Technical Note TN655

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Fertiliser recommendations for soft fruit and rhubarb crops

SUMMARY

- Soft fruit crops have a high potential value.
- Production costs are also high, with fertilisers accounting for a very small percentage of variable costs.
- Fertilisers should be applied at rates that are likely to result in the maximum yield of crops of acceptable quality, whilst ensuring protection of the surrounding environment.
- Nitrogen (N) recommendations for these crops have been updated in the light of results from recent trials and advisory experience.
- Tables that take account of N released from previous crop residues, grass leys and N available from reserves in different soil types have been updated.
- The recommendations are those that give the best financial return for the farmer/grower. Adoption of the recommendations is consistent with the new NVZ Action Programme rules and Nmax and will minimise losses of N to the environment.

A. Lime and nutrient recommendations for crop establishment

Soft fruit crops tend to be in the ground for several years. It is therefore very important to address problems of soil acidity and nutrient deficiency before planting, since it will be much more difficult to do so once crops have been planted. For this reason, analysis of the soil is recommended well before planting, in order to make accurate assessments of the requirements for lime, phosphorus (P), potassium (K) and magnesium (Mg). It may also be worth testing for sulphur (S) and trace elements, particularly where there has been a history of deficiencies of these elements. Further soil analysis is recommended at least every 2 years once the crop has begun fruiting.

A1. Liming before crop establishment

Most fruit crops are tolerant of slight acidity and grow best at pH values of 6.0 – 6.5. Blackcurrants are less tolerant of soil acidity and pH values of at least 6.5 should be maintained. Blueberries are unusual, in that they require soil pH values of between 4.5 and 5.5. Because it will be impossible to correct any acidity at depth once fruit crops have been planted, the quantity of lime applied should be calculated so that it will correct the pH of the top 40 cm of soil.

Acid soils deficient in Mg may be limed with magnesian limestone before planting. Be aware that over-application of Mg can reduce the availability of soil K. Where soil Mg levels are satisfactory, ground limestone or ground chalk should be used.

A2. Nitrogen recommendations for new crops

In order to assess the N fertiliser requirements during the establishment phase for each crop, the following factors need to be taken into account:

Stage A2a:	Assessment of soil type	Table 1
Stage A2b:	Assessment of N residues (taking account of the previous crop or previous grass/clover management)	Tables 2 and 3
Stage A2c:	Crop to be grown	Table 4
Stage A2d:	Adjustments for variety/production practices and Spring/Summer rainfall	
Stage A2e:	Adjustments for soil type	Table 5
Stage A2f:	Adjustments for Winter rainfall	Table 6
Stage A2g:	Adjustments following applications of bulky organic manures	

Adjustments to the standard fertiliser recommendations given for each crop (taking into account the previous crop or previous grass/clover management) should be made by following stages A2b to A2e as described in this Technical Note. Specialist guidance may be needed when making decisions for specific crops.

Stage A2a. Assessment of soil type

N residues from soil reserves have been arranged into six soil types (Table 1). "Shallow" means any mineral soil with less than 40 cm depth between the soil surface and the underground rock. Types of mineral soils can be identified by hand texturing. Take about a dessertspoon of soil. If dry, wet it gradually, kneading thoroughly between finger and thumb until aggregates are broken down. Enough moisture is needed to hold the soil together and for the soil to exhibit its maximum cohesion. There are two questions to be answered.

Question 1: Is it difficult to roll the moist soil into a ball?
Answer: YES, then the soil type is "Sand";
NO, then ask the second question.

Question 2: Does the moist soil feel smooth and silky as well as gritty?
Answer: NO, then the soil type is "Sandy loam";
YES, then the soil type is "Other mineral soil".

"Humose soils" and "Peaty soils" are identified by percent organic matter. They are characterised by a dark colour with a high organic matter content which can be confirmed by laboratory analysis.

Where more than one soil type occurs within a field, it may be practical to alter the rate of fertiliser N to suit the different soil types. If this is impractical, and the field is to be treated uniformly, you should select the soil type that covers the largest part of the field. In mineral soils of low organic matter content, the amount of available N residues is relatively small.

