.g. limestone based soils tend towards alkalinity whilst those deriving from shale, granite and sandstone tend to be acidic. Over time most soils will naturally become more acidic due to a number of factors but some soils never need liming.

To find out the pH of your ground you can purchase a test kit from a garden outlet but for an accurate pH figure your best bet is to get it analysed in a laboratory.

The amount of lime to apply will depend on your initial pH and the type of soil; heavy clay soils will require more lime than light sandy soils to increase the pH by the same amount. If you get your soil tested by a laboratory they will tell you exactly how much lime to apply to increase the pH of your soil to a set value – usually somewhere between 6.5-7.0. Typical application rates for a lot of soils will vary between 0.5-1.0 kg per m^2 but do not apply any more than 750g per m^2 at any one time. If your soil is very acidic and requires a lot of lime, spread the application over a couple of years. The form of lime that is normally used is ground limestone. Take note that it takes several months for the lime to react fully with the soil to effect the pH change, so plan ahead and apply in plenty of time. Lime can be applied at any time of the year but preferably apply over ploughed or dug ground in the winter and rotavate or fork it in during the spring. Be careful not to over apply lime as it's far easier to raise the pH than to decrease it.

Apart from correcting acidity lime also improves the structure of the soil, and renders the plant food contained in it more available to the crop. It can also have an effect on disease outbreaks. For example in low pH soils brassicas are more

liable to attack by club root disease; if the disease is already present the advice would be to lime the ground to pH 7.4 or greater to prevent its reappearance.

Nitrogen

Nitrogen is a key nutrient for growth and is available naturally in the soil. However we normally supplement soil nitrogen with fertiliser nitrogen and/or by adding organic matter. Vegetables vary in the amount of nitrogen they require. Some of the legumes such as peas and broad beans can fix their own nitrogen and don't require any. The following list groups vegetables into three categories of low, medium and high users of N:

Low: swede, French bean, runner bean, carrot
Medium: broccoli, beetroot, onion, courgette, parsnip, scallion, lettuce
High: leek, spinach, rhubarb, sweetcorn, cauliflower, cabbage, celery, sprouts

The following table gives suggested nitrogen application rates for a range of vegetables using sulphate of ammonia as the nitrogen source:

Crop	g/m^2
Pea, broad bean	0
Carrot, radish, swede	30
Parsnip, French bean, runner bean	40
Broccoli, parsley	50
Onion, lettuce, beetroot, courgette, early potato	60
Cabbage, c'flower, leek, spinach, potato, s'corn	70
Celery, Brussels sprouts	90

The correct amount of nitrogen to apply will depend on a variety of factors such as cropping history and soil type so the suggested amounts may be above or below what is optimum for your situation. In general lighter soils require more nitrogen than heavier soils. If you are using garden compost or farmyard manure these materials are a nitrogen source and the above figures will need to be adjusted downwards. At best a well rotted application of farmyard manure applied in the spring will supply the equivalent of 30 g/m^2 of sulphate of ammonia.

Nitrogen is normally applied prior to sowing but can be split into 2-3 applications with the higher nitrogen demanding crops. If too much nitrogen is applied at any one time roots can get scorched or seeds may fail to germinate. For example with transplanted brassicas you would apply half pre-planting and the rest about a month later – this is known as topdressing. Celery would get three equal splits – at planting, 3 and 6 weeks later. Be careful when applying nitrogen directly over crop foliage as it can scorch the leaf – if in doubt apply it to the side of the plant. Irrigation may be necessary after application to reduce scorch and to activate the nitrogen.

Example of excessive nitrogen application on a swede crop resulting in growth cracks.

Phosphorus

This element is important for root development, flowering, seed formation, straw strength in cereals, crop quality and disease resistance. It's also involved in cell division and is the carrier of energy within cells.

Potash

Potassium is used in a wide range of plant processes and hence a lot of it is needed. It's essential for photosynthesis, starch formation, translocation of sugars and in the development of chlorophyll but the bulk of potassium is in the cell vacuole where it is involved with turgor and water control. It also tends to exert a balancing effect on excessive availability to the plant of nitrogen and phosphorus.

Magnesium

There are usually plentiful supplies of magnesium in soils and shortages of this element are unusual in vegetable crops. This is particularly the case where regular additions of organic matter are added to the soil. Sometimes you can get an induced magnesium shortage showing up if the root system is under performing due perhaps to soil compaction, drought conditions or wet soils. The typical deficiency symptoms of interveinal chlorosis occasionally occur in broccoli crops close to harvest, but only rarely has any effect on yield. If you wish to alleviate magnesium deficiency symptoms use a 2% foliar spray of Epsom Salts (20 g per litre of water). Add in a couple of drops of washing up liquid to allow the spray droplets to spread evenly on the leaf.

Calcium

One of the commonest deficiency symptoms in vegetables of any element, apart from nitrogen, is calcium. It's usually an induced deficiency rather that an actual shortage of calcium in the soil. Calcium is not a very mobile element within the plant and if the transpirational stream in the plant is interrupted, for example in drought conditions, a shortage of calcium can occur within the plant and deficiency symptoms appear in the weeks following. The symptoms are called a number of different names depending on the crop: brassicas and lettuce (tipburn), celery (blackheart), tomato (blossom end rot), potato (internal rust spot). The most effective way to counter calcium deficiency is make sure that your crops are well supplied with water by irrigating in dry spells.

Black heart in celery.

Trace elements

Vegetables rarely suffer from trace element deficiency. The most common one is boron deficiency in swedes and turnips which causes a disorder called 'brownheart'. This is a brown discolouration in the centre of the bulb and to prevent it boron should be applied preventatively before the symptoms develop. Alkaline soils and dry summers are factors that can increase the incidence of brownheart. Boron deficiency can also show up in celery where it's known as 'cat's claw'. High pH soils can exacerbate low boron levels in the soil due to lock-up of the available boron. On the other hand very low pH soils can induce molybdenum deficiency in cauliflowers causing the formation of narrow, strap shaped leaves known as whiptail. Sometimes you may come across iron deficiency symptoms in module raised plants if they are watered with hard water. This causes the pH of the compost to rise and you end up with an induced iron deficiency. To cure the problem apply some iron sequestrene. Applications of compost or manure will ensure a plentiful supply of trace elements.

Organic matter

Additions of organic matter – usually garden compost or farmyard manure – are beneficial for several reasons. It benefits soil structure, improves water holding capacity and adds in small amounts of major and minor elements. It is

particularly beneficial for improving heavy and light soils. Compost, which is formed from the decay of plant material, is valuable for the humus and recycled nutrients it contains. All garden refuse, cut grass, kitchen waste, etc. should be collected into a heap and when rotted, dug into the soil. It is important to exclude from the heap the remains of any crop suffering from disease such as onions which have been attacked by white rot, or any brassicas which have suffered from club root. Farmyard manure is also a great source of organic matter when available. Spent mushroom compost, available in certain outlets, is pleasant to handle and compares more than favourably with farmyard manure and compost in nutrients.

Organic matter should be dug in during the autumn or winter months at a rate of about 5-10 kg per m^2. It can also be applied prior to planting, as for example with potatoes. Organic matter is normally applied in rotation to the high nitrogen demanding crops: transplanted brassicas, celery, leeks, courgettes, potatoes and spinach . Final word of warning – don't be tempted to apply copious amounts of organic matter every year to the same ground – it is possible to overdo a good thing.

Fertilisers

Fertilisers are as valuable in the garden as on the farm if used intelligently to supplement moderate dressings of farmyard manure or compost. They supply to the crop the particular nutrient that it most requires. Fertilisers come in two forms – straights and compounds. Straight fertilisers contain just one element, such as nitrogen or potash. Compound fertilisers contain more than one element and usually consist of various mixtures of nitrogen, phosphorus and potash or N-P-K. The advantage of using compounds is that it's a handy way of applying all three major elements to a crop.

The standard notation on a box or bag of fertiliser is to give a percentage figure for nitrogen, phosphorus and potash – or N : P : K – in that order. For example a bag of 7-6-17 contains 7% nitrogen, 6% phosphorus and 17% potash. Take note that UK sourced fertiliser always quote P as P_2O_5 and K as K_2O. In Ireland

we use elemental P and K. To convert P_2O_5 and K_2O to P and K multiply by 0.44 and 0.83 respectively. Nitrogen in both countries is quoted in elemental N.

One normally applies fertiliser just before sowing or planting a crop – sprinkle the fertiliser across the ground and lightly rake or fork in. One should apply only as much fertiliser as is required to grow the crop in accordance to the results of a soil sample and the following rates are only a guideline where that information in not available.

Straights

Superphosphate 8% P

Apply 35-50g per m^2 of 8% P at time of sowing or transplanting.

Sulphate of Potash 42% K

Apply 30g per m^2 at sowing or transplanting.

Sulphate of Ammonia 21% N, 24% S

This is the commonest form of nitrogen available to the gardener and is also a useful source of sulphur. Works within about a week of application under warm, showery conditions. With constant use will tend to acidify the soil. Apply at 15-30 g/m^2.

Calcium Ammonium Nitrate (CAN) 27% N

This is the most commonly used straight nitrogen in agriculture. Slightly faster acting than sulphate of ammonia. Apply at 15-30 g/m^2.

Compound Fertilisers

There are various compound artificial manures on sale which incorporate the three main fertilisers i.e. nitrogen, phosphate and potash and sometimes other elements such as sulphur or boron. Granular compound fertilisers such as 10:10:20, 8:5:18+ B or 7:6:17 are ideal for the vegetable garden and do not have to be mixed. They are normally available at agricultural outlets. Apply at a rate of 50-90g per m^2, or preferably in accordance with the results of a soil test. There are other proprietary compounds on the amateur market suitable for vegetables and these should be used according to the manufacturer's instructions. Organic based fertilisers are also available in retail outlets.

Liquid Fertiliser

Many proprietary brands of liquid fertilisers are available which when diluted with water according to instructions are valuable for vegetables as a quick acting source of nutrients. However it is a much more expensive way of applying nutrients than using solid fertilisers.

This image shows nitrogen deficiency in parsley. It shows up in the older leaves as a pale green to yellow colour with the younger foliage showing a healthier darker green.

Rotation

The very first farmers back about 10,000 years ago would have discovered two things about rotation pretty quickly. Firstly, that breaking fresh ground gave them healthy crops; secondly, that if they kept cropping the same bit of ground with the same crops they became unhealthy due to a build up of pests and diseases. And so they would have begun to move – or rotate – their crops around in order to maintain good yields.

The basic idea is that pests and diseases are usually specific to each family group of vegetables and that if you move the groups around you'll minimise the likelihood of an outbreak. But in a sense rotation is a bit of a nonsense for the small plot vegetable grower, as true rotation is something that only a farmer can carry out by moving his crops from *field* to *field*. Take carrot fly for instance. It's capable of flying up to a kilometre from its overwintering site and this year's carrot crop that's 2km away from last year's infected crop is unlikely to be attacked from that source. But the carrots in your allotment that are only a few metres away from the previous year's infected crop will get attacked.

The other problem with small plots is that in the process of growing your vegetables you'll inadvertently move soil from plot to plot via boots, tools and

wheelbarrow and in this way soil borne diseases like white rot and clubroot can be spread around.

Hence it's not easy to rotate crops in a small area but the advice would be to practice it in as far as possible. Divide your crops into roughly six groups: brassicas (cabbage, swede, Brussels sprouts, cauliflower, broccoli, kale), legumes (pea, bean), alliums (onion, scallion, leek, garlic), carrot group (carrot, parsnip, parsley, celery), solanums (potato, tomato) and the last group is everything else. The idea is not to grow any one group in the same ground more than 1 year in 4 or 5.

Notwithstanding the last piece of advice, an even simpler system is to divide your plot into three evenly sized areas and split up your vegetables into three groups: leafy crops (includes all the brassicas), peas and beans and root crops. Then follow the sequence in the table below.

	Year 1	Year 2	Year 3
Plot A	Roots	Peas and beans	Leafy crops
Plot B	Peas and beans	Leafy crops	Roots
Plot C	Leafy crops	Roots	Peas and beans

The above rotation would be particularly useful if you are growing organically without access to artificial fertilisers. Leafy crops are high nitrogen crops, roots are low nitrogen crops and peas and beans fix nitrogen and make it available to the following crop. Hence leafy crops follow after the legumes and root crops are placed at the low point in the nitrogen cycle.

The main problems that can stem from poor rotations include club root and white blister in brassicas, white rot and downy mildew in alliums and eelworm in potatoes – all of which are difficult to eradicate once they become established.

Other reasons for rotating crops include evening out what nutrients are absorbed from the soil as crops differ in their requirements and improving soil structure. Varying the crops grown allow for different types of cultivation to take place and this can help to preserve good soil structure. For example the deep cultivations required for a potato crop are different to the more shallow cultivations required for an onion crop.

Weed Control

Weeds are an ever present problem for the vegetable grower. Studies of soil taken from fields cropped commercially with vegetables have shown that it is quite common to find 10,000 seeds per square metre in the top 15 cm of soil, with the figure rising to 75,000 in very weedy fields.

Weeds of tilled ground are usually annuals that have the ability to grow, flower and set seed quickly e.g. chickweed, groundsel and shepherd's purse. They have adapted to survive in cultivated ground and will germinate throughout the year any time the soil is disturbed. They compete with the crop for space, light and nutrients but the effect on the crop can vary. For example, weeds can wipe out a direct drilled onion crop if not dealt with but have far less of an effect on a transplanted crop of cabbage.

The best way to beat weeds is to keep on top of them by constant use of a hoe. The weeds should be eliminated when they are quite small and never allow them go to seed. There is no need for 100% elimination – weeds growing within the crop-row are not a problem. Perennial weeds should be forked out before they become a problem.

Groundsel: abundant tillage weed which has the ability to grow, flower and set seed all year round.

An alternative to hoeing is the use of black polythene mulch. Black polythene laid on the ground prevents weed growth, conserves moisture and raises the soil temperature. It is of particular benefit with certain half-hardy vegetables such as courgette, melon, sweetcorn etc. Ideally the surface should be level and pierce the plastic with a sharp knife wherever water ponds to allow rainfall to drain through.

Another idea you might consider to reduce the amount of hoeing is the creation of a stale seedbed. This is where you prepare the area for sowing or planting several weeks before, to allow weed seeds to germinate. Then spray them off using a glyphosate product such as Roundup. As the weeds are only in the seedling stage you can get away with using reduced rates – suggest half rate. It's quite safe to sow or plant the day following treatment.

For weed identification please refer to www.teagasc.ie and search for "Illustrated Guide to Tillage Weeds".

Pests and Diseases

Let's get the bad news out of the way at the beginning. Pests and diseases go hand in hand with growing vegetables and are a natural part of the ecosystem. So we'd better learn to live with them.

It's a sad but inevitable fact of life that the fruits of your labours can be attacked by a wide range of pests. However the good news is that with a little bit of care and attention we can sidestep most of them – provided we know what to expect and take the necessary precautions.

Good control starts with good husbandry. Just like ourselves, if a plant is well looked after, it's far less prone to attack. Thorough preparation of the soil and use of manure or compost will pay handsome dividends in reducing the incidence of pests and diseases.

That said there will always be some pests that inevitably show up in certain crops. Cabbage root fly, carrot fly, caterpillars, slugs and aphids are sure to leave their calling cards at some stage during the season.

So what can we do? You have the option of using pesticides, organic methods or a mixture of both. In a garden situation the organic option is best with a couple of exceptions – slugs are one and the use of pellets is probably the handiest way of controlling this particular pest.

Large white butterfly caterpillar.

And indeed you may be faced with Hobson's choice in relation to turning organic – the chemical you once used is no longer there in a lot of cases. There are now very few insecticides or fungicides available to the amateur market.

PESTS

An excellent idea to keep the majority of pests off your crops is to cover them with an insect proof cover. You have two choices: fleece or insect netting. Both of these can be placed directly over your crops and anchored at the edges – they will keep the majority of pests out but still allow light and water to pass through. They are put on before the pest arrives and it's taken off when the

crop is past the susceptible stage of attack. Fleece is a light woven material and insect netting is a heavy duty plastic both of which can be purchased in good garden outlets. Nets are considerably more expensive than fleece but last far longer hence probably cheaper in the long run.

Cabbage root fly

Cabbage root fly is a major pest of all the brassicas. The damage it does is unmistakable – plants dying off with white maggots on the roots. You are courting disaster unless you take some precautions. The next time you are replacing the dining room carpet, don't dump the old one. Cut it into 10 cm squares, with a single cut to the middle and slide it into place around the base of each brassica transplant. This will stop the maggots from getting to the roots. Alternatively cover your brassicas with fleece or net.

