

# **Intensive Raised Bed Gardening for Allotment and Vegetable Gardeners**

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This is intended to be a practical guide for gardeners showing the how and the why of intensive deep bed cultivation. The guide has been produced following an unsuccessful search for a practical guide giving all the required information in a single place. Raised bed cultivation is mentioned in many gardening books and its advantages extols but the books rarely go on to provide the practical information necessary. This is not intended for the Coffee Table gardener but to be rolled up and carried in the back pocket whilst you are out on the plot.

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# WHAT IS INTENSIVE RAISED BED GARDENING?

The 'Bed System' of gardening is a system of growing vegetables in which the garden is divided up into narrow beds of 1.2 — 1.4 m wide (4 feet or under) separated by narrow paths 0.6 m wide (about 2 feet).

These beds can be 'raised' as a result of deep digging and incorporating organic matter. They stay raised above the level of the surrounding paths because they are never walked on, all work being carried out from the paths. Because the soil is deeply dug these are sometimes known as deep beds. It is also possible to raise beds by building a wooden frame round a bed and adding extra soil and organic matter, and these could be cropped in the same way as the raised beds described in this booklet.

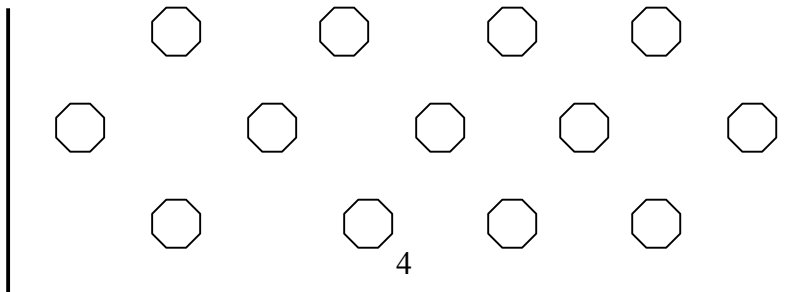
The beds are called 'intensive' because the whole bed is very intensively planted; crops are grown at close spacing with each plant an equal distance from the others around it. This gives a much higher plant density than a 'conventional' system where rows are widely spaced. (see Appendix 1 at the back of this booklet for a table of suggested spacing for various crops).

Intensive Raised Bed Gardening is much older than our present day conventional system, which only evolved when vegetables began to be grown on a field scale, with crops sown in widely spaced rows to allow the passage of a horse-drawn hoe for weed control. This wide spacing gave higher yields, but only because of the weed control obtained. On a smaller scale where hand weeding is possible the Intensive Raised Beds can produce much higher yields for the same area.

The methods and ideas expressed in this booklet are, in the main, based on the experience of the Henry Doubleday Research Association, the Colorado State University, the National Vegetable Research Station and my own experience gained over 30 years. I am not saying that this is the only way to garden on raised beds; this system has been developed to suit my individual requirements. This booklet is intended to introduce the concept of Intensive Raised Bed Gardening to vegetable growers; it is then up to you to experiment and modify the system if necessary, to suit your own conditions and requirements.

# WHY USE THE INTENSIVE RAISED BED METHOD?

- 1. Higher yields from less space:** Today more and more people are gardening in less and less space. The Intensive Raised Bed system packs many more crops into a small area than a conventional system could, giving higher yields for the space used, even when the area of paths is taken into account.
- 2. Waste less time and energy:** In a conventional garden system, the whole vegetable garden is dug over manured/fertilised and then only part of it used to grow plants in — the rest is wasted space between rows which only grows weeds. The space between the rows is often used as a pathway — this is a waste of digging. With the bed system only the growing bed is dug and matured; this is then intensively planted. The paths are not. Because the growing area is never walked on and compacted after the beds have been established, digging in subsequent years is relatively easy.
- 3. More control over crop size:** When the beds are sown/planted all the plants of one crop are equidistant from each other. In many cases if this distance is increased (within limits) the maximum size of the individual plants will increase; if the spacing is decreased, the size of the individuals will decrease. Some people like small onions for example, others larger ones, this system can suit both by varying the distance to meet the needs of you and your family.
- 4. Less work:** Once the beds are prepared, there is less maintenance work required. Only the bed area needs to be looked after, and very often weeds are smothered out by the closely spaced crop plants. Any weeds that do get through are easy to remove from the uncompacted soil. As the ground is never walked on and compacted all that may be required between crops is to fork the area over.
- 5. Earlier cropping:** Because the paths are permanent and the beds are not walked on this can mean that you can get on to the garden to start work early in the spring without worrying about compacting the soil by walking on it. The looser soil of the raised bed should also mean that it will be better drained and warm up more quickly in the spring. As the plants are closely spaced, growth of each one is limited, so crops may also finish earlier.
- 6. No more muddy wellies:** If the paths between the beds are well made, it should be possible to go out and sow, plant, weed and harvest without getting wet or muddy feet.