Table 1. Description of soil types

Shallow soils (SS)	All mineral soils which are less than 40cm deep.
Sands (S)	Soils which are sand and loamy sand textures to a depth of more than 40cm.
Sandy loams (SL)	Soils which are sandy loam texture to a depth of more than 40cm.
Other mineral soils (OMS)	Soils with less than 15 percent organic matter that do not fall into the sandy or shallow soil category, i.e. silty and clay soils.
Humose soils (HS)	Soils with between 15 and 35 percent organic matter. These soils are darker in colour, stain the fingers black or grey, and have a silky feel.
Peaty soils (PS)	Soils that contain more than 35 percent organic matter.

Stage A2b. Assessment of N residues (taking account of the previous crop or previous grass/clover management)

The amount of fertiliser N that should be applied to any fruit crop in its first year will depend on the previous crop or grass/clover management in the field in which the crop is to be grown. Details of how to allocate the correct "Previous crop/grass nitrogen residue group" to the field are given in Tables 2 and 3.

N residues from previous crops

Where crops other than grass have been grown prior to the fruit crop, these have been allocated into one of five previous crop groups. These groups are numbered 1 to 5 in ascending order of residual N in the soil, following harvest of the previous crop (Table 2). Residual available N in the soil following harvest will vary depending on the crop type grown. Residues following cereals are generally lower than those following leafy crops, potatoes and legumes. The management and performance of the previous crop can have a significant effect on the level of N residues. Residues are expected to be lower in a high-yielding season, or where N application has been less than normal, but may be higher than average if the crop has performed badly as a result of problems such as disease or drought. In the tables of N recommendations in this Note, it is assumed that all previous crops have been managed well and that previous N fertiliser use has been close to the recommended rate, taking into account of any use of organic manures. In Group 5, N residues can be very variable. In this group, analysis of the crop debris for total N and C content along with an estimate of the quantity ploughed down is recommended in order to help predict release of available N for the next crop. Soil mineral N (SMN) testing may also give an indication of the amount of residual available N present.

Table 2. Previous crop groups in ascending order of residual available N in the soil following harvest

Group	Previous crop
1	spring barley, spring oats, spring rye, spring wheat, winter barley, winter oats, winter rye, winter wheat, triticale, carrots, shopping swedes, turnips (human consumption), linseed, courgette, onions, asparagus, beetroot (red baby, other), radish, narcissus, tulip, swedes/turnips (stockfeed), parsnips, ryegrass (seeds)
2	harvested fodder (whole crop), forage maize, forage rape, kale cut, winter oilseed rape, spring oilseed rape, hemp, vining peas, potatoes (<60 days, seed and punnets), potatoes (60-90 days, seed and punnets), potatoes (60-90 days, ware), potatoes (90-120 days), potatoes (>120 days), blackberries, loganberries, blackcurrants, redcurrants, blueberries, tayberries
3	harvested fodder (root only), beans (broad), beans (dwarf/runner), beans (field vining), combining peas and whole-crop lupins, leek, rhubarb, strawberries (both types), raspberries, uncropped land
4	grain lupins, lettuce
5*	leafy brassica vegetables, leafy non-brassica vegetables, grazed fodder, turnips grazed, brussels sprouts, cabbage (all types), calabrese (broccoli), cauliflower, kale grazed

*N residues can be variable in this group. Analysis of the crop debris for total N and C content prior to ploughing down is recommended in order to help predict release of available N for the next crop.

N residues from previous grass/clover swards

Nitrogen fertiliser and manure use in the last 2 years of grassland management, and grazing management during the months immediately prior to ploughing out grassland will have a significant effect on the level of N residues. Management of the previous grass/clover sward have been allocated into one of five Groups. These Groups are numbered 2 to 6 in ascending order of residual available N in the soil following ploughing out of the grassland (Table 3). Groups 2 to 5 have the same N residues as Groups 2 to 5 in the Previous Crop Groups (Table 2), whereas Group 6 has a higher residue of available N. N residues can be very variable in Groups 5 and 6. In these groups, analysis of the sward for total N and C content, along with an estimate of the total quantity of the sward ploughed down is recommended in order to help predict release of available N for the next crop. Soil mineral N (SMN) testing may also give an indication of the amount of residual available N present.