Cabbage root fly start laying eggs about 20 April but in cold springs it can be as late as 8 May. Experience has shown that initial egg laying coincides with the start of flowering of hedge parsley when about 1 in 20 of its flower heads are showing white. The first generation peaks in May (usually around mid May), so by covering your brassica plants from mid April to mid June, you'll avoid the worst ravages of this pest. Young plants are the most susceptible and if you can get them past this vulnerable stage you can take the covers off, unless you want to protect against other pests such as caterpillar. Numbers are generally low in June but unfortunately there is a second generation to contend with in July and August but it's far less damaging than the first. Cabbage root fly is a ubiquitous pest that shows up every year and to ensure complete control cover your crops from mid April to mid September.

Carrot fly

Carrot fly is a major pest of carrot, parsnip, celery and parsley – all members of the same plant family, the Apiaceae. The small larvae of the adult carrot fly mine the roots and can totally destroy a crop. You may be lucky the first time you grow these crops and avoid damage but local populations of the pest can quickly build up. There are normally two generations per year – May to mid June and late July

to September. Celery is worst affected by the first generation while damage in carrots and parsnips normally shows up from September on. Parsley is less prone to being attacked but will suffer with high populations of carrot fly. The adult fly uses smell, vision and taste to locate its host and most of them will originate from a previously damaged crop within a square kilometre of your crop.

Carrot fly barrier with over-hang.

To prevent or reduce an attack from carrot fly try one of the following:

- Cover your crop with fleece or net from late April and leave it on until around mid September.
- Surround the area with a 60 cm high wall with something like clear plastic. The carrot fly isn't a strong flier and won't be able to find the carrots if they are barricaded off. The picture shows a metre high net barrier with a lip at the top for extra security – it managed to protect a plot 10 m wide.
- Sowing them in a garden frame or polythene tunnel will also probably be effective in warding off the ravages of this pest.
- Sow in mid May to avoid the first generation and put covers on from mid July to mid September.
- There's a new insecticide on the amateur market which contains lambda-cyhalothrin, the same active that commercial growers use for carrot fly control. It works by killing the adult fly and must be used preventatively. Use it only when the fly is active. The second generation spray protection programme usually starts around 20 July and would be applied every two weeks up to mid September.

Bean seed fly

Bean seed fly is a localised and occasional pest of beans, spinach, onions, cucurbits, beet, sweetcorn and brassicas. The flies emerge in March and April and the female lays eggs on freshly disturbed ground. They are attracted by decomposing organic matter and plant debris. The eggs hatch after a few days into white larvae, similar to cabbage root fly maggots, and grow to 5-8 mm in length. It's the larvae that do the damage by feeding on buried bean seed, on emerging Alliums and recently planted cucurbits. There are several generations

and attacks can occur until early autumn. Commercial growers use seed treatments to combat the pest on susceptible crops. A cultural control method is to delay sowing for about 10 days after cultivating to reduce the risk of attack.

Slugs

Common to every field and garden these pests can wreak havoc if present in large numbers. Given the amount of shelter available in an average garden they are a bigger problem in small plot areas than in the open field. There are several species including the grey field slug, the black slug and the keeled slug.

All are active throughout the year provided temperatures don't go too low and activity is highest in warm, humid weather. It's impossible to eliminate slugs so an integrated approach, using several different techniques is more successful than relying solely on pellets. The first step is to minimise areas where slugs can shelter – keeping the area around the vegetable plot tidy and controlling weed growth within it can help. Ensure that the remains of previous crops are dug in, or raked off and removed to the compost heap. Repeated cultivations, especially if carried out using a rotavator can also help in reducing numbers.

Use of slug pellets is the commonest method of control. They are based on one of three chemicals: methiocarb, methaldehyde and ferric phosphate; only the latter two are available for garden use. There is little difference in efficacy between any of the actives. Pellets are usually cereal based to make them attractive to slugs and coloured blue to make them unattractive to birds and other animals. The methaldehyde based pellets immobilises the slug and subsequently dies from desiccation. They can recover if the weather turns wet. Ferric phosphate pellets slowly poisons slugs and once ingested stop feeding. They become less mobile and die within 3-6 days normally underground as dead slugs are not usually visible overground. These pellets are more expensive than metaldehyde but more eco-friendly – they break down to iron and phosphate and are harmless to other wildlife. Use pellets sparingly and bear in mind that they will remain effective for 1-2 weeks depending on weather; they tend not to last in prolonged wet spells. Apply directly after sowing or planting out a susceptible crop.

Other controls:

- Nematodes: expensive but effective method of control. Must be sprayed on in rainy weather and will last for about 6 weeks.

- Traps: use of hollowed out grapefruit or orange, planks or black plastic bags laid on the surface of the soil will attract slugs which can then be subsequently destroyed. Beer traps are also effective in attracting and drowning slugs.
- Predators: encourage frogs, hedgehogs and ground beetles into the garden to help keep slug populations under control.
- Barriers: there are a variety of barrier materials sold to keep slugs away from desirable plants – of varying usefulness it must be said.
- Go out in the late evening or early morning and dispose of any slug or snail you come across.

Slugs will eat a variety of vegetables but not all. They prefer soft rather than fibrous material. However if choice of food is limiting they will graze on less palatable crops. The worst losses can occur at the seedling stage when complete crop rows can disappear. They mostly feed at night but if weather conditions are humid enough they continue during daylight hours as well. Having found a desirable food, slugs remember its location and return to it from their resting areas for subsequent feeds. The following table lists the susceptibility of various crops to slugs under three categories. To explain what intermediate means, take carrot for example. Slugs will eat seedling carrots, won't touch the more mature foliage but will eat the root when it forms. Commercial carrot growers don't need to apply pellets but in a garden situation it may be necessary.

Susceptible	Intermediate	Resistant
Brassicas	Spinach	Leek
Lettuce	Peas	Courgette
Celery	Broad bean	Beetroot
Rhubarb	Onion	Herbs (ex. basil)
Potato	Scallion	
Sweetcorn	Carrot	
French bean	Parsnip	
Runner bean		
Asparagus		

DISEASES

A wide range of diseases attack vegetables and we have a climate that is tailor made for the spread of disease. So we need to understand the nature of disease, be able to recognise the common ones and find out how best to deal with them.

Plant diseases are caused by fungi, bacteria or viruses. But it's important to realise that fungi and bacteria are also enormously beneficial – human life would be impossible without them. They carry out a myriad of essential life processes including nitrogen fixation and sorting out your compost heap.

There are many different species of fungi including mushrooms, mildews, moulds and yeasts. They are made up of thin thread like structures called hyphae and a visible mass of hyphae is called a mycelium. They propagate themselves by producing spores that are spread by wind and rain splash. There are two types of fungi: parasites and saprophytes; but one thing they have in common is the inability to manufacture their own food – unlike plants. Saprophytic fungi live off dead material and are commonly found in the soil and on rotting plant and animal material. Parasitic fungi are the ones that attack plants but in general don't kill them. The hyphae penetrate between the cells, secreting enzymes to break down the tissues and absorb the digested molecules.

Bacteria are tiny single celled organisms which increase in number by dividing in two. The majority of plant disease is caused by fungal pathogens but bacteria can occasionally cause problems such as blights, leaf spots and soft rots. Unlike fungi bacteria do not produce spores and hence don't get spread around by the wind. Plant pathogenic bacteria can exist on leaf surfaces without causing any problems; but if for any reason they multiply to sufficient numbers they are able to enter the plant through wounds or natural openings such as stomata or hydathodes. Once inside the plant they multiply and cause disease. Bacteria spread from plant to plant by rain or irrigation splash and are also readily transported around by contact e.g. machines, tools, trays, clothing or hands. A number of bacterial diseases are seedborne, e.g. Xanthomonas in Brassicas – if the seed is sown the disease can show up later in the growing crop. Plant pathogenic bacteria do not survive in the soil unless on partly decomposed plant material – the exception is *Streptomyces scabies* which causes common scab in potatoes and other root crops. Bacterial diseases in vegetable crops have

become more common in recent years due to wetter summers – it's a pathogen that develops in spells of wet weather. Examples of bacterial diseases are bacterial leaf spot on Brassicas, halo blight on beans and blackleg on potatoes.

Viruses are tiny, non-cellular structures that can only be seen with an electron microscope. They can attack a wide range of vegetables but not frequently. Most need a vector to transmit from plant to plant – aphids would be the commonest example of a vector. Examples of viruses are beet yellows virus, celery mosaic virus and virus x in potatoes.

Ring spot *(Mycosphaerella brassicicola)*
This is one the commonest diseases in brassicas, important on winter cauliflower, cabbage, kale and sprouts with swedes much less susceptible except in the wetter parts of the country. It's worst in wet seasons and is associated with intensive brassicas production areas. It starts off as small dark spots 3-5 mm in diameter which eventually enlarge to 2-3 cm. Leaf spots are restricted by veins so can appear angular in shape – this is a distinguishing feature in comparison to Alternaria leaf spot. Later on tiny black fruiting bodies appear in concentric rings. Badly affected leaves turn yellow and wither prematurely. The chief sources of infection are spores that blow in from a nearby crop or from plant debris on the soil.

White blister *(Albugo candida)*
The characteristic chalky white pustules on the leaves of brassicas make this disease an easy one to identify. The disease attacks most brassicas bar swedes. It's a common disease in the more intensive brassicas growing areas of the country and an awkward disease if it appears in the vegetable garden. Awkward because it will tend to persist in the soil from resting bodies known as oospores and also as there are no chemical controls available on the amateur market. It doesn't tend to reduce yield but does disfigure the plant. It's worst effects are on sprouts where a bad attack on the buttons will render a crop unmarketable. The initial infection can arise from the oospores and subsequent infection within the crop from airborne spores that arise from the pustules. White blister can also attack shepherd's purse but that strain of the disease will not attack vegetable brassicas.

Onion neck rot *(Botrytis allii)*

If you find your onions going soft in store then the most likely cause is neck rot. This common storage disease can originate in the sets or seed you buy. Both are possible carriers of Botrytis spores that may systemically infect the developing crop. Few if any symptoms appear during the growing season; but with infected sets one can get yellow leaves showing up in the crop. At the end of the season when the foliage begins to senesce the fungus sporulates and can infect the neck of the onion where the crop is topped or through breaks in the foliage when the tops bend over. The mycelium of the fungus then grows down into the bulb. After several weeks in storage a water soaked or light brown decay will appear on the neck of the onion along with grey sporulation. At a later stage small black resting bodies or sclerotia will develop on the surface of the bulb. The disease further develops to spread throughout the bulb which eventually rots. To reduce the chances of getting this disease buy your sets or seeds from a reputable outlet – heat treated sets should be free of the disease. The other thing to do is to ensure that the necks of the onion are completely dry before storing the bulbs. Take note that any sclerotia that reach the soil can also act as an infection source and can survive for two years on the buried debris.

Onion leaf blight *(Botrytis squamosa)*

This leaf spotting disease is most commonly associated with salad onions but can also attack the foliage of bulb onions. The source of the infection is airborne spores that originate from neighbouring crops, debris from previously infected crops or from sclerotia in the soil. The initial symptoms are the formation of small white elliptical spots surrounded by a green halo. With time these spots coalesce and lead to total bleaching of the foliage and general collapse of the plant. Don't confuse the initial symptoms of the disease with hail damage on the leaf which can look very similar. Twirl the leaf between your fingers and if the damage is one sided it's weather damage, and if the spotting is all around it's Botrytis. Leaf spot often breaks out after a spell of warm muggy weather and the disease can rapidly spread across an entire field.

Potato blight

This airborne disease arrives every year, initially attacking the leaves and stems but worse damage occurs if the spores wash down to infect the tubers. You have a number of options to reduce your risk:

- If you plant earlies or second earlies you have a good chance of harvesting before the blight season gets into full swing.

- Choose a variety with good blight resistance characteristics. To help you pick the right ones see the table below. Sarpo Mira, though not totally resistant to blight, is head and shoulders above the rest of them and with this variety you can get away with little or no blight spraying. If you choose varieties like Orla or Setanta with good tuber blight resistance you can get away with reduced number of sprays (2-3 perhaps).
- Listen out for blight warnings on the radio and tv and spray with mancozeb (if available) at regular intervals from June-July onward.
- Learn to recognise blight symptoms on both the leaf and stem and remove diseased tissue as soon as it's spotted – this will reduce the chances of the disease spreading further within your crop.
- If blight gets a hold in your crop and the tubers are of sufficient size, cut down and remove the tops to prevent the spores being washed down by the rain to infect the tubers. Do not dig the crop for a minimum of two weeks to allow spores on the soil surface to die off.

Weather

Weather is one of the major drivers of plant growth. The interplay of frost, rain, wind and sun all conspire to thwart or aid our ambitions to grow good crops. That ideal summer combination of sunshine and showers is one to hope for but seldom happens. The reality is that we get periods of wet or dry, cold or warmth which in turn gives periods of poor, middling or good growth. But in general over the course of a year the weather tends to even itself out. A worrying trend in the recent past has been an increase in extremes of weather. This may be related to climate change but whatever the cause it does not make the task of growing vegetables any easier.

When it comes to planned sowing and planting dates the calendar may well have to be ditched if the weather turns too wet or too cold. Experienced growers will tell you that a crop that is 'mucked in' in unfavourable conditions will often be passed out by a crop planted later on in good conditions. So be patient, and delay that sowing or planting until soil conditions or soil temperature come right, even if it means waiting a week or three.

Hardiness

The vegetables we grow in Ireland originate from many different parts of the world and as such vary in hardiness. There are two categories of hardiness: hardy and half-hardy. Hardy vegetables are those that survive the normal Irish winter and can be harvested during the coldest months. Half-hardy vegetables are those that are damaged by frost and are grown and harvested during the warmer months. So when it comes to sowing or planting these types we need to be mindful of late spring frosts and complete the harvest before winter closes in. Some vegetables such as beetroot lie in-between the two categories as they will survive outdoors in a mild winter – let's call them 'almost hardy'.

During 2010 we experienced a return to frosty conditions that hadn't been experienced for many years. Air temperatures greater than –15°C were recorded at several meteorological stations. The temperature you see on tv weather maps is *air temperature* which is measured at a height of 1.25 m. But a more meaningful figure for vegetable crops is the grass minimum (Gmin) which is measured at ground level – also known as ground frost. The grass min can be anything up to 5-6°C lower than air temperature. If you wish to check grass min temperatures you can find them on the Met Eireann website under *Latest Weather > Yesterday's Weather, Gmin.* The photographs show frost damage to sprout buttons and damage to the core of storage cabbage.

At temperatures below 0°C frost occurs and ice forms within the plant. The damage that subsequently occurs will vary from none to total tissue destruction depending on the hardiness of the plant and the degree of frost. Other factors can also affect the outcome: older tissue is more prone to frost damage than younger tissue and a rapid rate of thaw can exacerbate the situation.

One sometimes sees the instruction on a seed packet or bag of seed potatoes to sow or plant out after the last frost. So how do you know when the date of the last frost will be? The short answer is, you don't. However past weather records and personal experience can help us in picking a date that hopefully will be correct. The table below shows the average and extreme dates of last spring and first autumn air frosts, 1971-2000.

Station	Last		First	
	Mean	Extreme	Mean	Extreme
Valentia Obv	26 March	29 Apr	25 Nov	16 Oct
Claremorris	28 Apr	20 May	25 Oct	8 Sep
Kilkenny	29 Apr	30 May	13 Oct	10 Sep
Clones	26 Apr	31 May	30 Oct	8 Sep

The last date of the last ground frost can be considerable later that the date of the last air frost and has the potential to damage half-hardy crops in the ground at that stage. The table below gives the average and extreme dates of last spring and first autumn ground frosts at the specified stations.

Station	Last		First	
	Mean	Extreme	Mean	Extreme
Valentia Obv	4 May	15 June	18 Oct	31 Aug
Claremorris	28 May	28 Jun	11 Sep	3 July
Kilkenny	17 June	30 Jun	7 Aug	1 Jul
Clones	9 May	29 Jun	24 Aug	3 Jul

The following table is an attempt to rank vegetables in order of hardiness. Take note that relative hardiness can depend on the growth stage. In the case of rhubarb the dormant stools seem to be totally frost resistant but the young shoots produced in spring can be prone to damage. Swedes are pretty hardy in the mature stage but can bolt due to cold weather if sown too early. The experience of 2010 has shown that with the exception of parsnips virtually all vegetables will develop frost damage if temperatures go low enough. You are heading into the danger zone with Gmin temperatures of -10°C or greater.