# PLANNING AN INTENSIVE RAISED BED GARDEN

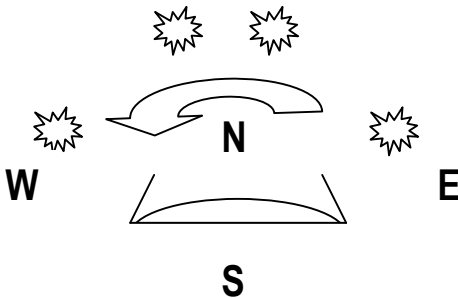
If you are establishing a new vegetable garden, or converting an existing one to the Raised Bed system, it is advisable to do some planning before you start. You will have to consider location and orientation of the beds and their dimensions — which will depend partly on the space available and partly on the cropping plan that you decide on. You will also have to decide on the width of the paths and what they are to be made of. Some advice on making these decisions is given below.

## Location

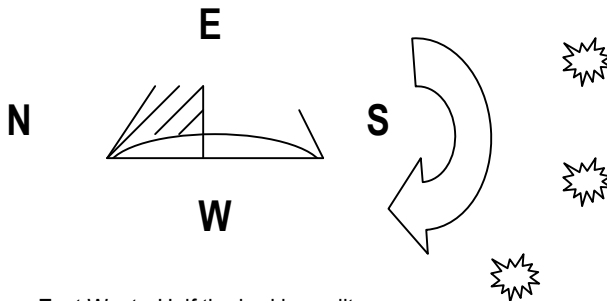
It is not always possible to choose an ideal location for the vegetable patch, especially in a small garden; if possible however it should be open to as much sun and light as possible and not too close to trees and hedges (whose roots will be taking goodness from the soil). For the majority of crops some shelter from the prevailing wind is also beneficial.

## Orientation

Ideally the beds should run with the long axis north/south, so that both sides of the bed get equal amounts of sunshine. It may not be possible to have them exactly north/south.



*North south - All the bed receives sunshine.*



*East West - Half the bed is sunlit*

## Bed size

As the beds are never walked on it is necessary to work from the surrounding paths. This means the bed must be of a width to allow you to reach the middle comfortably from the path; 1.2m is a usual width though 1.4m is possible (up to just over 4 feet) if you are taller and have longer arms. Any wider than this and it becomes very uncomfortable working the middle of the bed for any length of time. Narrower beds are possible but this increases the ratio of path to bed, making less use of the available space.

In theory the beds can be as long as you like, but it is often easier to manage the Cropping with more, smaller beds, than fewer larger ones. This is something you will have to decide while you are working out the cropping plan. Another factor to consider is that you should always walk round a bed to get to the other side. If the bed is too long it is very tempting to step across it, which invariably means that the soil is stepped on. Long beds also mean that it is further to carry manure, compost, etc., from the main paths at either end unless you pair up the beds as suggested below.

## Paths

The width of the path between the beds will depend on how much space you have to spare, how near the beds you will need to bring a wheelbarrow, and on how big your feet are! The minimum path width between the beds is really 450mm with wider paths on one or both ends to allow a barrow to be brought close. If you have larger feet a slightly wider path should be considered to prevent the edges of the beds being trampled. If space is not at a premium, it is more convenient to 'pair up' the beds, having a narrow path between them and a wider path between pairs so that a barrow can be taken the length of a bed, on one side anyway.

The paths can be made of sawdust wood shavings, concrete, bricks, strips of carpet or just plain earth kept weed free. If your land is stony, stones can be removed from the beds and used to provide an all weather surface for the paths. It is not really advisable to have grass paths as the grass will compete with the crops at least 150mm into the bed, and can reduce crop yields.

## Cropping -

Planning the layout of the crops in an Intensive Raised Bed garden requires some thought, especially if you have not used this system of growing before. A rough out-line at least should be decided on before you settle finally the site and number of beds to be made.