Table 3. Previous grass/clover groups in ascending order of residual available N in the soil following ploughing out

Group	Previous grass/clover management
2	1 – 2 year low N[1] leys and not grazed within 2 months of ploughing
3	1 – 2 year low N leys and grazed within 2 months of ploughing 1 – 2 year high N leys and not grazed within 2 months of ploughing Thin, permanent grass, low N, no clover
4	1 – 2 year high N leys and grazed within 2 months of ploughing 3 – 5 year low N leys and not grazed within 2 months of ploughing Thick, permanent grass, low N
5[2]	3 – 5 year high N leys and not grazed within 2 months of ploughing 3 – 5 year low N leys and grazed within 2 months of ploughing Permanent grass, high N, not grazed within 2 months of ploughing
6[2]	3 – 5 year high N leys and grazed within 2 months of ploughing Permanent grass, high N, grazed within 2 months of ploughing

[1]Low N means less than 150 kg/ha/yr fertiliser N used on average in last 2 years.
High N means more than 150 kg/ha/yr fertiliser N used on average in last 2 years or high clover content.
[2]N residues can be variable in these groups. Analysis of the sward for total N and C content prior to ploughing out is recommended in order to help predict release of available N for the next crop.

Stage A2c. Crop to be grown

The N recommendations for each of the main soft fruit crops grown in Scotland are listed in Table 4. The required N can be applied wholly as manufactured fertiliser, although some may be derived from bulky organic manures and from soil reserves.

Table 4. Nitrogen recommendations[1] (kg/ha) for soft fruit and rhubarb crops (establishment year)

Crop	Previous crop or grass/clover group[2]					
	1[2]	**2**	**3**	**4**	**5**	**6**
Strawberries (main season)	40	30	20	0	0	0
Strawberries (everbearers)	80	60	50	30	10	0
Rhubarb	160	150	140	120	80	40
All other soft fruit crops	0	0	0	0	0	0

[1]N application can be made at planting or split between planting (Spring) and early Summer.
[2]For full descriptions of previous crop groups and previous grass/clover groups, see Tables 2 and 3.

Stage A2d. Adjustments for variety, production practices and Spring/Summer rainfall

Adjustments to the N recommendations given in Table 4 may have to be made for different crop varieties in order to optimise early crop growth, crop quality and economic performance.

Where crops are grown under protection for all or part of the season (e.g. in Spanish tunnels), it may be possible to reduce the N application.

Some N may be lost from the soil profile between first (prior to planting) and second (early summer) N dressings. The amount lost will depend on the amount of rain that falls once the soil is already at water-holding capacity, the crop cover and rooting depth. It may only be necessary to make an adjustment for shallow-rooted crops.

Leaf analysis should be used to determine whether crops are receiving sufficient N for optimal yields of quality fruit (see Section E). Specialist guidance may be needed when deciding on N fertiliser application rates in relation to any of the factors discussed above.

Stage A2e. Adjustments for soil type

The standard N recommendations in Table 4 are for crops grown in sandy loams, other mineral soils, humose and peaty soils. For crops grown in sands and shallow soils, the N recommendation should be increased by 10% (Table 5).

Table 5. Adjustment to standard N recommendation for different soil types

	Soil type	
Crop	**Sands and shallow soils**	**All other types**
All fruit crops	Add 10%	No change

Stage A2f. Adjustments for Winter rainfall

The drier the Winter and the greater the soil capacity to hold water, the smaller the proportion of N from crop residues that will be washed out of the soil before crop growth starts in the Spring. If Winter rainfall between 1 October and 1 March is more than 450 mm, then the standard N recommendations should be adjusted according to Table 6.

Table 6. Adjustment to standard N recommendation following excessive Winter rainfall

Crop	Winter rainfall > 450 mm		
	Sands, sandy loams and shallow soils, previous crop group 2	Sands, sandy loams and shallow soils, previous crop groups 3 - 6	All other soils, previous crop groups 2 - 6
All fruit crops	Add 10 kg/ha	Add 20 kg/ha	Add 10 kg/ha

Stage A2g. Adjustments to N recommendations following applications of bulky organic manures

Many growers of fruit crops choose to apply bulky organic materials (including animal manures and composts) as part of their fertiliser strategy and in an effort to maintain or enhance soil quality. It is important that full account is taken of the fertiliser nutrients (including N) within them in order to optimise crop quality, economic performance and to minimise any environmental impact (for example through leaching of excess N as nitrate). The amount of N available to the crop in the years following the application of organic materials depends on the type of material applied, the method of application, the soil type and the month (and year of application). Applications of organic materials to individual fields should not exceed 250 kg/ha of total N from the organic material in any 12 month period (this is mandatory in NVZs). The area of the field used to calculate the 250 kg/ha limit should exclude any areas where manures are not spread. Information on the N contents of organic materials can be found in SRUC Technical Note TN650 on manures and organic materials.