Hardy	Almost hardy	Half-hardy
Parsnip	Winter cauliflower	French bean
Rhubarb	Perpetual spinach	Runner bean
Kale	Carrot	Courgette
Garlic	Storage cabbage	Marrow
Cabbage	Beetroot	Pumpkin
Leek	Scallion	Celery
Swede	Parsley	Potato
Brussels sprouts	Onion (overwintered)	Sweetcorn
Broad bean		Broccoli
		Lettuce

Bolting

A lot of vegetables are biennials; that is they grow vegetatively in the first year and flower and set seed in the second. Examples include most brassicas, celery, beetroot, onions, leeks, carrots and parsnips. Sometimes if they are planted or sown too early they can get a cold check and start to flower in year one – this is known as bolting.

Biennials require a period of cold to initiate flower buds – this takes place naturally during the winter and is a process known as vernalisation. However they are insensitive to cold in the seedling or young plant stage – this is the juvenile stage. The optimum temperature for vernalisation is usually within a degree or two of 4°C – at lower temperatures growth processes stop and at higher temperatures – above about 12°C – there is no stimulus to flower.

It's interesting to note that if a warm day follows a cold night it tends to cancel out the vernalising effect of the lower temperature but if cool days follow a succession of cold nights then a crop is set along the path to flowering. As a rough guide it only takes about 6 weeks of cold weather to initiate flowering – but the effect takes a while to show. A crop that bolts in early summer will have encountered a cold spell sometime during the previous spring.

So for a crop to bolt it has to have to be of a certain age and endure a period of cold. The cold conditions are a combination of temperature and time and can arise from a fairly low temperature for a long time or a low temperature for a shorter time – but it takes more than a few frosty nights to trigger the reaction.

The table below shows the differences with the swede variety Magres in sowing dates and whether the crop is covered or not. The covering material was perforated polythene which would have been removed in May. The trial was sown into modules under glass in January and planted out at the end of March and also direct drilled outdoors in March. You can see the effects of cold spring weather on both of the uncovered crops, and the elimination of bolting by covering.

Kinsealy Research Centre Trials, 1996

Treatment	t/ha	Bolting %	Harvest date
Jan sown, 308 cell + cover	40.0	0	28/6
Jan sown, 308 cell	22.3	83	3/7
Mar sown outdoors + cover	16.6	0	3/7
Mar sown outdoors	6.3	98	17/7

Variety can play a part and plant breeders do their best to develop bolt resistant cultivars. Beetroot is a crop that can run to seed if sown before April but if you choose a variety such as Bolthardy that's been selected for its cold tolerance, it can be sown in March. Breeders are also working hard to select out resistant strains of coriander which is also prone to bolting.

Daylength can also influence time of flowering. Annual vegetables such as radish, spinach and lettuce are triggered into flowering by the length of the day. Under normal circumstances a lettuce will only bolt after hearting. It is responding to the long days of summer in doing this, and at the height of the summer there may be only a few days between the heart being formed and the formation of a flowering shoot. But if the crop suffers a stress – for example if the weather turns hot and dry and the crop is left unirrigated – then the lettuce may well go straight to the flowering stage without forming a head. The same holds true for radish and spinach.

Varieties

With hundreds of varieties available to the vegetable gardener it can be puzzling to decide which ones to choose. While some of the varieties that are available in the garden catalogues have been around for many years, plant breeders are continuously trying to produce new and improved varieties of all crops. Varieties can be divided into two types – hybrids (designated F1) and open pollinated or standard varieties. Hybrids are becoming increasingly common in amateur catalogues due to their widespread use in commercial growing. They offer a number of advantages over open pollinated varieties, chiefly increased vigour and uniformity, though the latter is not always advantageous to the gardener. The downside of hybrid seed is that it costs more than standard seed. The best advice is to try out different varieties and see which ones suit your conditions best. The varieties mentioned in the book are all well tried and tested.

Plant Spacing

Different vegetables require different amounts of room to grow. And hence we space them accordingly. But it can get confusing when no one seems to agree what the optimum spacing should be! One can look up five different books and get five different spacing for the same vegetable.

But why do we space our vegetables the way we do and what are the end results for the spacings we choose? There are two parameters by which we can define spacing: population and pattern. For example if we were to plant a single cabbage plant in a hectare of fertile ground the *population* would be one per ha. We would grow a fine big cabbage but the overall yield would be pretty dismal. Say we were to plant two per hectare but put both plants into the one hole – we'd end up with two poor plants. So the *pattern* is how we space out our population. If we choose a different pattern and space them well apart, we'd end up with two very large heads.

And so as we keep increasing the population and keep them evenly spaced, the overall yield per hectare goes up in a step by step incremental fashion. As we pack yet more plants into our plot we notice at a certain stage that while

the overall yield continues to increase, the individual size of the heads begins to decrease due to the competitive effects of ever closer spacing. We eventually reach a point where the yield is at a maximum with a certain plant population. This holds true for all crops.

But what happens if we continue to put more plants into our plot? It all depends on the crop. With a crop like beetroot the yield will plummet quite rapidly as a beetroot requires a certain minimum framework of leaves to form a harvestable head. At very high populations all you will produce is leaves. However with a crop like carrots as the plant population is increased the overall yield is maintained but the size of the individual roots reduce. This can be useful as it allows us to control the size of carrot whilst maintaining maximum yield.

So as you can see spacing has a very direct effect on total yield and on the individual size of the vegetable. There is another effect – timing of harvest. If we are looking for earliness in a crop or indeed sowing late in the season, the spacing we choose will have an effect on those outcomes. The wider you space the earlier the crop and the better chance we have of harvesting a late crop.

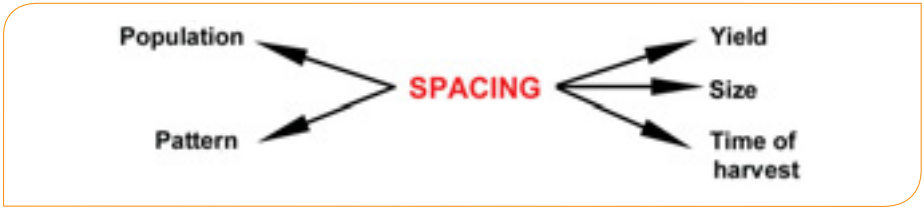
As you will have gathered by now spacing is a very useful tool for the vegetable grower.

Getting back to pattern, you would think the best system would be to space your plants as evenly as possible; but the standard advice is to grow most crops in rows, where everything can look unnecessarily crowded. To find the reason for this we have to go back to the agricultural revolution to the invention of the seed drill and mechanical hoe. For these inventions to work, crops necessarily had to be grown in rows. And so we use rows in the vegetable garden for weed control.

Growing in rows does not necessarily have a detrimental effect on yield. Broccoli is remarkably unaffected by row spacing up to a distance of 60 cm. So spacings of 60x10 cm, 40x15 cm and 30x20 cm will all yield approximately the same – in this example the population per m^2 is the same but the pattern varies. With parsnips if the ratio of the between-row spacing to the within-row spacing does not exceed 2.5:1, yield is not reduced. For a population of 22 per m^2 the maximum row spacing would be 34x13.6 cm but perhaps using a ratio

of 2:1 is simpler which would work out at 30x15 cm – both spacings will give you approximately the same population. Lettuce is an example of a perfectly round crop that works best at even spacings length by breath.

And as mentioned don't get too hung up about the spacings mentioned in this book or in any other for that matter. They are only suggestions and spacings will vary according to your growing system – beds, drills or on the flat – and even to the width of your hoe. They will also vary in accordance to what size you want your particular vegetable to be. For example higher populations per m^2 will reduce the individual head size of broccoli. Or you might choose slightly wider spacings for an early or late crop. If you see a reference to 30x15 cm in the book, this means a 30 cm row spacing and 15 cm in-row spacing.



Watering Vegetables

Despite the general impression that it rains a lot in this country, in most years there are dry spells during the growing season which affect plant growth. In response growers will irrigate their crops to maintain continuity and to improve quality and yields. Only very rarely will unirrigated crops actually die.

Soils play a vital part in water availability. Gardeners will be aware that a light sandy soil holds less water than a heavy clay soil, but less will appreciate the role of soil structure. A deeply dug, well-structured soil will allow for a bigger root system that is better able to tap the available water supply. And the best way to improve soil structure is by digging in compost or manure.

So how much water do you need to apply, when is it best applied and what crops will benefit most?

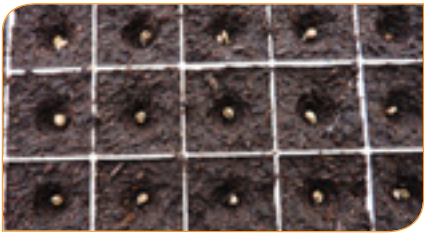
In the height of the summer a crop at full canopy can lose up to 2-3 litres of water per square metre per day. As a general rule it's best not to water a little and often as you will lose a high percentage of it through evaporation. And with the exception of seedlings and transplants it's not worth while giving any less than 10 litres per square metre at any one time and greater than 25 is excessive.

Crops vary in their requirements for water. For example in commercial practice celery is always irrigated while swedes are virtually never irrigated. Apart from celery other crops that are frequently irrigated are lettuce, potatoes (especially earlies), scallions, early cauliflowers, courgettes and spinach.

In an ideal world we would irrigate every time our crops need water but time constraints and hose pipe bans may well conspire to limit how much water we can apply. Fortunately research has shown us the critical times of a crop's life cycle when response to irrigation is greatest. All crops will be responsive at crop establishment – either at sowing or transplanting. If sowing in dry weather run a little water along the open drill before sowing. Other stages that have been identified are:
Cabbage, cauliflower, broccoli: 2-3 weeks before expected harvest.
Potato: when the tubers are marble sized.
Peas and beans: at flowering and during pod swelling.
Celery, lettuce, courgette: these crops (especially celery) require frequent watering – suggest weekly.
Carrot, parsnip, beetroot: apply 16-22 litres per m^2 every 2 weeks.
Onion: during the early plant growth stage.

1 inch of rainfall = irrigation equivalent of 250,000 L/ha = 25 L/m^2
1 mm of rainfall = 1 L/m^2

Plant Raising and Direct Drilling



The vast majority of vegetables are propagated from seed. As mentioned previously we either sow the seed direct into the ground where the crop is to mature or else it's raised in a seed bed or seed tray and transplanted out at a later stage into the vegetable garden.

The primary reason for transplanting is the more economical use of space and time. For the more widely spaced vegetables it makes more sense to propagate expensive seed under cover and plant out at exactly the plant population you require; it also allows for a quicker turn around of the ground and makes weed control that bit easier. The development of half hardy crops like courgettes and French beans can be speeded up if they are initially raised under protection and will give you greater yields by season's end in comparison to drilling.

The main disadvantage to transplanting is the check to growth that occurs mainly from damaged roots, and the gardener is conscious of doing everything in his or her power to ensure that transplants establish quickly and grow on with minimal check. The development of modular propagation has greatly reduced root damage and improved speed of establishment.

Crops like carrots and parsnips that have a tap root and are grown at high densities are of necessity direct drilled. Swedes are generally direct drilled but the early crop is sometimes transplanted but growers will tell you that the root shape is always poorer with the transplanted crop as against the drilled crop. Sweetcorn can be started indoors but it's a poor transplanter and will establish better from direct drilling.

Seed to germinate requires oxygen, moisture and a certain minimum temperature. One can divide vegetables into 3 groups in relation to minimum soil temperature requirements for germination:

- 5°C: brassicas, lettuce, pea, broad bean
- 7°C: carrot, parsnip, beetroot, onion, scallion, leek
- 10-12°C: French bean, runner bean, courgette, sweetcorn, tomato

These are minimum temperatures – they will germinate more quickly at higher temperatures. For every vegetable there is an optimum soil temperature for germination, and at that temperature the maximum number of seeds will germinate and in less time than at any other temperature. A good guideline figure that suits the majority of vegetables is 20°C. But take note that there are upper temperature limits for certain crops. Butterhead lettuce will not germinate at temperatures above 25°C, leeks and onions will not germinate well above 21-24°C and celery germinates best between 10-19°C – much higher and it won't come through. Be careful of covering seed trays with glass or polythene – during hot sunny weather if the temperature of the compost goes above 35-40°C you will end up killing the seed. Consider using newspaper or a polystyrene sheet over the glass in these situations.

You can buy a soil thermometer to check the temperature of your soil if you're interested. It's probably best to measure the soil when it's at its lowest which is usually around nine or ten o'clock in the morning and the standard dept of measurement is 10 cm. Taking a series of daily temperatures and averaging them will give you a more reliable figure in comparison to what the temperature is on any one day. Alternatively you can log onto the Met Eireann website and click on *Latest Weather* > *Agricultural Data* and there you'll see averaged weekly soil temperatures for a range of locations – pick the one that is nearest to you.

Say you want to grow a crop of French beans and wonder how early can you sow them? We know that the minimum temperature required is 10-12°C and if we study the average soil temperatures for Dublin Airport you can see that May is the month to pick – perhaps towards the middle of the month for this particular area.

Mean soil temperatures (10 cm) at Dublin Airport

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.1	4.1	5.5	7.9	11.5	14.6	16.2	15.4	13.0	9.7	6.6	4.8

Seed is sown at a dept that relates to the diameter of the seed – see Table 2 in the Appendix for details. You normally cover seed to make sure that it stays moist for the requisite period of time after rainfall or irrigation but some seed like celery or certain varieties of lettuce require light to germinate and is normally sown on the surface of the compost.

Sowing under protection

The majority of seed that's sown under protection (glasshouse or polythene tunnel) is now grown in modules – essentially a tray with individual compartments – using special compost that is disease and weed free. The cells are normally single seeded but crops like scallions and onions can be multi-seeded.

You may get a check to growth if plants raised under protection are planted straight out into their final quarters. This is because there can be a big difference in climatic conditions between the glasshouse and outdoors. To overcome this we 'harden off' our young plants to acclimatise them prior to planting out. Commercial propagators will lay the trays out in a sheltered area beside the glasshouse for a number of days before they are sent to the grower. You could also place your plants in a frame and give increasing amounts of air to harden off.

The most usual way to ensure continuity of supply is to stagger your sowings or plantings. To make things a bit easier with modular raised brassicas, make one big sowing and plant out what you require when the plants are fit. Put the remainder of the plants into a plastic bag and keep them in a fridge and plant out at weekly intervals. Plants may be kept in the fridge for up to 3 weeks.

Outdoor plant bed

If you don't have a greenhouse, tunnel or frames you can raise your plants in a nursery bed outdoors. Outdoor seed beds would commonly be used for raising brassicas, leeks and lettuce.

Prepare your soil well as it needs to be in a fine condition for sowing seeds. If lime is needed it should be applied during the previous winter. If a soil sample result is not available the following fertilisers should be forked in: 50g per m^2 of superphosphate, 30g per m^2 sulphate of potash and 15g per m^2 of sulphate of ammonia. Seed is usually sown in rows known as drills.

When sowing brassicas a seed bed plant population of 400 per m^2 is recommended. A spacing of 10x2.5 cm would achieve this. If a 10 cm drill width is too narrow, then suggest using 15x2.5 cm which will give a plant population of 266 per m^2. Do not go below an in-row spacing of 2.5 cm – this is equivalent to 40 plants per metre run. No thinning is required. Plant out when the plants have reached the 3-5 true leaf stage. Water before lifting if the soil is dry.

If slugs and snails are troublesome slug pellets should be used. Cover outdoor beds with netting to keep birds, cats and dogs away.

It takes from 5 to 8 weeks to produce a brassica transplant depending on the time of year. Under protection it typically takes 6 weeks to produce a transplant.

Kinking of stem (hockey stick) of a sprout plant raised outdoors. Kinking seems to be due to anything that makes the plant grow too quickly, too etiolated: heat, fertilizer, lack of light but can be varietal; some varieties seem to suffer regularly and others do not.

Direct drilled crops

If sowing outdoors it is important that you prepare the ground well by forking and raking to produce a fine tilth. For direct drilled crops it's critical to sow your seeds at an even dept that leads to even emergence, as you want to end up with a uniformly sized crop. It's not easy to make a drill by hand that has an even dept all the way along its length. Seed that is deeply buried will emerge later in comparison to more shallowly sown seed – and this difference is maintained right through to harvest. To get over this you can make a wooden sowing frame to help you control the dept of sowing.

Sowing frame to control dept of sowing

Once seed is sown it requires water to germinate, supplied from either rainfall or irrigation. Uneven emergence can also be caused by an irregular water supply when the crop is germinating. Another problem that can arise with outdoor sowings, especially on poorly structured soils, is soil capping if the rainfall or irrigation following sowing is very heavy. This is where the very fine particles are washed into the spaces between the larger particles and the soil is said to have slumped. If it then dries out, a hard surface crust develops, which can physically prevent the germinating seed from emerging. One way around this problem is to water the bottom of the drill before sowing your seed. If the soil does cap keep the soil damp with frequent light applications of water to allow the crop to emerge. Always use a watering can with a fine rose when watering seed or seedlings.