Ideally it is best to sow and plant up a whole bed at the same time; it is also best to completely empty each bed once a year so that it can be re-dug and shaped as necessary. This may mean small re-organising your normal way of cropping.

Firstly, work out approximately how much of each crop you require (either in number of plants or length of row) and calculate the area of bed that this will require (using the information given in the 'Crop by crop section'). If you grow a large amount of any crop, such as potatoes, the layout is simple; that crop is given a whole bed (or beds) to itself. Where there are going to be several crops in one bed, try and group together those to be sown/planted/harvested at the same time of year. You could, for example, have 'early spring' sown beds, 'late spring' sown beds, a winter

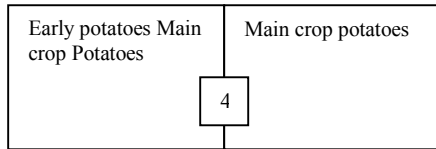
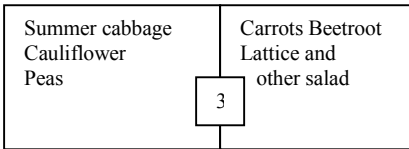
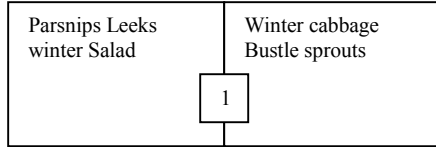
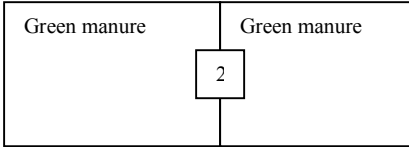
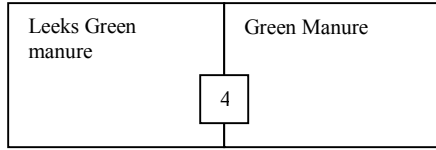
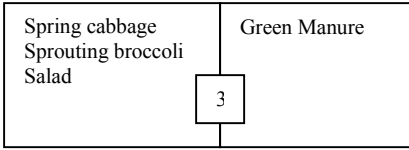
cropping bed and 'after the last frost' beds. By juggling around the crops to follow on it is usually possible to empty each bed completely once in the season; this does not have to be in the autumn or in the spring necessarily. For example, the early sown bed(s) would include parsnips, which are left in over-winter, so the rest of that bed can be used for other over-wintering crops such as winter cabbage, sprouts etc. This would then be empty for re-digging in the late spring of the following year.

As you juggle crops around you should begin to see the size that the beds will need to be to suit your situation. They should really all be the same size, so that when crop rotation is practised there is room for each set of crops on every bed. It is not easy to use a conventional 3 or 4 course rotation with this particular system unless you grow large amounts of each type of vegetable. One can, however, follow the principals of the rotation; such as by not growing brassicas or potatoes on the same bed more than once in three or four years. This is to prevent the build up of clubroot (of Brassicas) and eelworm (of potatoes) in the soil. Remember also that if you lime the cabbage beds, potatoes should not be grown there for a couple of years.

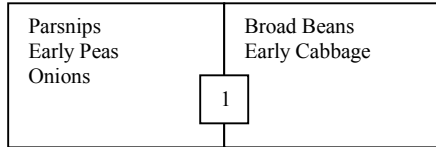
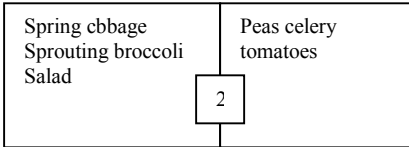
When planning the layout of the crops on an individual bed, try and always put the taller crops at the north end of the bed to avoid shading the shorter ones. Do not put less vigorous (such as onions) next to more vigorous ones (such as carrots) or the one will smother the other and reduce the yields at the edges of the block. Either put the same sort of crops next to each other, or leave adequate space between them. If it seems clear that you may want to dig a bed before it is empty (which may be the case when over-wintering crops such as leeks or spring cabbage are involved) put term crops at other end of the bed, or digging will be impossible.

An example of a cropping system on Intensive Raised Beds is given on the following page. There are 8 raised beds, each 1.2m x 3m through they treated in some crops as if they were four beds of 1.2m x 6m. Remember that this is only one example and that you will have your own requirements and come up with a different plan. Don't worry if you don't get it right at first, it is much easier to see what will work and what won't once you get started. It will be better next year.