A3. Phosphate (P_2O_5), Potash (K_2O) and Magnesium (MgO) recommendations for new crops

In order to assess the P, K and Mg fertiliser requirements during the establishment phase for each crop, the following factors need to be taken into account:

Stage A3a:	Crop to be grown	Table 7
Stage A3b:	Adjustments following applications of bulky organic manures	

Stage A3a. Crop to be grown

Where soil analysis before planting shows low concentrations of soil P, K or Mg, it is important to correct these shortages by thorough incorporation of appropriate quantities of fertilisers (Table 7).

Where more than 120 kg/ha of potash is required for redcurrants, gooseberries and raspberries, sulphate of potash (K_2SO_4) should be used rather than muriate of potash (KCl), since fruit crops are sensitive to excessive soil chlorine concentrations. For phosphate fertilisers, use only those that contain a large proportion of water soluble phosphate. To avoid inducing Mg deficiency, the soil K:Mg ratio (based on soil mg/l K and Mg) should be no greater than 3:1.

Table 7. Phosphate, potash and magnesium recommendations (kg/ha) for soft fruit and rhubarb crops (establishment year)

Crop	Soil P, K or Mg status (SAC)			
	Very low	Low	Mod-erate	High
Strawberries				
Phosphate (P_2O_5)	110	70	40	40
Potash (K_2O)	220	150	80	0
Rhubarb				
Phosphate (P_2O_5)	175	150	120	80
Potash (K_2O)	250	225	200	150
Blackcurrants, redcurrants, gooseberries, raspberries, loganberries, tayberries,				
Phosphate (P_2O_5)	110	70	40	40
Potash (K_2O)	250	180	120	60
Blackberries				
Phosphate (P_2O_5)	110	70	40	40
Potash (K_2O)	220	150	80	0
Blueberries				
Phosphate (P_2O_5)	20	20	10	10
Potash (K_2O)	30	30	20	20
All crops				
Mg (MgO)	100	65	50	0

Stage A3b. Adjustments to Phosphate (P_2O_5), Potash (K_2O) and Magnesium (MgO) recommendations following applications of bulky organic manures

The amount of P, K and Mg available to the crop in the years following the application of organic materials depends on the type of material applied, the method of application, the soil type, the month of application and the number of years since application. Information on the P, K and Mg contents of organic materials can be found in SRUC Technical Note TN650 on manures and organic materials.

B. Nutrient recommendations for established crops

B1. Nitrogen recommendations for established crops

In order to assess the N fertiliser requirements for established fruit crops, the following factors need to be taken into account:

Stage B1a:	Crop being grown, taking account of soil nitrogen supply (SNS)	Table 8
Stage B1b:	Adjustments for variety/market	
Stage B1c:	Adjustments for Winter rainfall	Table 6
Stage B1d:	Adjustments following applications of bulky organic manures	

Stage B1a. Crop being grown, taking account of soil nitrogen supply (SNS)

The N recommendations for established fruit crops are listed in Table 8. The fertiliser recommendation should then be adjusted by following stages B1b to B1d as described in this Technical Note. Note that the required N can be applied wholly as manufactured fertiliser, although some may be derived from bulky organic manures and from soil reserves.

Soil nitrogen supply indices (or SNS indices) can also be used to give an indication of the amount of N which is likely to be available from soil reserves during cropping years. The SNS system was developed for use by farmers and growers in England and Wales and is described in detail in the Defra Fertiliser Manual (formerly RB209). An index of 0 – 6 is assigned to the soil (in a given field, in any year) which indicates the likely supply of N from the soil. The SNS index should be determined by the "Measurement Method" when following advice in this technical note. This method is based on measurements of soil mineral N, plus estimates of the amount of N already in the crop, plus estimates of the likely mineralisation of N from soil organic matter and crop debris during the period of active crop growth. The SNS index can usefully provide evidence to show the instances where N applications can be reduced from the recommendations provided in Table 8, though reference to the Defra Fertiliser Manual must be made in order to ensure that the correct method is followed and that interpretation of the results is appropriate.