Even emergence means an even end product.

Vegetable Storage

Some vegetables won't store, go over quickly and have to be eaten fresh. Examples include butterhead lettuce, scallions and spinach. They can be kept in a fridge for a week or two but after that will need to be consumed. Onions and garlic on the other hand are natural storage organs with papery outer skins protecting the fleshy inner scales from physical damage and drying out. Another example is haricot beans where the beans are allowed to mature on the plant to dry off the individual seeds, which can then be stored in jars.

A lot of our winter vegetables – mainly brassicas, leeks and root crops – are best stored where they are growing, in the ground. The weather is cold enough from November to March to restrict growth and development – think of it as natural refrigeration. However we need to be mindful of severe frosts causing

damage. Winter brassicas are normally not protected but in colder parts of the country it may be worthwhile to earth up root crops with soil. Better still would be to cover them with a layer of straw, bracken or leaves.

Crops grown for winter consumption need to be planted or sown early enough to allow them reach the desirable size before growth ceases but late enough so as to prevent them getting too large and in the case of root crops too woody and tough. For example a good time to drill carrots for overwintering would be from mid May to mid June.

Building a clamp was the old way of storing root crops through the winter but is not much used nowadays. A clamp is where the crop was harvested in late autumn, put in a pile outdoors and covered by straw and clay. The idea is that the covering will keep the temperature of the roots from going too high or too low and maintain them at a high humidity. If you want to try one, pick the coolest part of the garden and make a long stack of roots about a metre wide and high, cover with 15 cm of straw and top that off with 15 cm of soil. Dig the soil from around the sides of the clamp so as to provide a degree of drainage. Keep an eye out for rats to prevent or minimise spoilage.

Potatoes are a root crop that needs to be lifted and stored by the end of October at the latest. They require to be stored in a cool, dark, frost-fee shed. If light gets at the tubers they develop poisonous alkaloids in the surface of the tuber as they turn green in colour. Paper sacks that the commercial crop is sold in, would be useful for storing the home saved crop as they allow it to breath and prevents light damage. Potatoes are susceptible to frost but the main problem for the gardener is keeping the temperature low enough; 4°C is an ideal storage temperature but hard to achieve. The higher the temperature the greater the risk of storage rots and sprouting. The tubers will eventually sprout if held for longer than their natural storage period but will sprout prematurely if the storage temperature is too high. If this happens go through the crop and remove the sprouts – this will give you a few extra weeks storage. The question is sometimes asked about leaving potatoes in the drills over-winter and whilst it is possible provided they are sufficiently insulated, it's not recommended as you may well end up with increased levels of slug attack and rodent damage.

Onions are available all year round in the shops with most of the supply coming from refrigerated stores where they are stored at 0-2°C and 70-75% relative humidity. These conditions are difficult to replicate at home but do your best to store onions and garlic as cold as you can and as dry as you can. Onions will store for several months at ambient temperatures in an unheated building – a north facing unused bedroom could be used. The key point to remember is that dormancy in onions or garlic will quickly be broken by water or moisture on the bulb hence the reason to keep them dry and also the reason for not storing them in any sort of plastic bag.

Successful onion storage begins at sowing time by choosing a variety that has good storage qualities. Onions from sets will not store as well as those from seed. The best of the seed varieties (e.g. Hyfort F1, or Vision F1) will store until March or April before sprouting becomes a problem.

Equally important is ensuring that the crop is harvested correctly. When the tops fall over on the plants in August or September, sprout inhibitors are produced in the leaves that are translocated down to the bulb and it's for this reason that the leaves are dried on the bulb. When most of the tops have fallen over lift the crop and dry off, ideally in a glasshouse. It's essential to seal the neck of the bulb by ensuring that the leaves are completely dry before removing them. The bulbs can be tied into 'onion ropes' or put into a net bag and hung up. Alternatively they can be put into stackable slatted wooden trays going to a maximum of two deep in the tray. The main idea is to have a flow of air around the bulbs to remove the moisture that's continually produced by respiration.

Finally just to say that the invention of refrigeration has revolutionised vegetable storage. With freezers now commonplace in most homes, this is becoming a increasingly popular way to store home grown veg and also a handy way of dealing with the inevitable gluts.

Asparagus

Asparagus is a perennial vegetable that's grown for its edible young shoots (spears) that appear in late spring. A well drained site is essential for this crop. As asparagus will remain in the same place for as long as 20 years the site should be carefully dug over as deeply as possible taking care to remove all perennial weeds such as scutch-grass, docks, etc. Plenty of farmyard manure or bulky organic material should be well mixed with the soil during digging.

Asparagus is grown from seed or from one-year old crowns planted in March. Either way the plants must be allowed to establish for 2 years before taking your first harvest in year 3.

Sow seed in modules in January at 16-18°C under glass. Plant out in late May to early June in a staggered double row at a spacing of 45x30 cm, leaving 90 cm between rows. Plant in a 10 cm deep depression and as the plants grow gradually level off the bed by the end of the first season's growth.

The easier alternative is to buy in 1 year old crowns and plant in March taking care to space out the roots in all directions and covering with soil to a depth of 10 cm.

A light cut can be taken in the second year but the best advice is not to take the first harvest until the third year and don't cut beyond May 23. The harvest period in subsequent years can extend over a 6-8 week period from mid April to mid June. Cut the stems about 2.5 cm below ground level when the spears are 13-18 cm tall.

When the foliage has turned yellow in the autumn cut it down to within 2.5 cm of soil level. Top-dressings of farmyard manure should be given each autumn and supplemented in spring with a dressing of artificial.

Varieties: Backlim F1, Gijnlim F1, Millenium F1
Diseases: rust, wilt
Pests: slugs

Beans, Broad

Broad or fava beans are a hardy leguminous crop that can be sown in the autumn or spring. There are three main types – Seville, Longpods and Winsors and can be further divided on the basis of seed colour, green or white. Seville (e.g. Aquadulce) are the hardiest suitable for overwintering. Longpods have eight seeds per pod while Winsors have four seeds in shorter, wider pods. A fourth type is the Dwarf or Fan-podded (e.g. The Sutton) which are bushy, short plants that mature quickly.

The very earliest crop can be sown in late October or November, weather permitting. The two varieties recommended for overwintering are Aquadulce and The Sutton. Most of the varieties grow about 1.3 m tall and require some sort of support but The Sutton is smaller at around 80 cm and is free standing. The spring sown crop is drilled any time from February to May. For succession sow the next batch when the first sowing reaches 8 cm in height.

The seed should be sown in staggered double lines, 23 cm apart each way. If more than one double-row is to be grown allow 60-75 cm between them. Where you want to add organic matter to the soil, open a trench 30 cm deep and wide and add a layer of well-rotted manure or compost to the base and mix with the soil to leave a trench 5 cm deep. Sow your beans and cover over with the remaining soil.

To support the crop erect posts at either end of the drill and tighten a double row of twine between them. Cut off the tops as soon as four clusters of flowers have formed to ward off possible attack by the black bean aphid. They take around 3½ to 4 months to crop from a spring sowing and last for up to a month. Pick the pods when quite young – before the scar on the pod turns black; if left too long the beans will be tough to eat. At the end of the harvest cut the stems down at base level to leave the roots in the ground to allow the nitrogen containing root nodules to rot down for the next crop.

Varieties: Express, Imperial Green Longpod, Aquadulce, Jubilee Hysor, The Sutton
Pests: black bean aphid, pea and bean weevil, crows
Diseases: chocolate spot (Botrytis), rust

Beans, Dwarf, French or Kidney

This versatile vegetable can be harvested as immature green pods (green beans), left grow on to a half ripe stage where the pods can be shelled like peas (flageolet) or let mature completely to dried beans (haricot). There are two forms: bush and climbing.

NB: take note that beans at the flageolet stage (especially if they are a bit overmature) can be poisonous if eaten raw. Cooking renders them completely safe to consume.

French Beans are sensitive to cold temperatures and exposure, so chose a warm, sheltered spot for them. They require a minimum soil temperature of 10-12°C for germination. In early districts the first sowing may be made early in May and in late districts about the third week of that month. Further sowings can be made to the end of June. Open lines 5 cm deep and 45 cm apart. Place the seeds 5-10 cm apart in the drill. An early sowing may be made around mid April in a glasshouse by single seeding 5 cm pots for transplanting out in May when the plants are about 8 cm tall. This early planting should be covered by fleece to protect against late frosts or cold wind. French beans take about 9-10 weeks from sowing to mature. Pick every two to three days to keep the plants productive and to maintain quality by preventing seed development. Outdoor crops can be harvested from July to October.

Commercial crops of French beans are always produced under glass using climbing varieties. Climbing varieties are more productive than bush varieties and especially so when grown under protection. For indoor production start off the plants in 5 cm pots and plant out after about 3 weeks when 8 cm high. Plant in double rows 60 cm apart, with 25-30 cm spacing between the plants in the row. Allow 1.5 m for the paths between the double rows. The crop is grown up twines supported on overhead wires 2 m from the ground. The stem should be allowed to grow along the wire for a metre before being stopped. It takes about 8 weeks for the first pods to be ready for harvest.

Bush varieties: The Prince, Nomad, Delinel
Climbing varieties: Cobra, Emerite
Pests: black bean aphid, slugs
Diseases: halo blight, root rot

Beans, Runner

More popular in the UK than Ireland – in the supermarkets in any case – this is another example of a half hardy vegetable which cannot be sown too early. The runner bean is not only a nutritious vegetable, but also an ornamental plant for growing against a fence or wall, or to form a screen for an unsightly corner. It is a climbing plant that will twist itself around a string or a pole.

The seed is sown from mid May to mid June in double rows. Sturdy supports are required, such as 2.5 m bamboo canes, one per plant, that are arranged in a tent like fashion secured at the top with a horizontal bar. The seeds are sown 5 cm deep, 30 cm apart, in rows 60 cm apart. Alternatively make a wigwam out of 6 or 7 poles with a plant per pole. One sowing is usually sufficient.

Twist the young shoots around the cane to encourage them to climb. When they reach the top of the support pinch out the top of the plant to prevent it becoming top-heavy. From the flowering stage on make sure to water your plants in dry periods as this will help the flowers to set. Regular picking of the crop will also encourage more pods to develop. Runner beans will crop from mid July to mid October.

Varieties: Scarlet Emperor, Desiree, Kelvedon Marvel, Red Rum, Lady Di
Pests: black bean aphid
Diseases: halo blight, root rot

Beetroot

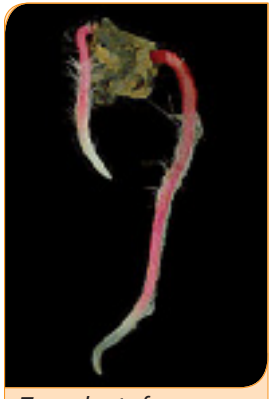
Beetroot is high in folate, manganese and fibre.

This is an easy crop to grow and will succeed on most soils. There are two types – long and the more popular round or globe shaped. What you get in the seed packet are 'clusters' or dried seed heads that may contain up to 3 seeds, unless you have purchased a monogerm variety that's been bred to produce one seed per cluster.

Seed may be sown from April to the end of June to crop from July to March. For earlier sowing in March use one of the bolt resistant varieties such as Bolthardy. Cover that sowing with fleece to get it to crop in early June.

The drills should be 25 cm apart and the seed sown every 4 cm about 2.5 cm deep. Start lifting the roots as they are needed when around 5 cm in diameter – this gives the remaining crop more space to develop. The crop is not fully frost hardy, so unless you are in a mild area, it is advisable to cover them with 15 cm of straw sometime in November. Alternatively cover with a double layer of fleece.

Varieties: Boltardy, Detroit 2, Burpee's Golden, Pablo F1, Red Ace F1
Pests: mangold fly (leaf miner), black bean aphid, beet flea beetle
Diseases: leaf spot (Ramularia), scab



Two plants from one seed.

A Guide to Brassicas

Crop	Sow seed	Plant out	Row Width cm	Plant Width cm	For use	Varieties	Comments
Spring cabbage	Third week July	Mid-Sept – early October	30	30	March (Greens) April-May (Hearted)	Myatts Offenham Compacta, Pyramid F1 Sennen F1	When spring growth starts apply a side dressing of Sulphate of ammonia or CAN at 30g/m^2
Spring greens	August (direct drill)		25	25	January – March (unhearted)	Wintergreen	Sow *in situ*
Summer cabbage	February (Frame or modules)	March – April	45	45	June – July	Caramba F1 Pyramid F1 Hispi F1 Greyhound Caraflex F1	York varieties are less prone to bolting from early sowing than round head
	March – May (open ground)	May – June	45	45	July – September	Caramba F1 Caraflex F1 Duchy F1	Watch out for aphids and caterpillar in the summer period
Autumn cabbage	May – June	June – July	45	45	September – October	Pyramid F1 Duchy F1 Caraflex F1	Fertiliser side dressing as above in July.
	June – July	July – August	45	45	October – December	Pyramid F1 Duncan F1	Do not top dress winter York's

A Guide to Brassicas – continued

Crop	Sow seed	Plant out	Row Width cm	Plant Width cm	For use	Varieties	Comments
Savoy cabbage	End April Early-mid May	June July	60	35	November – December January – March	Tarvoy	Follow early potatoes
Brussels sprouts	March Early April Mid April Late April	Early May Mid May Late May Early June	60	60	Sept – October Oct – November Nov – Dec Dec – March	Abacus F1 Maximus F1 Helemus F1 Doric F1 Exodus F1	Two side dressings of sulphate of ammonia or CAN at 30g/m^2
Summer cauliflower	Mid October (frame) March/ April	March May to early June	60 60	45 50	June – July August	Nautilus F1 Nessie F1 Gipsy F1	Water well after planting to avoid buttoning
Autumn cauliflower	Late April/ June	June – July 20	60	60	September – November	Nessie F1 Skywalker F1 Belot F1	
Winter cauliflower	May/ early June	July	75 70	75 70	January – February March – June	Miracle F1 Medallion F1 Aalsmeer	January – February production only for coastal districts
Broccoli Calabrese	Mid-February – early June	Mid-April – early August	30 45	15 30	July - November	Aquiles F1 Ironman F1 Parthenon, Green Magic F1	Broccoli does not require a lot of N
Kale	April – May	June - July	60	45	Nov – April	Bornic F1 Reflex f1	
Sprouting broccoli	April – May May	May – July July	60 60	45 60	July- October February - May	Summer Purple, Rudolf, Red Arrow	New varieties increase season of harvest

Brassicas

Brassicas are an enormously versatile family covering the common or garden vegetables like cabbage, cauliflower, broccoli, sprouts and swedes to the more exotic rocket, mizuna and pak choi. A guide to the cultivation of these crops is set out in tabular form and from this a selection of sowings may be made to suit your requirements. Most brassicas are transplanted but some like swede, turnip, radish and rocket are direct drilled.

Pests: cabbage root fly, mealy aphid, peach potato aphid, caterpillar, pigeon
Diseases: ring spot, dark leaf spot (Alternaria), white blister, downy mildew, powdory mildew, club root, black rot (Xanthomonas)

Broccoli (calabrese)

This popular vegetable which only began to be grown in Ireland from about 1980 is easy to grow and can be harvested from July into November from mid February to early June sowings. The main harvest comes from a large centre head, but once that is removed you can get a second harvest from side shoot production depending on variety. The wider the spacing the greater the number of side shoots produced.

Ideally this crop is sown in modules as bare root transplants may induce buttoning (production of a small premature head). It could also be direct drilled and thinned out to the required spacing.

Broccoli is grown at a number of different spacings depending on the size of the centre head required but the overall yield doesn't vary from plant populations from 5 to 100 plants per m^2. The suggested spacing of 30x15 cm is equal to 22 plants per m^2 which gives a nice balance between centre head and side shoot production. If you want a larger centre head try using a 45x30 cm spacing.

Broccoli is the least hardy of the brassicas so don't plant out before about 8 April otherwise blindness in plants (death of the growing point) can occur. The latest you can plant broccoli is up to the first week in August. Broccoli has quite a low demand for nitrogen, so an application of manure or compost should suffice especially for crops maturing in the August to October period. Otherwise apply 15g per m^2 at planting and repeat a month after planting. For early crops increase the rate to 50g per m^2 applied in two splits.