You may provide one bed with permanent supports for soft fruit and/or climbing beans, cucumbers etc. If so this bed should be dug each winter and large quantities of manure or compost added to ensure the roots are kept moist during the following summer and well fed.



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### One Example of a Cropping Plan for four intense raised beds

1. The crops move on one bed each year in a clockwise direction.
2. If clubroot is a problem each bed can be divided along the middle to make 8 separate small beds. In this case the rotation is exactly as before (the crops from two half beds staying together), but after 4 years the crops change ends.

# PREPARING THE BEDS

## First season

It was motioned earlier that Intensive Raised Beds are raised partly as a result of 'double digging'. This process is not always essential but it is a good initial soil preparation, making sure that there is not a 'pan' preventing adequate drainage for rooting; it also helps to remove the more pernicious weeds. If you feel, however, that your soil is already adequately dug, move on to the next section. ('Subsequent Seasons'). If your soil is shallow and sitting on a stony or chalky subsoil it is not a good idea to double dig as this will bring the stones/chalk to the surface and plants don't grow in stones.

In the first season then, mark out the area of each bed with sticks and string, making sure it is 'square', and then (double) dig each one as outlined below. 'Double digging' means that the soil is disturbed two spits (spade depths) deep. If your soil is very compacted it may be impossible to dig that deep the first season; in that case just as deep as possible, increasing the depth each season. This is the one time when you will have to walk on the bed, so to minimise compaction it is advisable to stand on a board or similar while you are digging.

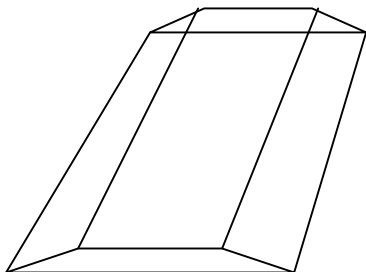
*Note:* If the 'topsoil' is shallow and you come across a layer of stones or clay do not mix that material with the topsoil.

## Double Digging

1. Dig a trench one spit wide and one spit deep; put the soil into a wheelbarrow.
2. Stick a fork into the soil of the 'second spit' below, and move it backwards and forwards to loosen the soil; do this across the width of the bed.
3. Dig-out the next top spit, placing the soil in the first trench. If the soil changes colour in the depth of the first spit be very careful to keep the layers the right way up. This can take practice. Make sure you dig right to the edge of each bed.
4. Loosen the soil of the second spit with a fork as above.
5. Repeat 2 and 3 to the end of the bed. Here you will find you have an empty trench; this is filled with the soil from the first trench, which was put in the wheelbarrow.

After digging, rake the bed to form a shallow mound. The sides of the mound should not be too

'steep' or else erosion will occur. If the mound is rather high, as a rest of double digging a heavy soil for example, shape the bed into a squarer mound with a flat top. Rake the soil to give a fine tilth and plant as soon as possible. After digging you may find the bed is higher at one end than the other; in this case rake some soil back to the lower end before finally shaping the mound. Depending upon your soil type, each bed need only be double digging once. After crops are harvested and before new ones are planted during the year the bed need only be lightly forked and raked back into shape.



# CROPS

## BRUSSLES SPROUTS



*The plants will need staking to keep them up'*



If they are planted too close together you will get lots of plant but very few sprouts. A minimum spacing of 500mm (20in) should give a good crop, with the sprouts tending to be ready to pick all at the same time, which can be ideal if you want to freeze them. A wider spacing of 610mm to 750mm (30in) should give a longer cropping season. The plants are raised in a greenhouse or in a seed bed elsewhere and planted out when the land is available. It is advisable to press down the soil well round the plants and also to stake them if the soil is light to prevent them rocking in the wind, as this can cause the sprouts to 'blow'. The Brussels can be interplanted with lettuce, for example, to use up the space.

## CABBAGE.

### Spring Varieties

Plants should be raised in a seedbed or boxes and planted out as usual. They can't be spaced at 225 or 300mm and gradually thinned for eating so that the later ones end up at 300mm. As the crop over-winters it should go in an over-wintering bed, or at least be planted at the end of a bed so that it does not get in the way when preparing the bed for planting the following spring.

## **CABBAGE (continued)**

### **Summer Varieties**

These can be grown at a wide range of spacings, depending on the size of cabbage that you require. A spacing of 250 — 300mm (10in — 12in) will give small heads of any variety and there are also specific varieties such as Hispi and Minicole which are designed to grow at such spacings. For larger heads, plant out at 450mm (18in).