Table 8. Nitrogen recommendations (kg/ha) for established soft fruit and rhubarb crops

Crop	Soil type		
	Shallow soils and sands	Sandy loams and other mineral soils	Humose and peaty soils
Strawberries (main season)	60	40	20
Strawberries (everbearers)	80	60	40
Rhubarb[1]	180	160	120
Blackcurrants	140	120	80
Raspberries[2] **redcurrants, gooseberries, loganberries, tayberries, blackberries**	120	100	60
Blueberries	60	40	20

[1]When rhubarb is to be forced, may have to apply up to 400 kg N/ha, split into two or more dressings.
[2]With continuing change in raspberry varieties, adjust N rate depending on crop vigour

Stage B1b. Adjustments for variety/market

Adjustments to the N recommendations given in Table 8 may have to be made for different crop varieties in order to optimise early growth, crop quality and/or yield. Leaf analysis should be used to determine whether crops are receiving sufficient N for optimal yields of quality fruit (see Section E). Specialist guidance may be needed when deciding on N fertiliser application rates in relation to any of the factors discussed above.

Stage B1c. Adjustments for Winter rainfall

If Winter rainfall between 1 October and 1 March is more than 450 mm, then the standard N recommendations should be adjusted according to Table 6.

Stage B1d. Adjustments to N recommendations following applications of bulky organic manures

Information on the N contents of organic materials can be found in SRUC Technical Note 650 on manures and organic materials.

B2. Phosphate (P_2O_5), Potash (K_2O) and Magnesium (MgO) recommendations for established crops

In order to assess the P, K and Mg fertiliser requirements for established fruit crops, the following factors need to be taken into account:

Stage B2a:	Crop type	Table 7
Stage B2b:	Adjustments following applications of bulky organic manures	

Stage B2a. Crop to be grown

Further soil analysis is recommended at least every 2 years once the crop has begun fruiting. Recommendations for P, K and Mg for established crops are the same as those for crops in the establishment year. Crops should therefore be top-dressed according to the recommendations in Table 7.

Where more than 120 kg/ha of potash is required for redcurrants, gooseberries and raspberries, sulphate of potash (K_2SO_4) should be used rather than muriate of potash (KCl), since fruit crops are sensitive to excessive soil chlorine concentrations. For phosphate fertilisers, use only those that contain a large proportion of water soluble P. To avoid inducing Mg deficiency, the soil K:Mg ratio (based on soil mg/l K and Mg) should be no greater than 3:1.

Stage B2b. Adjustments to Phosphate (P_2O_5), Potash (K_2O) and Magnesium (MgO) recommendations following applications of bulky organic manures

Information on the P, K and Mg contents of organic materials can be found in SRUC Technical Note TN650 on manures and organic materials.

C. Fertigation

Where strawberries or raspberries are grown under a polythene mulch with sub-irrigation, nutrients can be applied through an irrigation system (fertigation). On soils which encourage vigourous leafy growth, it may be beneficial to reduce N rates where fertilisers are applied through fertigation. Where growth is not excessive, N rates for the whole season should be the same as those recommended for soil applications, but with less being applied during the fruiting period.

At P and K status of moderate or above, maintenance rates of phosphate and potash can be applied through fertigation. However, where soil analysis shows that soil P or K status is low or very low, the recommended amounts of phosphate and/or potash should be cultivated into the planting bed before the soil is mulched. Irrigation water may also contain nutrients, particularly calcium (Ca) in hard water areas, and care should be taken when mixing with fertiliser, as insoluble compounds may form, which can block emitters.

D. Substrate strawberry production

It is often more practical or cost-effective to grow strawberries in an inert substrate in containers, rather than in soil. In this case, a complete nutrient solution is required. Normally a conductivity of at least 1.4 mS/cm is maintained during growth and production for main crop “June bearers” and the conductivity should not exceed 2.0 mS/cm. High salinity can cause marginal necrosis and may stimulate leaf and flower tip burn. During vegetative growth, the soil K:Ca ratio (based on mg/l K and Ca) should be maintained at 0.65 and at 0.8 during flowering and fruiting to improve fruit taste and firmness. Plants grown on substrates are very sensitive to excessive concentrations of zinc, boron and sodium in the nutrient solution. Deficiency of manganese and iron can occur when the pH values in the substrate are high (alkaline).