During hot weather you may find some of the beads on heads that are close to harvest opening up and turning yellow. Certain varieties are more prone to this problem than others but is worst where the heads are slightly over mature so harvest on time.

Broccoli, Sprouting

This is a hardy crop that was grown to fill in when there wasn't much else around in the vegetable garden in the spring time. However new varieties have been developed that allow for a greatly extended season of production. Depending on the variety chosen sprouting broccoli can be harvested from July to May.

For late summer to autumn production through to spring sow from April to June and transplant from May to July. For the over wintered crop it is essential to protect your plants from pigeon damage by netting or black thread. The plants may need to be staked as they are tall growing.

Come harvest time a centre head develops and side shoots or spears grow out from the main stem below the centre head. Both the centre head and side shoots should be harvested before the tiny purple flowers open out to a yellow colour. A succession of pickings can be made as long as side shoots continue to develop.

Brussels sprouts

Plant breeders have done a number of favours for this much maligned vegetable – the season now stretches from September to March, the sprouts are easier to pick and are better flavoured and the development of hybrids has rendered blown sprouts a thing of the past. However sprouts can be a difficult enough crop for the amateur to grow for a few reasons. The crop – including the bit you eat – can be prone to a variety of pests and diseases which the professional grower can counter by using a range of chemicals that are not available to gardeners.

Sprout varieties can be roughly divided into early, mid season and late, spanning the months mid-August to October, October to December and December to March. They need a long season of growth and start off with being propagated as bare root transplants or in modules. The following table is a guide to sowing and planting dates.

Sow	Plant	Harvest
Late February (frame)	Mid – Late April	August – September
Mid – Late March	Early May	September – October
Early April	Mid May	October – November
Mid April	Late May	November – December
Late April	Early June	December – March

The main sowing period is March – April with the bulk of the planting taking place in May and up to the end of the first week in June. You can plant later in June but yields will reduce.

Succession in sprouts derives from using different planting dates combined with different varieties. One possible suggestion to use Maximus or Helemus planted in mid May for October to December period followed by Doric or Petrus in early June for December to February; but there are lots of other varieties and timings to pick from.

Sprouts develop naturally from the base of the stem to the top and most gardeners will harvest them on a 'cut and come again' basis. However commercial crops are sometimes stopped by removing the growing point to allow the sprouts to mature evenly for machine harvest. This is done when the bottom sprouts are a centimetre in diameter. You might consider using this technique if you were growing a crop for freezing but in general stopping confers no benefit to the gardener.

Plant spacing for sprouts varies from 2.8 to 3.7 per m^2. Populations greater than 3.7 incurs the law of diminishing returns. Increasing your plant population results in:

- reduced sprout size on the stem
- increased stem length
- delayed maturity
- increased uniformity of sprout development on the stem

In relation to these characteristics overall plant population has been found to be more important than the spatial arrangement of the plants. The old traditional spacing for sprouts was 90x90 cm which is too wide for the hybrid varieties that are currently in use. For regular picking over of sprouts suggest using 60x60 cm or 60x50 or 45 cm for a tighter spacing. If you are growing for freezing try out a spacing of 50x50 cm, stop the crop and carry out a once-over harvest.

Sprouts have a high nitrogen requirement as you need to get height into the plant for optimum yields. Apply 30g per m^2 of sulphate of ammonia at planting, and repeat a month later and again in July.

Start picking your sprouts when the bottom ones are between 2-4 cm in diameter. The sprouts you buy in the shops are normally sold in two separate size grades: 22-30 mm and 30-38 mm. The interval between picks is from 3-5 weeks and a single variety can crop for up to 4-5 months. A single plant will yield 60-70 sprouts or about a kilogram in weight.

Aphids can be a problem with this crop if they are allowed to establish within the buttons. They tend to start to build up in July with large populations developing by early autumn. As there are no effective aphicides available to the amateur market the plants should be covered with fleece from July to

October. Slugs can also be troublesome as they will climb up the plant to feed on the sprouts. Apply 3 applications of pellets during the summer to autumn period. The main diseases on sprouts are ring spot and white blister.

Cabbage

Cabbage is a crop that can be harvested virtually all year round. There are several different types – round headed (ballhead), pointed (York), Savoy (winter maturing), red cabbage, white cabbage (for coleslaw) and winter cabbage (Tundra type). Cabbage is planted at a variety of spacings depending on variety. York cabbage can be grown 12 months of the year but during the winter months it is harvested as 'greens', which is unhearted heads of cabbage.

Cabbage requires generous feeding but the quantity and the kind of fertiliser varies with the season. Autumn planted cabbages which have to withstand the rigours of winter are given little nitrogen but relatively high potash. With the advent of fine weather in the spring nitrogen is given as light top-dressings. For cabbage planted in September-October give a light dressing of farmyard manure or compost. As soon as growth commences in spring give 30g per m^2 of calcium ammonium nitrate (CAN) or sulphate of ammonia and repeat three weeks later. Compound fertilisers such as 0:7:30 or 0:10:20 are suitable for autumn planted crops while 8:5:18 + B is suitable for spring or summer sown crops. For summer and autumn maturing cabbages farmyard manure or compost is very desirable supplemented with 30g per m^2 sulphate of ammonia, plus a top dressing of 30g if necessary.

Cauliflower

It is possible to have cauliflowers in season during most of the year but take note that production in the January-February period is usually only possible in mild coastal locations. Careful selection of varieties and sowing and

transplanting dates will go a long way towards successional cropping. Weather conditions will influence harvesting dates.

A general rule of thumb is that plant spacing increases as the season progresses. This is because a larger plant size is required to produce a head of cauliflower in the depths of winter than an early crop in June.

Early summer cauliflower for cutting during June and early July are sown either in cold frames in mid October or under glass in January. They are planted out in warm well-manured ground in March as soon as weather conditions allow, at a spacing of 60 x 45 cm. This crop is particularly susceptible to buttoning, which is where a small curd (edible white portion) forms prematurely caused by a check to growth. The crop must be kept growing to produce a big frame so make sure to water during dry spells.

Summer cauliflower for cutting from mid July to August can be sown in March-April for May planting.

Autumn cauliflower is the easiest to grow and gives the biggest yield. Seed should be sown from late April to June for transplanting from June to about 20 July. The plants should be planted out at 60 cm square 5-7 weeks after sowing. It is a mistake to leave them too long in the seed-bed or modules as this may lead to buttoning.

Winter cauliflower may be had in succession from December to May by planting a number of varieties. Development of the heads is greatly influenced by the prevailing weather – mild spells may cause rapid maturing while cold, wet weather with little sun will delay development. Hence, it may be difficult to accurately time the harvesting of this vegetable. Crops that mature in the January to February period can only be grown in the milder coastal areas of the country. Commercial crops of winter cauliflower traditionally follow early potatoes.

Where winter cauliflower follows an early potato crop, 90g per m^2 of a compound vegetable fertiliser should be given. Nitrogen top-dressings in the early spring are necessary for the late maturing kinds (February-May).

Carrots

Carrots can be grown on a range of soils from heavy to light but the majority of the commercial crops are grown on medium to light soils. Nairobi is possibly the variety to use for heavy soils. They can be produced outdoors from July to March. The best place to store carrots for winter and spring use is in the ground where they are grown. However they are quite susceptible to frost so spread some soil over the tops in November or cover with a double layer of fleece. In the colder areas of the country cover the beds with 25-30 cm of loose straw. It might be no harm to apply some slug pellets prior to strawing down. The use of leaves would be a suitable alternative to straw.

There are several different types (root shapes) of carrots such as Amsterdam and Nantes and plant breeders have used them to produce hybrids, which is now the dominant type on the supermarket shelf.

The early crop is sown in February/March for July production. The main crop is normally sown in May. A late sowing of an early variety can be made in June to give you a tender tasting crop in about 12 weeks. Seed may be sown in lines 15 cm apart on the flat at a dept of 1-2 cm. Carrots are difficult to sow by hand as the seed is small, but try to sow thinly so as to avoid thinning; otherwise thin the resultant seedlings to 5-7 cm apart. One can get pelleted carrot seed which although more expensive is easier to sow evenly by hand.

Varieties
Early: Mokum F1, Trevor F1
Maincrop: Ulyses F1, Nairobi F1, Kingston F1, Flyaway F1
Pests: carrot fly, aphids, slugs
Diseases: cavity spot, Alternaria, Sclerotinia, scab

Celery

There are three types of celery – green, self-blanching (SB) and trench. The old fashioned trench celery is no longer favoured having being replaced by the easier to grow self blanching and green varieties. Virtually all of the commercial crop is now green celery. Trench celery was grown in rows but the self blanching and green varieties are always grown on beds. In order to get self blanching celery to blanch correctly it needs to be grown in a block at close spacing. Blanching is the development of a light colour by the process of excluding light.

The main input to growing celery is water. A high level of fertility is also necessary as you need to aim at maintaining continuous growth in order to grow succulent sticks of celery. A heavy dressing of farmyard manure or compost should be dug in and supplemented with artificial fertiliser if necessary.

Celery needs to be propagated and grown on under glass or polythene before being planted out. Sow the seed in March or April on the top of a moist compost and keep covered with polythene or glass until germinated in about 2 weeks. Grow on until large enough to handle (1 true leaf) and prick out into trays at 3 cm square spacing. They could also be pricked singly into modules. It takes 4-5 weeks from sowing to pricking off and a further 4-5 weeks from pricking off to planting out.

The crop is transplanted out in May and June; a late crop can be planted up to July 20 for harvest in November and December but this crop is a bit of a gamble as it can be damaged by early frosts. Celery is normally planted on the flat in beds, typically four rows across a bed, 28-30 cm square in a diamond shape. A dressing of sulphate of ammonia at 30g per m^2 may be given pre-planting and topdress at about the 4 and 6 week stage with another 30g per m^2.

Irrigate after planting and after topdressing to establish the plants and to wash the fertiliser in. Copious watering should also be given during dry weather.

It might be no harm to sprinkle some slug pellets among the plants before the crop leaves close in as slugs can move up into the developing celery head and consequently be difficult to remove. The crop is in season from August to November.

Varieties: Galaxy (SB), Loretta F1 (SB), Victoria F1 (green), Tango (green)
Pests: carrot fly, aphids, slugs, celery fly
Diseases: celery leaf spot (Septoria), Pythium root rot, pink rot
Disorder: black heart (calcium deficiency)

Chicory

Chicory can be grown on any light fertile soil provided the site is deeply worked and heavily manured. Farmyard manure, potash and phosphates should be incorporated in the soil during the autumn in preparation for seed sowing towards the end of May or early June. Seed is sown in lines 30 cm apart and 1 cm deep; the plants are later thinned to 20 cm apart.

By October the roots will be fully grown and may be lifted for blanching. Those not needed at once should be heeled in temporarily.

Forcing is done by introducing medium-sized roots of about 2.5 cm in diameter into the forcing shed or glasshouse. The roots are cut to a uniform length of 20 cm and placed in an upright position in rows 5 cm apart and 2.5 cm apart in the rows. After watering they are covered with light soil, sand, or peat to a depth of 17 cm so as to blanch the subsequent growth. If a suitable house is not available a forcing bed may be prepared out of doors by erecting boards 23 cm wide along its sides. The prepared roots are placed in position and after watering are covered with suitable blanching material. Fermenting stable manure, if available, may then be placed on top to speed up growth but if such material cannot be obtained the bed should be covered with glass lights, corrugated iron or other protective material. Some new varieties are now available which can be forced without covering with soil.

Varieties: Witloof, Normato, Mitado, Tardivo.

Courgettes

Courgettes or zucchini are immature marrows which are harvested when about 15 cm long or less. It is a frost tender crop that is normally sown indoors in the latter half of April, single seeded into small 8 cm pots. Heat (20°C) is desirable to get the seeds to chit (germinate) – a process that takes 2-3 days. If you wish to save on heated propagation space, germinate the seeds in moist paper or peat and when chitted prick off into pots. Grow on at lower temperatures but frost protection must be provided. It takes about 4 weeks from sowing to planting out at the 2-3 true leaf stage. Plant out the last week of May to the first week of June after the threat of frost has gone, spacing the plants 80 cm apart each way or 90x75 cm to give a plant density of about 1.5 plants per m^2. If late frosts threaten cover the plants with fleece. They can also be sown directly into the ground in June, using 2-3 seeds per station.

Courgettes have separate male and female flowers; you will see a small undeveloped fruit at the base of the female flower. Early in the season you may notice that the flowers are initially all male but later on settle into a pattern of producing both types. If a plant is under stress (low light, cold or wet) it tends to produce all male flowers. Pollination is carried out by flying insects.

Courgettes in good growing weather develop their fruit very rapidly and should be picked over every 2-3 days. They will crop from mid July to October.

Varieties: Defender F1, El Greco F1, Firenze F1
Pests: slugs, aphid
Diseases: powdery mildew, Botrytis

Garlic

Garlic, a member of the onion family, is grown from cloves, not from seed. And unlike most of its relatives, the bit you eat, the bulb, grows underground. There are two types: hardneck and softneck. Hardnecks develop a stiff neck from the flowering spike sometimes refereed to as a rocambole. Bulbs from this type are frequently purple or pink in colour. The soft necks are usually white in colour

and store well. We import most of our garlic from China and Spain.

Clove of Garlic.

The best crops are grown on light, free draining soils. On heavier soils grow the crop on a raised bed to improve drainage especially for the over-wintered crops.

You can use ordinary shop garlic but as there are many clones of garlic you may find you get better results with named varieties purchased in a garden outlet. In addition shop garlic is often treated with a growth regulator that will give poor sprouting when planted out. Garlic needs exposure to cold temperatures (0-2 °C for 1-2 months) to initiate bulbing – this can happen during storage or post planting.

Garlic is a hardy vegetable that is either over-wintered or planted in early spring. Plant in October-mid December for June/July harvest or in February-March for July/August harvest. The bulb must be broken up into cloves for planting, ideally 1.5 cm in diameter. Plant the cloves with the basal plate facing downwards, 5 cm deep, in rows 20 cm apart with an in-row spacing of 10 cm.

Garlic is not a high nitrogen demander but does need irrigation during dry spells. If any flower stems are produced, just snap them off to allow the plant concentrate all its energy into the developing bulbs. Harvest the crop when 10% of the tops have fallen over or when the foliage just starts to turn yellow; trim them with a shears to 15 cm, lift and tie together in bunches and hang in light, airy, place to dry. Or else lay them on wire mesh in a glasshouse. After about 2 weeks they should be sufficiently dry. The art of drying garlic is to achieve tight, full cloves in the bulb with the leaves around the bulb and the stem completely dry but not brittle. Store in a cool dry place – can last up to ten or eleven months.

Varieties: Arno, Cristo, Germidour, Purple Wight, Solent Wight
Pest and Diseases: as for onions but main problem is rust

Kale

Kale is one of the hardiest and also one of the most nutritious of vegetables but has never taken off in the popularity stakes. However the newer varieties are better flavoured than those of old. The leaves are the edible part and these can be harvested individually, or the complete head can be harvested in one go.

Although it's produced commercially from June to April, it's still regarded as a traditional winter crop available from November through to March. To cover the June to April period five or six plantings will be required at approximately monthly intervals from March to the end of July for the late crop; this will entail sowing the crop in modules from January to June. Plant density for kale is in the order of 3.7-4.5 per m^2. So use a spacing of 60x45 cm for early and late crops and 60x37 cm for the main crop.

Varieties: Bornick F1, Firbor F1, Reflex F1
Pests: aphid, caterpillar
Diseases: ring spot, white blister, largely resistant to club root

Kohlrabi

This underrated brassica vegetable is far more popular on the continent than in these parts. It originated in northern Europe in the fifteenth century and its name comes from two German words: kohl meaning cabbage and rabi meaning turnip. The turnip-like globe of kohlrabi is actually the swollen base of the stem, not the root. There are green and purple versions.

Kohlrabi can be either direct drilled or sown into modules and planted out. Sow from April to July in rows 30 cm apart with 20 cm in-row spacing. If sown too early there is a risk of bolting and if going earlier into March sow in modules under protection and plant out later. Sow every 3 weeks for succession. It's a quick growing crop – ready for harvest about 2 months after

sowing during the summer months; so keep the crop moving along during dry spells by watering it. Harvest the crop when the bulb is between golf and tennis ball size.

Varieties: Domino, Congo, Superschmelz
Pests: as for brassicas
Diseases: as for brassicas

Leek

One of the hardiest vegetables and often a valuable substitute for onions, leeks are in season from August to April. The edible part is the blanched white lower portion of the stem and to achieve this we plant into 15 cm holes in the ground that gradually fill in as the season progresses. They can also be deep planted using a trowel.

Bare root transplants.