### **Autumn and Winter Varieties**

Plant out at 450 — 600mm (18in — 24in) each way.

## **CARROTS**

These are ideal crop to grow on the bed system; they appreciate the deeply dug soil and give a very good foliage cover that smothers the majority of weeds.

### **Early Carrots**

These can be sown from February onwards, sprinkled as thinly as possible in wide drills. They can then be pulled from pencil size onward, leaving some to grow larger. To get the quickest crop of decent-sized early carrots, though, they should be given plenty of space to grow, sown at 125mm (5in) spacing. The easiest way of doing this is either to sow a pinch of seed every 125mm, or to sow rows 125 mm apart across the bed and then thin to 125mm within the row as soon as the seedlings are big enough.

### **Maincrop Carrots**

These can be sown from March onwards, waiting late May early June to sow for storage. Spacing should be about 75 — 100mm each way. The seed can be sown as above either station sown at required spacing, or in rows and thinned to the right distance.

## **CELERY**

Self blanching celery is the easiest to grow and it is usually recommended that this be grown in blocks anyway as this aids the blanching. Plants should be raised indoors, preferably in peat blocks or divided polystyrene trays, and kept growing steadily; any check to growth will encourage bolting. Plant out after the danger of frost is past, into a well matured soil, at 250mm (10in) spacing. Keep the plants well watered especially immediately after transplanting.

## **CHINESE CABBAGE.**

This crop is usually sown directly where it is to grow. However, plants can be transplanted when small if raised in peat blocks or small pots. If the roots are disturbed at transplanting the plants will tend to bolt. Some varieties can be sown in the spring; others are only suitable for growing when the day length is shortening (after mid-summer), otherwise they will bolt. The final spacing should be 225 - 300mm (9in — 12in). Chinese cabbage is best grown quickly with no check to growth, so it must always be adequately supplied with water. The addition of organic matter to the soil, either dug in and/or as a surface mulch, which helps water retention in the soil, will benefit the crop. Otherwise regular watering is essential in dry periods.

## **COURGETTES, MARROWS AND CUCUMBERS (Outdoor)**

These crops appreciate a well dug and manured soil. It is best to choose bush varieties of courgette and marrow so that one plant does not take over the bed, and to pinch out the tips of cucumbers if they trail too far. These crops would be best grouped together on one bed, or sharing with another vigorous crops. Raise seedlings in pots indoors or in the greenhouse and plant out at 600mm (24in) spacing. Alternatively, once the soil has warmed up (in early May or later) sow direct at 600mm with two or three seeds per 'station'. Cover with a cloche or polythene sheet to encourage germination and thin to one seedling.

## **FRENCH BEANS**

### **Dwarf varieties for eating fresh**

These beans can be sown as close as 100mm (4in) for the highest theoretical yields. Unfortunately this tends to make the plants tall and straggly so that they fall over. This makes harvesting difficult unless you use a yellow-podded variety (whose pods are easily seen), and also creates a perfect environment for slugs and snail. A spacing of 225mm (9in) or even 300mm (12in) is much more practical. The seed should not be sown until late April/early May (at the earliest) as it will not germinate well in a cold soil. Cover with polythene or a cloche to aid germination. Alternatively, raise plants in peat pots in frame or greenhouse for transplanting after the last frost.

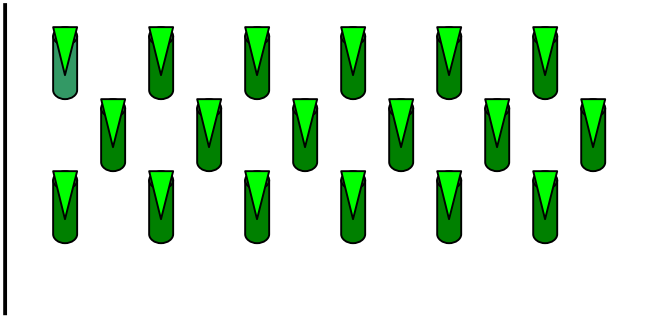
**Tip** – Grow dwarf French beans in a block through horizontal netting supported 225mm (9in) above the ground to provide support.