The nutrients applied will need to be adjusted depending on the substrate used. Peat or coir are the usual substrates for strawberry production. Coir is usually supplied dried and unfertilised. It should be thoroughly wetted for 2-3 days prior to planting with a nutrient solution. It needs more Ca, Mg and sulphur (S), but less boron (B) and K when used fresh. Since it has an inherently high pH, coir needs a lower solution pH (5.3 – 5.8) than peat (which requires 5.6 – 6.0). Nutrient solution recipes also depend on the chemical composition of the irrigation water and should be modified during the growing season according to the results of substrate, leaf tissue and drainage solution analysis.

Table 9. Guidelines for optimum nutrient concentrations in feed for strawberries produced in substrate

Nutrient element	mg/l in dilute feed	Nutrient element	mg/l in dilute feed
Nitrogen (NO_3)	110 - 140	Iron (Fe)	1.1 - 1.7
Nitrogen (NH_4)	7 - 14	Zinc (Zn)	0.46 - 0.65
Phosphorus (P)	46	Boron (B)	0.11 - 0.17
Potassium (K)	140 - 250	Manganese (Mn)	0.55 - 1.11
Magnesium (Mg)	30 - 40	Copper (Cu)	0.03
Calcium (Ca)	140 - 180	Molybdenum (Mo)	0.05
Sulphate (SO_4)	50 - 100		

Values obtained from Leiten, P (2003) Nutrition of protected strawberries. International Fertiliser Society Proceedings No. 528, York, UK.

E. Leaf analysis in growing crops

Leaf analysis is an important tool, which can be used in fruit crops to monitor crop nutrient status and to diagnose nutritional disorders. Separate samples should be taken from the same parts of good and poor plants, so that the results can be compared.

An understanding of leaf nutrient concentrations has proved useful in assessing the nutritional status of crops, and therefore their potential to produce good yields of quality crops. Satisfactory ranges for optimal growth of the main fruit crops are shown in Tables 10 and 11. Where analysis results are to be compared to these standards, it is essential that a representative sample is taken in the correct way, and at the correct time. Since there are seasonal and other factors that affect leaf nutrient concentrations, the results of leaf analysis must be interpreted with care. For example, leaf nutrient concentrations can vary between varieties. Where there is sufficient information, the standard ranges take into account differences between varieties.

Where the leaf nutrient concentration is consistently above the satisfactory range for several years, there is justification for a reduction in fertiliser use.

Table 10. Leaf analysis – satisfactory ranges for major nutrients expressed as elements

Crop	Leaf sampling position[1]	% in dry matter				
		Nitrogen (N)	Phosphorus (P)	Potassium (K)	Magnesium (Mg)	Sulphur (S)
Strawberries	1	2.6 – 3.0	0.25 – 0.30	1.5 – 2.0	0.15 – 0.20	0.10 – 0.20
Blackcurrants	2	2.8 – 3.0	0.25 – 0.35	1.5 – 2.0	0.15 – 0.25	
Raspberries	3	2.4 – 2.8	0.20 – 0.25	1.5 – 2.0	0.30 – 0.35	
Blueberries	4	1.8 – 2.1	0.08 – 0.40	0.4 – 0.7	0.12 – 0.25	0.12 – 0.20

[1]Leaf sampling position: 1 – lamina of recently matured leaves, sampled at fruit ripening; 2 - fully expanded leaves, extension growth, sampled prior to harvest; 3 - fully expanded leaves, non-fruiting canes, sampled at fruit ripening; 4 - fully expanded leaves between late July and mid August.

Values for strawberries, blackcurrants and raspberries obtained from Defra (2005) Fertiliser Recommendations for Agricultural and Horticultural Crops (RB209)

Table 11. Leaf analysis – satisfactory ranges of trace elements (m/kg in dry matter)

Trace element	Deficiency	Optimum	High
Manganese (Mn)	20	30 – 100	100[1]
Boron (B)[2]	15	20 – 40	40[3]
Zinc (Zn)	10	15 – 30	50
Copper (Cu)	5	7 – 15	15
Iron (Fe)	<45	45 - 250	

Values obtained from Defra (2005) Fertiliser Recommendations for Agricultural and Horticultural Crops (RB209)
[1]Mn concentrations >100 mg Mn/kg indicate that the soil is becoming acid: check soil pH
[2]Fruit analysis is the most reliable diagnostic technique for B deficiency. Optimum concentrations are 1.5 to 4.5 mg B/kg fresh weight. Below 1.5 mg B/kg indicates deficiency.
[3]Excess B concentrations can promote premature ripening and senescence in fruit.

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