This crop can be direct drilled or planted. Leeks sown directly suffer from the same problem as direct drilled onions – competition from weeds. So it's probably easier to sow into modules or use bare root transplants. Leeks are not the easiest of plants to grow in modules and would recommend the easier option of sowing into frames or open ground.

The early crop is sown in January under glass for planting out in April. The main crop is sown in March in a frame or in an outdoor seed bed in drills 15 cm apart using a seed rate of 75 per metre run. Leeks are quite slow growing in the early stages and will take about 10 weeks before being large enough to transplant out in May or June. The late crop can be sown from April to early May for transplanting out in June – July. Trim the leaves of the pulled plants and also the roots to leave a pencil thick 12 cm long plant. Leeks will readily regrow new roots from the base plate so don't be afraid to trim them back. They are put in rows 30 cm apart with 15 cm between the plants. Planting is done with a dibber making a hole 15 cm deep. A single plant is dropped into the hole and watered in.

Varieties: Zermatt, Longbow, Porvite, Oarsman F1, Kenton F1, Bandit
Pests: thrips
Diseases: rust, white tip (Phytophthora), white rot, Fusarium foot rot

Legumes

Legumes are members of the Fabaceae family (formerly Leguminosae). They include the peas and beans both of which have long been recognised as hugely important to mankind. Important for two reasons – they are a source of protein in the human diet and most of them have an ability to fix nitrogen from the air. Hence they have been in cultivation since near the dawn of modern agriculture 10,000 years ago.

Nitrogen fixation occurs when nitrogen fixing bacteria colonise the roots of clover, peas and beans resulting in the formation of nodules. Here the bacteria convert nitrogen gas in the soil air into nitrogen compounds utilisable by the host plant in exchange for carbohydrates supplied to the bacteria. And when the nodules break down they release their nitrogen for other crops.

Peas and broad beans are nodulated by a bacterium called *Rhizobium leguminosarum*. This species is very common in European soils as it nodulates the vetches which are wild relatives of peas and beans. On the other hand French and runner beans originated in South America have no compatible bacteria in European soils and have difficulty in fixing nitrogen. However it has been found that they can nodulate on certain soils. To check for active nodules, dig up some roots to look for nodules; if present cut them open and a pink colour (due to iron compounds) means they are fixing nitrogen, no pink means they are inactive. The other thing that causes a lack of fixation is high soil nitrogen – legumes will use soil nitrogen (from fertiliser or organic matter) in preference to fixed nitrogen as the latter takes a lot more energy. To improve nodulation on French and runner beans, it's possible to buy inoculants to mix with the seed prior to sowing.

Legumes		N fixing	Pollination	Germination	Origin
Pea	Annual	Yes	Self pollinating	Hypogeal	Europe
Broad bean	Annual	Yes	Bees	Hypogeal	Europe
French bean	Annual	Little	Self pollination	Epigeal	S America
Runner bean	Perennial	Little	Bees	Hypogeal	S America

Lettuce

There are many different varieties of lettuce but there are two basic types: those that are leafy and those that form heads. Butterhead, iceberg and cos are examples of head forming lettuce. Lollo Rossa and oakleaf are just two representatives of leafy lettuces that exhibit a range of shapes and colours. Once mature, lettuce will not hold well; for succession make subsequent sowings when seedlings of the previous sowing have just emerged. Alternatively one can buy a packet of seed with a mixture of varieties with differing maturity dates.

Lettuce is normally a transplanted crop but some of the leafy types can be direct drilled. It can be sown in a seed bed or tray and transplanted as bare-root plants but will establish better from modules. Take care when planting lettuce to ensure that the module is planted level or slightly proud of the surface of the soil – deep planting may induce basal rots in the young plant.

Cos is a type of lettuce that produces upright oblong plants with a crisp inner heart. The Little Gem variety is one of the earliest to mature in a more compact frame. Seed may be sown from March to mid July in drills 23 cm apart and thin out the seedlings to 23 cm apart.

Varieties: Little Gem, Little Gem Maureen, Pinokkio

Butterhead lettuce can be produced from June to October from sowings made from March to mid August. Space the crop at 30 cm square. Because lettuce is a perfectly circular crop, some savings in space can be made by

planting in a triangular pattern – circles of 30 cm will fit into 30 cm rows and 27 cm in-row spacing.

Varieties: Cassandra, Roxy, Diana

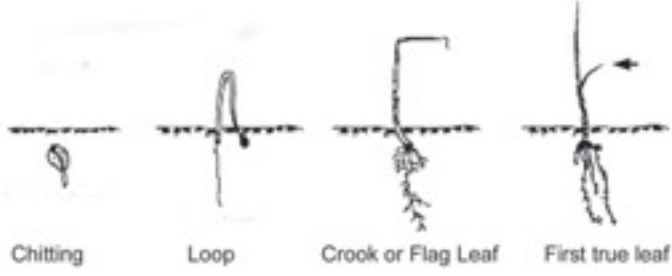
Lettuce needs to be kept growing so water during dry spells and a rich, moisture retentive soil will help in this regard. Farmyard manure or compost may be used to enrich the soil and improve its moisture retaining capacity.

Pests: aphids, root aphid, slugs, caterpillars
Diseases: downy mildew, botrytis, bottom rot, ring spot, sclerotinia

Onion family

The Alliaceae or onion family is a very important food group that has been in cultivation for thousands of years. Members include onions, scallions, shallots, garlic, chives and leeks.

Most vegetables are dicots meaning that they have two seed leaves or cotyledons. But the onion family and sweetcorn are monocots possessing just one seed leaf. The diagram below shows the seedling growth stages of an Allium.



Chitting is the visible start of the germination process after the seed has imbibed water. The seed coat breaks and produces an initial root followed shortly by the cotyledon. The solitary seed leaf or cotyledon arches up through the ground in the shape of a loop and then gradually straightens itself out to reach the crook or flag leaf stage. Shortly after the crook stage you'll notice a second leaf coming through – this is the first true leaf (arrowed), which looks

identical to the cotyledon. As more true leaves are developed the cotyledon begins to wither and fade away. It takes about a month from sowing to the first true leaf stage.

The initial emergence and growth of an onion crop can be slow due to low temperatures. As the days lengthen and the weather gets warmer new leaves are produced and the plant gets bigger. But at a certain stage leaf production stops and the plant switches over to bulbing. This is where the leaf bases begin to swell into fleshy scale leaves that go to form the familiar bulb. The environmental trigger for this change in development is day length. For spring sown varieties this equates to a day length of 16 hours which occurs in June. It follows then that the more leaves we have before the switch-over takes place the bigger your bulb will be. And this is the reason why we need to sow our crop in early spring or by starting them off in modules under glass. And it is also the reason why sets are so handy – they establish and grow away quickly.

Sets are very small onion bulbs that are produced by late sowing and close spacing. By sowing late only a few leaves are formed before the switch-over to bulbing takes place and hence small bulbs are produced. These are then stored over-winter for planting in the following year.

Bulbing in the field becomes obvious when you notice the base of the onion beginning to swell during July and warm temperatures at this time greatly helps the process.

Harvesting windrowed onions in Co Dublin.

Onions, shallots and garlic all share the same ripening process. When the tops start to topple over, it's a sign that the crop is maturing and getting close to harvest. With the exception of garlic leave them for 2 weeks to complete the process and then lift with a fork. To store them successfully the crop has to be dried. If the weather is warm and dry the drying can take place outside; get the crop up off the ground onto something like suspended chicken wire to allow air to circulate and cover with plastic if rain threatens. But better still, bring them into a glasshouse or plastic tunnel and spread on staging for 2-3 weeks until the necks are completely dry.

Any thick necked onions can be set aside for immediate use. Twist off the foliage and store the bulbs in trays, net bags or tie into onion ropes for hanging from rafters.

When applying nitrogen to onions it is normally split 50:50. With direct drilled onions apply half at sowing and the other half at the first true leaf stage. With sets and planted onions apply the first split at planting and the second about a month later. The latest date for nitrogen application is mid June.

Pests: thrips (mainly leek), bean seed fly (scallion)
Diseases: downy mildew (onion), rust (mainly leek), Botrytis leaf spot (onion), Botrytis neck rot (onion), white rot, white tip (leek), Cladosporium leaf spot (onion)

Onion, Potato

The potato onion bulbs should be planted in well manured ground early in February. Plant in rows 30 cm apart and 23 cm between the plants in the rows.

Cover the bulbs to rather more than half their depth. Early in August, as the bulbs are ripening, they should be pulled up and left on the surface to dry. When thoroughly dry, they should be stored in a cool dry place. Reserve a quantity of the smaller, well-ripened bulbs for planting in the following spring. Planting stock of this type of onion is not commonly available.

Onion, Seed

We can grow onions perfectly well in Ireland but the problem for the commercial grower is to get a couple of dry, fine weeks in September to harvest the crop. Drilled onions need a long season to provide yield and good bulbing development for harvesting in early autumn. But the advantage of seed onions over sets is they will store for longer, can have less problems with disease and there's a greater choice of varieties.

Direct drilled onions.

Bull Necks
The formation of an unusually thick neck on an onion is called a 'bull neck'. It is difficult to dry these sorts of onion and as a consequence don't store well. The most common reason for this disorder is too much nitrogen either from too much manure or fertiliser, especially if topdressed too late. It tends to be worse in a wet year. It may also be related to a poor bulbing response brought on by low light levels and high rainfall. Late sown crops, late varieties and sets are the most prone. Use bull neck onions immediately and don't bother to store.

Sow the crop from mid February to mid March with the very latest date being the first week in April. For late sown crops apply irrigation if the weather is dry to get the crop off to a flying start.

Most commercial crops are spaced to give a plant density of about 55 per m^2 – this gives a high percentage of bulbs in the pre-pack size grade of 50-70 mm. Plant populations can vary from 25 to about 85 per square metre depending on the size grade required. In respect of size, the greater the density the smaller the bulb, and visa-versa. So space your crop accordingly to your own specifications but don't go beyond 30 cm row widths. Some sample spacings are shown in the accompanying box using 25 cm rows as standard.

Spacing cm	Density per m2
25 x 5	80
25 x 6	67
25 x 7	57
25 x 8	50
25 x 10	40
25 x 12	33
25 x 15	27

As onions are a slow crop to develop from seed and complete poorly with weeds it is imperative that you keep the crop well weeded throughout the season.

As an alternative to direct drilling, you can propagate your onions in modules under protection for planting out at a later stage. This method is well suited to the gardener who prefers to use seed to sets. Sow 5-6 seeds per cell between late January to mid February and germinate on a warm bench if possible. Once germinated the modules can be grown on in a glasshouse or polythene tunnel. Plant out in early to mid April at a spacing of 30x30 cm. The individual plants look far too close together but you'll be surprised at how they are able to elbow each other out of the way as the season progresses.

The number of seed/seedlings per cell has a major influence on the eventual size of onions produced. A seeding rate of 5 per cell will produce a lot of onions in the 60-80 mm size grade; if you up the rate to 8 or 9 per cell you will get a high proportion of 40-60 mm grade.

Varieties: Golden Bear F1, Hyton F1, Hygro F1, Hyfort F1, Vision F1, Red Baron

Onion, Sets

The easiest way to grow onions is by planting sets. These are small immature bulbs specially produced for planting. The advantage of sets over seed is they are quicker to establish and hence more accommodating in relation to time of planting, easier to weed and mature earlier. Plant in March to mid April but the season can extend from February to the end of April at a push. Ensure that late planted sets are watered if the weather is dry to make sure they get off to a rapid start. Spacing for sets is identical to spacing for seed onions so consult that section. However a common spacing is rows 23 cm apart with sets 10 cm along the row (43 per m^2). Use a trowel to plant sets about 2.5 cm deep rather than just pushing them into the soil, as they may push up out of the ground when the roots start to grow. If you plant them just covered with soil it will stop birds from rooting them up.

Sets can also be planted in the autumn for an over-wintered crop maturing in July. Plant in the first week of October.

Sets for the commercial market are sold in four size grades: 10-14 mm, 14-17 mm, 17-21 mm and 21-23 mm. The very smallest grade can lack vigour and the very largest grade can be more prone to bolting. The ideal size is 14-21 mm.

Set onions normally mature in August. Onions from sets do not store as long as onions from seed. They will store satisfactorily until about January, after which time they start to sprout.

Varieties:
Spring: Stuttgarter Riesen, Sturon, Setton, Hercules F1, Centurion F1, Red Baron
Autumn: Shakespeare, Troy

Grow your own sets
Just for the fun of it try growing your own sets. You are looking to grow a set somewhere between 14 to 21 mm in diameter, so correct spacing of the seed is critical. Ideally grow them in a glasshouse or polythene tunnel. If grown outdoors you will need to bring the seed trays indoors at the end of July to dry them off.

Variety: Sturon
Sow: second week May in a seed tray or suitably sized module
Spacing: 3x3 cm

Grow until the end of July and then stop watering to dry off the plants. In early September top and tail the dried sets with a scissors and store in a cardboard box placed in a cool dry place for winter storage.

Onion, Shallots

A shallot is a small onion, that when planted grows to give a small cluster of bulbs at harvest time – they will multiply up about 8-10 fold.

Shallots are quite hardy and can be planted in February or March 15 cm apart, in lines 30 cm apart. Plant with a trowel, leaving just the tips of the bulbs visible. When the leaves topple over and begin to die back sometime during July or August, the clumps should be pulled up and left on the surface to dry. When thoroughly dry, they can be broken up and stored in a cool dry place. All the bulbs should not be used in autumn or winter; a quantity of the smaller, well-ripened ones should be kept back for planting in the following spring.

Shallots can also be raised from seed, with each giving rise to a single shallot. Sow in March or April in drills 10 cm apart with seeds spaced 4 cm apart in the drill; you require about 250 seeds per m^2.

Varieties: Golden Gourmet, Matador F1

Onion, Salad

Salad onions or scallions are a direct drilled onion crop sown quite thickly and harvested immature when they are about pencil thickness for use in salads. They are produced commercially from outdoor production from April to November and imports from Mexico and Egypt supply the winter to early spring period.

Sow from February to July for cropping from June to November and the over wintered crop is sown during the last 2 weeks in August to the first week of September for cropping from April to June. The early spring sowings can be covered with fleece to ensure a late May to early June harvest.

The recommended density is around 320 seeds per m^2. You can use row spacings down to 10 cm but using a spacing of 15 cm means a seed rate of 48 per metre run or a seed approximately every 2 cm.

Four row air drill sowing onions.

There are two types of onion sown as salad onion. The old standard Allium cepa White Lisbon has been in cultivation since the late 1800's and is an excellent garden variety. There is a selection of it called White Lisbon Winter Hardy that is more suited to overwintering but more prone to bulbing in the spring. The newer *Allium fistulosum* or Japanese bunching onion has a more upright growth habit to White Lisbon, freer from bulbing but not suited to over winter production. Also not quite as good to eat.

Varieties:
Allium cepa: White Lisbon, White Lisbon Winter Hardy, Lilia, Ramrod
Allium fistulosum: Savel, Green Banner, Ishikura

Parsnips

Parsnips are a root crop that will grow in a wide range of soils, more tolerant of heavy soils than carrots, and can be harvested from August through until March. Sowings are direct drilled from March to May. The March sowing can be covered with fleece for a mid July harvest.

Prior to sowing the surface should be forked over to a depth of about 10 cm and raked free of stones and clods. The seed should be sown in drills 30 cm apart and 15 cm apart in the drill, sowing 2-3 seeds per station. This spacing equals a plant population of 22 per sq m giving you a medium sized root. For larger roots go up to 30x20 cm. They will take from 2 – 4 weeks to germinate depending on the weather. Thin to one plant per station. Parsnips are one of the hardiest of vegetables and can be left in the ground during the winter, digging them as required.

Varieties: Cobham Improved, Gladiator F1, Javelin F1, Countess F1.
Pests: carrot fly
Diseases: canker, various leaf spotting diseases

Peas

Peas are one of the most ancient and nutritious vegetables. There are two types – round and wrinkled seeded – in the dried form. The round are hardier and used for early and late crops and wrinkled are less hardy and generally sweeter.

Sow from March to June, every two weeks for succession if required, in flat bottomed drills 5 cm deep, 15 cm wide, spacing the seeds roughly every 5 cm apart. Allow 90 cm between the rows.

On poor soil, where it is necessary to apply manure at the time of sowing, a trench should be opened 30 cm wide, and of the same depth, in which a layer of well rotted manure should be placed, dug in and mixed with the soil from the trench. No nitrogen is required.