### **Dwarf varieties for eating dry**

There are many varieties suitable such as Purley King, Chevrier vert, Brown Dutch. The plants for producing dry-beans should not be picked fresh at all, to give the pods the maximum drying time. They can be sown once the soil has warmed up at 100mm (4in) spacing and then supported by a piece of wire netting stretched horizontally over the bed, about 225 mm (9in) above the ground. When the pods are dry the whole thing is removed and the plants pulled out of the netting. This could be done with beans for eating fresh but it would make picking more difficult. If the pods are not fully dry the netting and plants can be hung up together to finish drying.

## **LEEKs**

Leeks can be sown from March to May, being planted out to final positions from June to early August. As they over-winter well it is advisable to plant them out on an 'over-wintering' bed. The ultimate size of the leek depends on size at transplanting, the spacing, and the nutrient status of the soil. Planting out large plants into well-manured soil (into dibber holes as usual) at a spacing of 225mm (9in) will give highest yields. The closest spacing recommended is 75mm (3in), which does give a lot of leek, but each individual is very thin and obviously many more plants are required. As always vary the spacing to suit your requirements.



*'plant leaks into dibber holes'*

## LETTUCE

### Heading Lettuce

This is traditional lettuce with a heart. These should be planted out at a spacing of 225mm (9in) or sown in rows 225mm apart and gradually thinned to 225mm in the row.

### Leaf Lettuce

This is a loose-leaf lettuce, which does not form a solid heart. Individual leaves can be picked as required, and the plant left to grow on. Sow/plant as for heading lettuce.

### Cut and Come Again Lettuce

This is a method of growing lettuce, which is well suited to the bed system, giving high yields from a small area. The lettuce is sown in rows 125mm (5in) apart with approximately 25mm (1in) between seeds, and the plants are not thinned. This encourages formation of leaves rather than hearts. As soon as the plants are tall enough to harvest (in 4-7 weeks), the leaves can be cut for eating, leaving a 25 mm (1in) stump. The stumps are watered well and left to re-grow another crop of leaves, which can be cut again later. This type of lettuce can be sown through the season from mid April to the end of August to give a supply of leaf lettuce from mid May to October, much more quickly than a conventional heading lettuce. Avon Crisp, Valmaine, Lobjoits Cos and Paris White Cos are suitable varieties or growing by this method; others may be bitter at the young stage at which they are harvested.

## MIXED SALAD

This is a relatively new introduction into the country from Europe. Seed is sown broadcast from early spring. A range of salad plants come up — usually including rocket, lettuce, purslane, chicory and others; these can be cut to give an instant mixed salad, and some will regrow. Some plants die out early and others appear to take their place, surviving the winter and ready to grow the next spring.

## **ONIONS**

### **Spring Salad Onions**

These make a good 'intercrop' between rows, of widely spaced crops such as cabbage, tomatoes and broad beans. They can also be sown in a wide drill across the bed at about 2.5mm (1in) and picked as required.

### **Bulb Onions**

These can be grown from sets or plants, planted out in the spring. A spacing of 100mm (4in) will give high yields of medium sized onions; increase the spacing up to 225mm (9in) to give large individual bulbs. The only problem with the 100mm spacing is that it seems to make the plants more likely to be infected by mildew, presumably because there is less air movement around them. If this is a problem on your plot increase the spacing to 150mm (1½in).

## **PARSNIPS**

Another crop where spacing easily controls the size of the individual plant. Station sow (3 seeds/station) when the soil has warmed up slightly, as the seed is very slow to germinate. Spacing of 75 - 150mm (3in - 6in) can be used, depending on the size of root you require and the fertility of the soil.

**Tip:** If you have difficulty getting parsnip to germinate try chitting the seed on wet paper towel in a sealed plastic container (a sandwich box is ideal). Chitted seeds should be transplanted into a seed tray filled with seed compost as soon as signs of growth are seen and then into the growing position as soon as they are big enough to handle.

## **PEAS**

### **Early Dwarf Varieties**

These can be sown in a block spaced at 75mm (3in) and grown without support, as they only grow 300-450mm (12in - 17in) high.

**Tip:** If pea moth is a problem in your area growing early peas will minimise attacks.

Also - growing short rows across the bed will enable you to stagger the crop and prevent a glut which can occur when long rows are planted at the same time.

### **Maincrop Varieties**

These generally need some kind of support, so sow them in triple rows across the bed, at 100mm (4in) spacing, with 300 - 450mm (12 - 18in) between the triple rows. These peas do not really suit the bed system well; much better are the so called 'leafless or semi leafless varieties such as Bikini and Eaton. These are mainly stem and tendrils with leaves very much reduced; sown in a block they support themselves well and the lack of leaves means that air and light penetrate the block. They are easier to harvest and do not provide perches for birds.

## POTATOES

It is a good idea to devote a whole bed (or several whole beds) to potatoes as the foliage is luxuriant and can quickly smother neighbouring crops/weeds. The bed should be well manured and the chatted tubers planted out at a spacing of 225mm (9in) for early varieties, and 300mm (12in) for maincrop varieties, in trowel holes 150mm (6in) deep.

The shoots emerge very quickly through the light, well-dug soil, so make sure that they are not damaged by the frost; either plant a little later than usual or cover the early shoots with straw, leaves or horticultural fleece if frost is likely. The plants also grow extremely quickly with foliage soon covering the whole bed, it may be necessary to weed the crop once but the luxuriant foliage should suppress any subsequent weeds. At such close spacing earthing up is not possible, but there does not seem to be a problem with green tubers. When the plants are so close each produces fewer tubers than usual there is not the usual over-crowding that forces some tubers to the surface where they go green in the light. The close spacing also makes the haulms much taller than normal and they tend to flop over, and will overwhelm neighbouring beds if nothing is done. The foliage can be pruned to certain extent and/or tied back with strings all round the bed. The potatoes use large quantities of water, so increase water-holding capacity of the soil with organic matter and if necessary water in dry periods. The earlier start and the close spacing, which limits growth of individual plants, means that the crop can finish a week or two earlier than a conventionally sown. Yields/sq m can be increased appreciably. Unfortunately the higher yields are only obtained at the expense of many more seed potatoes than conventionally sown. In order to maintain crop and reduce the cost it is possible to cut tubers over 60g (2oz) in weight lengthways (making sure there are sprouts on both halves) just before planting the seed potato. This practice is not always recommended as they may fail because of disease; this should not be a problem if you are using healthy large tubers and anyway at such close spacing loss of one or two should not be a problem. It is not a good idea to cut early potatoes if you want them early, as they rely on the food reserve in the tubers for fast early growth. Care should be taken at harvesting to ensure that the tubers are not damaged.

The bed system is ideal for growing under black plastic, which will reduce water loss, smother early weeds and prevent any greening of the tubers. However, this also provides an ideal environment for slugs and snails and therefore it is recommended that anti slug treatment is applied before the black plastic is installed.

# Appendix 1

## Plant Spacing

Conventional kitchen gardens plant out in rows. However, deep bed growing offers the opportunity for more intensive planting. The advantages are that it is possible to:

- Maximize the yield by optimizing the size (wide spacing) with intensity (close spacing).
- Control the size of plants to meet individual needs – if you have a small family then many smaller cabbages may be more useful than fewer larger plants.

## Plant spacing Table – Vegetable Planting Guide

	Germination temperature (°C)			Planting / (inches)		Days to germination	Typical days to harvest	Age of transplant (weeks)
	min	ideal	max.	spacing <sup>2</sup>	depth			
Beets	7°	27°	32°	4-6"	¾-1"	7-10	60	
Bean broad								
Beans climbing				6-12"				
Beans French				4-6"				
Beetroot				2-4"				
Broccoli <sup>4</sup>	7°	27°	32°	12-18"	½"	3-10	65T <sup>4</sup>	5-7
Brussels sprouts				15-18"				
Cabbage <sup>4</sup>	7°	27°	32°	15-18"	½"	3-10	85T <sup>4</sup>	5-7
Cabbage Chinese				10-12"				
Carrots	7°	27°	32°	2-3"	¼"	10-17	70	
Cauliflower <sup>4</sup>	7°	27°	32°	15-18"	½"	3-10	65T <sup>4</sup>	5-7
Endive				15-18"				
Kale				15-18"				
Kohlrabi	7°	27°	32°	6-9"	½"	3-10	50	
Leeks	7°	27°	32°	3-6"	¼"	3-	120	
Lettuce (leaf)	1.66°	21°	21°	7-9"	¼"	4-10	60	
Lettuce	1.66°	21°	21°	10-12"				