Peas require some sort of support for the leaf tendrils to hold on to. Traditionally tree branches (especially Elm) were cut in winter and used to stake the pea crop. Nowadays it's more likely that plastic pea netting or sheep fencing will be used. Whatever you choose it's important that the support be placed to the peas before the stems bend, i.e. before they have reached a height of 10 cm. If staking is not done, peas seldom give satisfactory results. Extra early crops of peas may be had by sowing first early varieties in pots placed in frames, early in February and planting them out in April.

If you don't like the rather tedious job of shelling peas, consider growing either mangetout or sugar snap peas where you can eat the pod and all. Same cultural details, just the varieties are different.

Varieties:
Earlies: Early Onward, Meteor, Kelvedon Wonder
Maincrop: Hurst Green Shaft, Onward
Mangetout: Oregon Sugar Pod
Sugar Snap: Sugar Ann
Pests: pea and bean weevil, pea aphid, thrips, birds
Diseases: root rot, leaf and pod spot, downy mildew

Potatoes

Potatoes are a half hardy crop that hail from South America and first reached these shores around 1586. Being half hardy means that frost can cause problems. It can kill off newly emerged shoots from an early planted crop or damage tubers (potatoes) if the harvest is left too late.

The crop is grown from tubers; you can use your own but it's probably best to buy fresh seed annually that is certified free of disease. Seed about the size of a hen's egg is ideal. These should be planted whole, but in the event of larger seed being used, they may be cut into two sets. The tubers can be directly

planted into the soil but it's advantageous to sprout them first as they will emerge more quickly and mature earlier. Buy your certified seed in February or March and place them upright in a tray placed in a light, cool, frost free place. In a few weeks the tubers will have developed short (about 12 mm long), sturdy, dark green sprouts.

Potatoes can be divided into 3 types in order of harvest: Early (June), Second Early (July-August) and Maincrop (September-October).

Early potatoes are planted in March. If well sprouted potatoes planted at this time they should be ready for use during June and July. Main crops are planted in April to early May.

Potatoes are traditionally grown in ridges or drills. Space the drills 70 cm apart for early and second early varieties and 75 cm for maincrop. Using a garden line to guide you, dig out a shallow trench with a shovel, and spread compost/manure (if you have it) and fertiliser along the base. Space the tubers out 25 cm apart in the row for earlies and 30 cm for maincrop. Open up a second drill parallel to the first and cover in the first trench with the soil from the second as you go along. Continue across the plot until you are finished to leave the ground roughly level.

The crop will require to be earthed up as it grows during the early part of the season. As mentioned, potatoes are prone to frost damage and if the shoots are showing and frost is forecast cover the exposed shoots with soil from between the rows. Ridge them up again when the emerged shoots are about 20 cm high covering them to about 10 cm. If necessary first loosen the soil between the rows with a hoe and then use a shovel to earth up.

If you are growing on beds potatoes can be planted on the flat. Dig over the bed, rake it level and plant the tubers using a trowel. Space them 30x30 cm in a diamond pattern at a dept of 10-12 cm for earlies/second earlies and 15-16 cm for main crops. When planted on the flat there is no need to earth up.

What makes for a good potato crop? A fertile soil with a full leaf canopy by the end of May; and the development of a deep extensive root system which is important for water uptake. And keep potato blight at bay.

The table below gives a ranking to a number of different varieties in relation to blight resistance in both foliage and tuber, where 1 equals lowest disease resistance and 9 equals highest disease resistance.

Table: Blight resistance

Variety	Foliage	Tuber
Duke of York	2	2
Home Guard	2	2
Sharpe's Express	2	2
British Queen	3	3
Kerr's Pink	4	4
Maris Peer	4	4
Coleen	3	6
Record	4	6
Sante	4	6
Rooster	4.5	6
Orla	4	7
Setanta	5	8
Cara	7	7
Sarpo Mira	8	8

Slugs: if you find you crop riddled with holes along with hollowed out cavities the chances are that slugs are the culprit. The problem tends to be field or plot specific – it's a problem in certain fields but not in others. Slug attack tends to worse in wet years on heavy soils and varieties vary in their susceptibility. Varieties like Kerr's Pink, Maris Piper and Rooster are vulnerable; Golden Wonder, Nicola and Pentland Dell are among the least susceptible varieties. Two slug species are implicated: the keeled slug and the garden slug. The problem with trying to counter the keeled slug is that it lives mostly underground and only comes to the surface to mate. Because of this applying slug pellets may be of limited use. Slugs will feed on tubers from late summer into the autumn; and essentially the longer you leave the tubers in the ground the greater the damage. For example in a trial they discovered that Maris Piper

lifted on August 8th suffered 10% damage, lifted on October 3rd 30% damage and lifted in early November 45% were damaged. The following suggestions may help:

- Grow early or second early varieties as they are harvested early and hence less susceptible to slugs.
- Sprinkling a small amount of pellets along the open drill at planting time may have some effect on reducing damage later in the season.
- For main crops apply two applications of slug slug pellets in mid July and August. Alternatively use four half-rate applications.
- Consider the use of Nemaslug in early August; this is a species of eelworm that actively seeks out slugs and kills them. But it's not cheap and not 100% effective.
- Avoid growing pink skinned varieties.
- If you do notice slug damage towards the end of the season lift the crop promptly as the damage will only get worse the longer the crop is in the ground.
- Do not get unduly alarmed if you notice slug damage to the potato leaves as this may well be the grey field slug at work, a species that generally doesn't attack the tubers.

Harvest the earlies and second earlies direct from the drill when they are big enough and as you require them. The main crop haulm will naturally die back in the autumn allowing the crop to be lifted in October. If you wish you can cut the haulm off 3 weeks prior to lifting. Store the crop in a dark, frost free shed.

Varieties:
Early: Home Guard, Duke of York, Coleen, Sharpe's Express
Second Early: British Queen, Orla, Maris Peer
Maincrop: Kerr's Pink, Rooster, Record, Pink Fir Apple, Cara, Setanta, Sante, Sarpo Mira, Sarpo Axona (the Sarpo varieties may not be to everyone's liking)
Pests: slugs, aphids, wireworm, eelworm
Diseases: potato blight, black leg, pink rot, soft rot, dry rot

Radish

Radish which comes in a number of different shapes and sizes is divided into two main types: summer and winter. Summer radishes are quick growing maturing in 4-8 weeks and are used in salads. Winter radish is ready in 8-10 weeks and is much larger than its summer cousin; it can be eaten raw in salads or cooked like turnip or swede.

Sow summer radish from March to August and winter varieties from July to August. The summer crop can be thinly sown to aim for a final spacing of 15 x 3 cm. Allow more room for the winter crop – 15 x 15 cm. Summer radish can be harvested when quite small – about 2 cm in diameter. They can go woody quite quickly so only sow in small batches and every two weeks if succession is required.

The summer crop needs to be grown quickly so make sure to keep it well watered in dry spells.

Varieties:
Summer types: Cherry Belle, French Breakfast, Sparkler, Rudi
Winter types: China Rose
Pests: flea beetle, slugs, cabbage root fly
Diseases: downy mildew, Rhizoctonia root rot

Rhubarb

This is an extremely useful early vegetable and a good plantation may remain in production for many years.

Rhubarb requires a deeply worked free draining soil well manured and free of weeds. Farmyard manure is beneficial and should be applied in the autumn prior to planting or the ground may be fertile enough after a previously heavily manured crop such as potatoes; fertiliser requirements can be made up by subsequent topdressings.

Planting material may be obtained by dividing up two to three year old stools into a number of portions, each portion or set as it is called, should have at least one bud and a fair portion of a root system. Plants raised from seed are likely to be variable and are best avoided.

Plant anytime during the winter up to March if weather and soil conditions are suitable. Sets should be planted about 1 metre apart each way and sufficiently deep that the crowns are level with the surrounding soil. When growth starts a dressing of 30g sulphate of ammonia per m^2 should be given to help build up the root system. It's best not to pull the stems the first season after planting to allow for good establishment. When the leaves have died down in the autumn farmyard manure should be put around the crowns without covering them.

The rhubarb harvest normally starts in February in mild areas in the south and in March further north in the country. During the pulling season an occasional application of liquid manure or sulphate of ammonia will help to promote a further flush of leaves. Take around a third to one half of the stems per stool at any one harvest leaving the rest to allow regrowth of new shoots. When pulling the sticks, put your hand down near the base of the stem and ease it out of the ground. Finish pulling in August or September to allow the plant to rebuild its reserves for the following year's crop. A simple method of forcing rhubarb for an early supply is to invert a tub over the crown at the end of January.

It may happen that some of the stools occasionally throw up flowering shoots. These should be removed to stop the plant from expending its energy into flower and seed production. Most commonly seen in the season following a wet summer.

Varieties: Timperely Early, Victoria
Pests: slugs
Diseases: leaf spot (Ramularia), crown rot (Erwinia)

Seakale

Seakale may be propagated either from seed sown in late March or early April, or by means of root cuttings. Planting roots can also be purchased from horticultural seedsmen. When planting out permanently remove all buds except one, and place the rooted plants in lines 60 cm apart allowing 38 cm between the plants in the lines.

Plants are then encouraged to grow luxuriantly until the following January when preparations for blanching should begin. The crowns can be covered with special earthenware pots, or alternatively, with flue liners covered on top with tiles or slates. Fermenting manure, if placed round these coverings, will provide gentle warmth and force the crop.

Very good blanched seakale can be obtained by heaping fine cinder ashes, sand, sawdust or dry peat moss over the crowns. Blanching can also be done in certain well-drained soils by covering the crowns with earth from alleyways. When blanching is finished and the crop harvested, the materials used for blanching should be removed and the plants encouraged to grow vigorously and naturally through the summer, removing flower heads as they appear. In spring a dressing of a balanced fish meal or meat-and-bone meal fertiliser plus sulphate of potash should be given.

Spinach

This crop is grown in the same way as lettuce, but it does not transplant well. Small successive sowings are made in rich ground, at three week intervals throughout the spring and summer. The early sowings should be made in a warm position, but for the summer sowings a cool site should be chosen. Early thinning to 15 cm apart and watering with liquid manure, or dressing with nitrogen, tend to check bolting. A sowing should be made of a prickly seeded variety at the end of August for use in early spring.

Varieties: Fiorana F1, Medania
Pests: black bean aphid
Diseases: downy mildew

Spinach, Perpetual

Also known as spinach beet or leaf beet this vegetable continues to produce leaves even during hot, dry weather. Two sowings may be made, one in April and one in July. Sow in drills 45 cm apart and thin the plants to 23 cm.

Seakale spinach or Swiss Chard is cultivated like perpetual spinach. The green leaves are eaten like spinach and the fleshy white mid-ribs are cooked and eaten like seakale.

Swede

Swedes are a traditional winter vegetable, popular in Ireland, that's now available all year round in the shops. It's a hardy vegetable well able to withstand most frosts but can bolt if sown too early.

Swedes will grow on a wide range of soils and have a low nitrogen requirement. If conditions are too rich they will split and develop soft rots. So it's best not to apply any compost or manure prior to sowing the crop and watch the nitrogen. They are also tolerant of low pH (see Table 1 in the Appendix).

Magres which was introduced in 1980 is the standard commercial swede variety. It is a high dry matter variety and as such hardy in most winters but also renders it hard to chop in the kitchen when it reaches maturity. Marion has good resistance against clubroot and powdery mildew. Helenor which has increased in popularity in recent years has a dark purple colour with a sweet taste. Gowrie is a Scottish variety that exhibits vigour, good resistance to downy mildew and is suitable as an early variety. Hybrid varieties are a new development in swedes and the best of them is Tweed which is a vigorous variety well suited to less fertile soils and produces uniform globe shaped roots.

The crop is normally direct drilled but early crops can be sown under protection in modules and planted out. The direct drilled crop is sown from April to the end of June with the main crop sown in May. In comparison to turnips swedes are quite a slow crop to develop but will stay fit for harvest for many months. It takes about 15 weeks for the first ones to come fit. For an early crop (mid June to early July) sow in modules mid February, transplant out in March to early April using a wide spacing and cover with fleece. This early crop may bolt but you will still be able to harvest a crop.

Crop density usually varies from 10-16 plants per m^2 with around 13 per m^2 fairly typical for a commercial crop that requires a 0.8-1 kg head weight. You can experiment with different spacings depending on your requirements but try 40x20 cm that equals 12.5 per m^2. For early or late crops increase the spacing a bit to 40x25 or 40x30 cm.

Swedes are prone to a disorder called 'Brown Heart' which is caused by a deficiency of boron, that can be particularly prevalent on high pH soils. If you come across the problem apply 2-4 g per 10 m^2 of Borax at the 4 leaf stage to prevent its occurrence in subsequent seasons. Commercial growers spray routinely for this common problem.

There are two pests that can cause trouble. If you notice pin-prick holes in the leaves when the plant is small, particularly during a spell of fine weather, it's probably flea beetle. If you spot white maggots feeding on the roots it's more than likely to be those of cabbage root fly. In both cases the best way to avoid them is to use crop covers, either fleece or bionet. If you delay your sowing to late May you'll avoid the first generation of cabbage root fly, which is always significantly worse than the second generation which occurs from July to September. Swedes are also prone to downy mildew but is normally not a problem as the crop will grow out of it. In warm dry summers powdery mildew can make an appearance and if desired can be controlled with sulphur sprays.

Varieties: Brora, Helenor, Marion, Ruby, Magres, Gowrie, Tweed F1
Pests: cabbage root fly, flea beetle, aphid
Diseases: powdery mildew, downy mildew, crater spot, dry rot (Phoma), club root

Sweetcorn

Sweetcorn developed thousands of years ago as a natural variant of maize which is a native of central America, probably Mexico. It was brought to Europe by Columbus and subsequently spread worldwide to become one of the most important food crops for mankind. Sweetcorn differs only in a single gene from maize which slows down the conversion of sugar to starch. This produces kernels with a high sugar content and pleasant texture in contrast to the starchy grains of maize. It now only exists in cultivation and thus could be described as being a man-made crop.

This vegetable was transformed for the commercial grower by the development of supersweet varieties in the mid 1980's. These varieties possess sh2 genes which causes them to convert much less of their sugar to starch to produce kernels about 30% sweeter than the standard ones (known as normal sugar), but more importantly hold their sweetness for longer. The old varieties, once ripened, quickly converted their sugars into starch and had to be used immediately. Other types you may come across in catalogues are 'sugar enhanced' varieties which have a sweetness in-between normal and supersweet and 'extra-tender sweet' varieties which are a sweeter and less chewy version of the supersweets.

Sweetcorn is one of the half-hardy vegetables and is better suited to the warmer eastern and southern parts of the country. But the development of new varieties has rendered the crop less susceptible to the vagaries of an Irish summer. That said it will always do better in a warm summer and select a warm sheltered site if possible.

Most of the varieties available are hybrids. The supersweet and extra-tender varieties can be grown together but must be separated from the normal sugar varieties plus the whites and multicoloured types. All varieties must be isolated from forage maize by at least 75m as the starchy character of maize is dominant to the sweet character of sweetcorn. If you're growing sweetcorn in one of the colder areas of the country you'd be advised to stick with using just the early varieties such as Earlibird or Northern Xtra Sweet.

Maize is grown commercially in Ireland for silage production and a lot of the crop is direct drilled through a strip of biodegradable clear plastic. The plastic increases the

soil temperature by about 2-4°C which generates better growth especially for the earlier sown crops. Maize requires a temperature of 10-12°C to germinate and doesn't thrive at air temperatures less than 10°C.

Unusually for a vegetable crop it's a member of the grass family (Poaceae) and as such is wind pollinated. For this reason sweetcorn is sown or planted in blocks to allow the pollen produced by the male tassels produced at the top of the plant to fertilise the female flowers known as cobs.

Sweetcorn is not a crop that takes to transplanting well but the first sowing can take place indoors to be planted out carefully later. Sow 2.5 cm deep in large modules or pots under glass in mid April to early May and plant out when the plants are 10 cm tall. Plant in a block formation at a spacing of 45x45 cm or 45x40 cm for a higher density – plant population for sweetcorn can vary from 4.8-6 plants per m2. Alternatively direct drill the crop outdoors at similar spacings, in May to the first week in June. In warmer parts of the country and if drilled under clear plastic an early crop could be sown in April. The earlier drillings can with advantage be covered with fleece until well established, particularly if the weather is on the cool side. If not covered by fleece or plastic crops probably shouldn't be drilled until mid May.

Sweetcorn is quite a nitrogen demanding crop. Up to 70 g/m2 of sulphate of ammonia can be used split half at sowing or planting and the other half a month later.