(head)								
Onion spring	1.6°	27°	32°	2-3"	¼"	7-12	60	
<b>Plant spacing table - continued</b>								
	germination temperature <sup>1</sup>			planting		days to germination	typical days to harvest	Age of transplant (weeks)
	min	ideal	max	spacing <sup>2</sup>	depth			
Onions seed sets	1.6°	27°	32°	4-6" 4-6"	¼" 1-2"	7-12	110	
Parsnips	1.6°	21°	32°	5-6"	½"	15-25	170	
Peas	4.5°	21°	27°	4-6" or 3" x 8"	1"	6-15	65	
Potatoes	7°			10-15"	4-6"		125	
Radish	4.5°	27°	32°	2-3/2"	½"	3-10	30	
Spinach	4.5°	21°	21°	4-6"	½"	6-14	40	
Swiss Chard	4.5°	30°	1.6°	7-9"	1"	7-10	60	
Turnips	4.5°	27°	37.7°	4-6"	½"	3-10	50	
Cantaloupe <sup>5</sup>	15.6°	32°	37.7°	36-48"	1-1½"	3-12	85	2-3 <sup>5</sup>
Sweet Corn	10°	27°	37.7°	12" x 30" 9" x 36"	1-1½"	5-10	60-90	
Cucumbers	15.6°	32°	37.7°	6" trellised 24-36" untrellised	1"	6-10	55	2-3 <sup>5</sup>
Eggplant / Aubergine	15.6°	27°	32°	18-24"		7-14	60T <sup>6</sup>	6-9
Pepper	15.6°	27°	32°	12--18"		12-20	70T <sup>6</sup>	6-8
Tomato	10°	27°	37.7°	trellised: 18-24" between plants		6-14	65T <sup>6</sup>	5-7
Squash, Summer	15.6°	0°	37.7°	36-48"	1-1½"	3-12	50	2-3 <sup>5</sup>
Squash, Winter	15.6°	0°	37.7°	36-48"	1-1½"	6-10	100	2-3 <sup>5</sup>
Watermelons	15.6°	0°	110°	36-48"	1-1½"	3-12	85	2-3 <sup>5</sup>

1. **Germination temperature** – Soil temperature is one of the best methods to determine spring planting time. Plant when soils reach minimum temperature measured at 8 a.m., 4 inches deep. Beans are an exception, being measured at 6 inches deep. Optimum temperatures listed in the table are useful for starting seeds indoors. Maximum temperatures are listed in regards to high soil temperatures that may interfere with seed germination in the summer.
2. **Plant Spacing** – Spacing given are equal-distance spacing for crops grown in block or deep beds. For example, beetroot, with a spacing of 6” are thinned to 6” between plants in all directions. In other words, beets are thinned to 6” between beets in the row and 6” between rows. The closer spacing listed should be used only on improved soils with 4-5% organic matter or where smaller plants are required.  
Close-row or block style planting works well for raised bed gardening, with blocks/beds 4 feet wide (any length desired) and 2 foot wide walkways between blocks/beds.
3. **Cool Season Crops** – Cool season crops prefer a cool soil. Lawn newspaper covered with lawn clipping make an excellent mulch for these crops by cooling the soil, preventing weed germination and conserving water. Apply fresh grass clippings only in thin layers (less than ½”) and allow it to dry between applications. Thick layers will mat and smell. Do not use clipping from lawns treated with weed killers or other pesticides. Several layers of newspapers covered with grass clippings also work well between rows. Do not use glossy print materials.
4. **Transplanted Brassicas** – Since brassicas (cabbage, cauliflower, broccoli, and Brussels sprouts) germinate better in warmer soil, they are typically started from transplants in the spring. Days to harvest are from transplants. In the warmer areas, these crops produce the best quality when direct seeded mid summer for harvest during autumn. Before planting out, harden off seedlings.
5. **Transplanting Vine Crops** – Vine crop (cucumbers, squash, melons, courgettes) roots are extremely intolerant of being disturbed, and perform best when grown by direct seeding rather than by transplants. With the use of black plastic to warm the soil, direct seeded crops germinate rapidly. If using transplants, select small, young plants, not more than 2-3 weeks from seeding.
6. **Tomato family transplants** – The tomato family is traditionally planted from transplants. In warmer areas, they can also be direct seeded with minimal delay. Days to harvest are from transplants.

# Appendix 2

## Conversion - Approximate metric to imperial distances

13mm	½ inch
25mm	1 inch
35mm	1½ inches
100mm	4 inches
150 mm	6 inches
230mm	9 inches
300mm	12 inches
910mm	36 inches
1000mm	39 inches
1220mm	48 inches