The crop is harvested from August through to October. The silks which hang from the developing cobs turn brown shortly after pollination and to a dry dark brown when the cob is close to harvest about 30 days later. The final test of ripeness is to push a fingernail into one of the grains – if the liquid runs clear it's unripe; if it's milky it's ready to harvest. You will normally harvest 2 cobs per plant. The top cob matures first followed by the one further down the plant. The supersweet varieties will last satisfactorily in a fridge up to a week.

Varieties
Normal sugar: Sundance F1
Supersweet: Northern Xtra Sweet F1, Earlibird F1, Mainstay F1, Seville F1
Extra-tender: Lark F1, Lapwing F1, Wagtail F1
Pests: aphids
Diseases: rust

Tomato

Tomatoes are a half hardy vegetable that give the best results when grown in a glasshouse or polythene tunnel. That said, if you have a sheltered warm spot in your garden or allotment, you can try growing them outdoors. There are two types – bush (or determinate) and cordon (or indeterminate). The bush varieties require little staking but don't yield as well as the more traditional cordon types which require both staking and side shooting. Bush types are possibly more suited for containers or pots and would recommend the cordon type for the vegetable garden.

Outdoor tomatoes are raised under protection and planted out in June when all frosts are gone. You can propagate your own plants or more conveniently buy them in at planting time. Sow 1-2 seeds in a 8 cm pot sometime in April, about 8 weeks before your chosen planting date sometime in June.

You require a plant density of about 4 per m^2 so space them at 50x50 cm and put a 1.2 m stake beside each plant. As the plants grow they will have to be tied into the stake and the little side shoots that develop in the leaf axils need to be removed by snapping them off when they are about 3 cm long.

Tomatoes are heavy feeders so they would be a good crop to receive manure or compost and when watering apply a liquid feed as standard. Pinch out the growing point in August two leaves above the last flower truss – this is to get the plant to put all its energy into developing and ripening the fruit before the first frosts of autumn.

Varieties: Gardeners Delight (cherry), Alicante (round), Ailsa Craig (round), Ferline (beefsteak)
Pests: caterpillar
Diseases: potato blight
Disorder: blossom end rot (calcium deficiency)

Turnip

Turnips are a quick growing crop maturing in as little as 6 weeks from sowing. They come in a variety of shapes – flat, round or long – and in a variety of colours – purple, green or white. It's a versatile crop that can be harvested when small and eaten raw or left to grow in size and cooked; the tops can also be harvested like spring greens from a late summer sowing.

A small sowing should be made about every three to four weeks from March to August in drills 30 cm apart and 2 cm deep. Sow thinly and gradually thin out to 15 cm apart. Start harvesting when they are golf ball sized for salads or grow on to tennis ball size for cooking.

The main problems will stem from attack by cabbage root fly, flea beetle and slugs. Your best bet is to cover the crop with fleece for the first two and a small amount of pellets to keep slugs at bay. As with any quick maturing crop water the crop during dry spells.

Varieties: Oasis, Purple Top Milan, Goldenball, Green Globe, Sweetbell F1
Pests: Flea beetle, cabbage root fly, slugs
Diseases: downy mildew

Herbs

There is a very wide selection of these useful flavouring plants and only the enthusiast grows all of them. Room should be made in every garden for few of the more commonly used kinds. Choose a warm, sunny site for your herb garden.

Thyme: Sow seed in April and thin or transplant to 15 cm apart. Will last for several years.

Mint: Plant in October or March in a cool, rich soil. Cut down the tops in autumn and cover with 5 cm of manure or compost.

Sage: Grow from seeds in April or cuttings in July or August. Plant 40 cm apart in a dry position. Each spring prune back the branches to ensure a supply of fresh growth.

Chives: Clumps may be bought from seedsmen and planted in early spring. Leaves are cut during summer as required.

Coriander: This annual plant is grown for both its leaves and seeds. Direct drill from March to July for harvesting from May to October. For May harvest sow under protection or in a garden frame. Sow every 3 weeks for succession. This crop is prone to bolting so keep well watered to prevent checks to growth. This plant hails from the Mediterranean and doesn't thrive outdoors in cool, wet summers.

Parsley: There are two types of this popular herb: curly and flat leaved. The flat version is the more flavoursome of the two. The seed should be sown in March/April, in lines 45 cm apart and thinned to 5 cm apart. A sowing may also be made in July for winter and spring use. Parsley can also be raised in modules and planted out. It's a biennial plant and several cuttings can be taken from a single sowing before the plants go to seed.

Tender and out of season vegetables

Dutch lights, polythene tunnels or polythene mulch will be found of great assistance in raising out of season and frost tender vegetables.

Dutch light frames – Dutch lights consist of a single frame of 600g glass measuring 142 x 73 cm slipped into grooves on the long sides of a light wooden frame. These lights can be used to cover a frame with 60 cm back wall and 45 cm front wall. The frame may be heated by electric cables or crops may be grown without heat.

Polythene Tunnels – These are of two main types:-

(1) Low tunnels which have replaced cloches. A roll of 150 gauge polythene is supported by wire hoops and secured by twine. These tunnels are very useful for low growing crops or for providing shelter in the early stages of a crop's development.

(2) Walk in tunnels – these are a low cost alternative to glasshouses. Polythene (600 gauge) is drawn tight over galvanised metal tubing forming a semicircular shape. These tunnels can be used for raising plants or growing more tender or out of season vegetables including tomatoes, cucumbers, melons, aubergines and sweet peppers.

Black Polythene mulches – If black polythene is laid on the ground and secured at the edges, many tender crops grow better than if planted into the open ground. The best system of culture is to raise the plants indoors or in a heated frame or glasshouse and to plant through holes in the polythene mulch when all danger of frost is gone. Tomatoes, gherkins, marrows and sweet corn benefit especially from these mulches.

Cropping Programmes – Under any of the above systems careful planning and management are needed if the protected area is to be utilised to full advantage. Suitable varieties should be used and dates of sowing and transplanting carefully studied. Many variations in cropping programmes can be employed. Early sowings of carrots in January will mature in May and can be followed by tomatoes, cucumbers, peppers or aubergines which in turn can be followed by lettuce. Alternatively lettuce can be succeeded by celery planted in late July for harvesting in early December.

Vegetable production in Ireland

Area of commercial vegetables grown: 4590 ha.

Home grown produce supplies 60% of the market.

Top 5 vegetable growing counties: Dublin, Meath, Cork, Wexford, Louth.

Top 5 vegetables grown in Ireland: Cabbage, carrots, broccoli, swede, cauliflower.

Top 5 vegetables eaten in Ireland: Tomato, carrots, mushrooms, peppers, onions.

Source: Bord Bia National Field Vegetable Census 2009

APPENDIX

Table 1: Guide to pH values below which crop growth is affected

Crop	Soil pH	Crop	Soil pH
Asparagus	5.9	Mint	6.6
Bean	6.0	Mustard	5.4
Beetroot	5.9	Onions	5.7
Broccoli	6.0	Parsley	5.2
Brussels sprouts	5.7	Peas	5.9
Cabbage	5.4	Potato	5.0
Carrot	5.7	Rhubarb	5.4
Cauliflower	5.6	Spinach	5.8
Celery	6.3	Sweetcorn	5.5
Chicory	5.2	Swede	5.4
Leeks	5.8	Tomato, outdoor	5.2
Lettuce	6.1	Turnip	5.4

The above picture shows a swede plant growing in a mineral soil at a pH of 4.9. Notice the cupping of the leaves with a pale outer rim to the leaves that are characteristic symptoms of manganese toxicity.

Table 2: Guide to dept of sowing

12-20 mm	20-25 mm	25-38 mm	38-50 mm
Beetroot	Broccoli	Pea	Broad bean
Carrot	B. sprouts	Sweet corn	French bean
Leek	Cabbage		Runner bean
Lettuce	Cauliflower		
Onion	Cucumber		
Parsley	Marrow		
Parsnip	Radish		
Spinach	Swede		
	Tomato		
	Turnip		

Table 3: Soil sample laboratories

Any local Teagasc office will accept samples **www.teagasc.ie**

Southern Scientific Services
Dunrine, Killarney, Co Kerry
Tel: 064 - 6633 922

F.B.A. Laboratories Ltd
Carrageen Industrial Estate, Cappoquin, Co Waterford
Tel: 058 - 52861

EURO Environmental Services
Unit 35, Boyne Business Park, Drogheda, Co Louth
Tel: 041 - 9845 440

IAS Laboratories
Unit 4, Bagenalstown Business Park, Bagenalstown, Co Carlow
Tel: 059 - 9721 022

Dairygold Feed Laboratory
Lombardstown, Mallow, Co Cork
Tel: 022 - 47275

Table 4: Seed companies

Suttons Seeds Woodview Road Paignton Devon TQ4 7NG	Thompson & Morgan Poplar Lane Ipswich IP8 3BU
Unwins Alconbury Hill Huntingdon Cambridgeshire PE28 4HY	Mr Fothergill's Kentford Suffolk CB8 7QB
Kings Seeds Monks Farm Kelvedon Colchester Essex, CO5 9PG	Moles Seeds Turkey Cock Lane Stanway Colchester Essex, CO3 8PD
The Organic Gardening Catalogue Riverdene Business Park Molesey Road, Hersham Surrey, KT12 4RG	Dobies of Devon Long Road Paignton Devon, TQ4 7SX
Johnsons Seeds Kentford Suffolk CB8 7QB	Tamar Organics Cartha Martha Farm Rezare, Launceston Cornwall, PL15 9NX
M.G. Seed Company (Moles Seeds) Sutherland Ratoath Co Meath 087 - 262 3133	Colum O'Regan Horizon Farm Kinsale Co Cork Tel: 087 - 763 7574

Table 5: Latin names of vegetables

ALLIACEAE		
Allium cepa	Var ascalonicum	Shallot
	Var cepa	Onion, salad onion
Allium fistulosum		Japanese bunching onion
Allium porrum		Leek
Allium sativum		Garlic
Allium schoenoprasum		Chives
APIACEAE	Formerly Umbelliferae	
Apium graveolens	Var dulce	Celery
	Var rapaceum	Celeriac
Coriandrum sativum		Coriander
Daucus carota		Carrot
Foeniculum vulgare	Var azoricum	Florence fennel
Pastinaceae sativa		Parsnip
Petroselinum crispum		Parsley
ASTERACEAE	Formerly Compositae	
Cichorium endivia		Endive
Cichorium intybus		Chicory/Radicchio
Cynara scolymus		Globe Artichoke
Helianthus tuberosus		Jerusalem Artichoke
Lactuca sativa		Lettuce
BRASSICACEAE	Formerly Cruciferae	
Armoracia rusticana		Horseradish
Brassica napus	Var napobrassica	Swede
	Var napus	Oilseed rape
Brassica oleraceae	Var acephala	Kale
	Var botrytis	Cauliflower
	Var capitata	Cabbage
	Var gemmifera	Brussels sprouts
	Var gongylodes	Kohlrabi
	Var italica	Broccoli/calabrese

Table 5: Latin names of vegetables *continued*

Brassica rapa	Var chinensis	Pak choi
	Var nipposinica	Mizuna
	Var pekinensis	Chinese cabbage
	Var rapa	Turnip
Eruca sativa		Rocket
Nasturtium officinale		Water cress
Raphanus sativus		Radish
Rorippa x sterilis		Garden cress
CHENOPIACEAE		
Beta vulgaris	Subspecies cicla	Leaf beet, Swiss chard
	Subspecies vulgaris	Beetroot
Spinacia oleraceae		Spinach
CUCURBITACEAE		
Cucumis melo		Melon
Cucumis sativus		Cucumber, Gherkin
Cucurbita pepo		Marrow, Courgette
FABACEAE	Formerly Leguminosae	
Phaseolus coccineus		Scarlet runner bean
Phaseolus vulgaris		French bean
Pisum sativum		Pea
Vicia faba	Var major	Broad bean
POACEAE		
Zea mays	Var saccarata	Sweet corn
POLYGONACEAE		
Rheum x cultorum		Rhubarb
SOLANACEAE		
Capsicum annum		Sweet pepper
Capsicum frutescens		Chilli pepper
Lycopersicon esculentum		Tomato
Solanum melongena		Aubergine
Solanum tuberosum		Potato

Vegetable production guide

Crop	Season	Sow	Plant	Spacing cm	Harvest
Bean broad	Early Main	Oct – Nov Feb – May		23x23 60 rows	Early June on June – Sep
Bean French		Mid May – June		45x8	July – October
Bean runner		Mid May – June		60x20	Aug – Sep
Beetroot		Apr – June		25x4	July – March
Carrots	Early Main Late	Feb – March April – May June		15x7 15x5 15x5	July – Aug Sep – March
Celery	Early Main Late	March April May	May June July	30x30 30x30 30x30	Aug – Sep Sep – Oct Nov – Dec
Courgettes	Main Late	April – May June	May – June June – July	80x80 90x75	July – Sep Sep – Oct
Garlic	Early Main		Oct – Nov Feb – Mar	20x20 20x20	May – June July – Aug
Leeks	Early Main Late	Jan – Feb March April	April May – June June – July	30x20 30x15 30x20	Aug – Sep Oct – Feb March – Apr
Onion	Shallot Sets Seed	 Feb-March	Feb – Mar Feb – Apr Early Oct	30x15 25x10 25x10 25x7	July – Aug August July Aug – Sep

Vegetable production guide *continued*

Crop	Season	Sow	Plant	Spacing cm	Harvest
Parsnips	Early Main	March April – May		30x15	July on Aug – March
Parsley	Early Main	September March – July		45x5	May June on
Peas	Early Main Late	March April – May June		90 rows	June – July July – Aug Sep – Oct
Potatoes	Early Main		March April	70x25 75x30	June – July Aug – Oct
Radish		March – Aug		15x3	May – Oct
Rhubarb			Winter time	1x1 m	March – Aug
Scallions	Early Main	August (last 2 weeks) Feb – June	Sow 20-30 seeds per 30 cm	25 cm rows	April – May June – Oct
Spinach	Early Main	September Mid Mar - July		30x15 30x15	March – April June – Oct
Swede	Early Main Late	March (fleece) April – May June		40x23 40x20	July Aug – March October on
Sweetcorn	Early Main Late	April (glass) May Early June	May	45x40 45x45 45x45	August September Sep – Oct
Turnip		April – Aug		30x15	June – Nov

Vegetable aphids (greenfly)

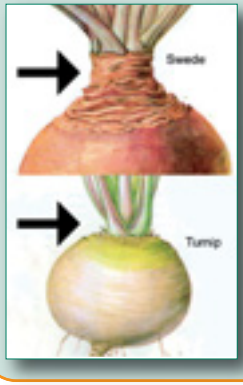
Crop	Species	Occurrence
Beans Broad/French/Runner	Black bean aphid *Aphis fabae*	Common
Brassicas	Mealy cabbage aphid *Brevicoryne brassicae* Peach-potato aphid *Myzus persicae*	Common Frequent
Carrots/Celery	Willow-carrot aphid *Cavariella aegopodii* Carrot root aphid *Pemphigus phenax*	Common Uncommon
Lettuce	Potato aphid *Macrosiphum euphorbiae* Peach-potato aphid *Myzus persicae* Lettuce aphid *Nasonovia ribisnigri* Lettuce root aphid *Pemphigus bursarius*	Common Common Frequent Uncommon
Peas	Pea aphid *Acyrthosiphon pisum*	Common
Potato	Potato aphid *Macrosiphum euphorbiae* Peach-potato aphid *Myzus persicae* Glasshouse-potato aphid *Aulacorthum solani*	Common Common
Spinach	Black bean aphid *Aphis fabae*	Common

History of the Swede

The swede is a comparatively recent vegetable whose origin is uncertain but possibly originated in Finland. It arose from a cross between *Brassica rapa* (turnip) and *B. oleraceae* (possibly kohlrabi) and was first recorded by a Swiss botanist Caspar Bauhin in 1620.

The swede spread to other countries including Holland and Sweden where it became popular as stock feed and as a winter vegetable for humans. There is a record for its introduction into Scotland in 1781-1782 and a mention in the Gardeners' Chronicle of its introduction into England in 1790. It presumably arrived in Ireland sometime after.

The name 'swede' derives from the time that Sweden began to export their crop to Britain – it's a shortened version of 'Swedish turnip', turnip being very similar in looks to swede. Sweden also exported the crop to North America from whence came the American name for swede, rutabaga, which comes from the old Swedish word *rotabagge*, meaning "root ram".



What's the difference between a turnip and a swede? Both are formed from the hypocotyl (that bit of the stem just below the seed leaves) swelling up into the familiar 'root', but in the swede the top and bottom of the bulb are derived more from stem and root tissue, respectively, than is turnip. This leads to leaf scars giving a swollen neck around the top of the swede and the presence of adventitious roots on the bottom of the bulb.

A Guide to Vegetable Growing

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