

Deciduous Fruit

Apple (*Malus pumila* Mill.)

French: Pommier; Spanish: Manzano; Italian: Melo; German: Apfel

Pear (*Pyrus communis* L.)

French: Poirier; Spanish: Peral; Italian: Pero; German: Birne

Peach (*Prunus persica* L.)

French: Pecher; Spanish: Melocotonero; Italian: Pesco; German: Pfirsich

Apricot (*Prunus armeniaca* L.)

French: Apricotier; Spanish: Albaricoquero; Italian: Albicocco; German: Aprikose

Plum (*Prunus domestica* L.; *Prunus salicina* Lindl.)

French: Prunier; Spanish: Ciruelo; Italian: Susino; German: Pflaume

Sweet Cherry (*Prunus avium* L.)

French: Cerisier douce; Spanish: Cerezo des aves; Italian: Ciliegi dolce; German: Suesskirsche

Sour Cherry (*Prunus cerasus* L.)

French: Cerisier aigre; Spanish: Guindo griego; Italian: Ciliegi amaro; German: Sauerkirsche

Crop data

Perennial with winter rest. Harvested part: fruits.

Flowering late winter to middle spring; harvested 60 to 200 days after flowering, depending on species and cultivar.

Plant density: 250-700 (traditional) to 1 200-3 000 (intensive) plants/ha. Preferably grown on light to medium soils, pH 6.5-7.5.

Nutrient demand/uptake/removal

Nutrient demand/uptake/removal - Macronutrients									
Species	Cultivar /Rootstock	Source	Yield t/ha	Kind of demand	kg/ha				
					N	P2O5	K2O	MgO	CaO
Apple	Red	Greenham,	44.8	a	20.8	14.4	67.9	3.7	6.2
	Delicious	1980		b	18.4	9.6	17.2	3.8	64.1
				c	39.2	24.0	85.1	7.5	70.3
				d	47.6	7.6	62.9	30.1	120.1
				e	11.9	3.9	17.8	1.8	5.2
				f	11.8	5.3	4.3	2.8	39.2
				g	71.3	16.8	85.0	34.7	164.5
				h	110.5	40.8	170.1	42.2	234.8
	Cox's/M 2	Greenham,	23.3	a	16.5	7.3	40.4	2.2	1.7
		1980		b	9.5	3.7	8.8	2.3	15.0
				c	26.0	11.0	49.2	4.5	16.7
	Cox's/M 7	Greenham,	28.8	a	18.0	4.6	48.0	3.3	2.8
		1980		f	11.0	4.6	9.6	3.3	15.4
				b	4.0	<2.3	3.6	<1.7	16.8
			c	33.0	11.5	61.2	6.6	35.0	
-	Janik, 1986	34	a	38.0	7.8	43.1	9.3	4.8	
Pear		Boulay,	25	a	14.0	3.9	39.8	5.0	8.0
		Decroux,		b	7.0	2.1	3.5	1.0	62.0
		Diris,		c	21.0	6.0	43.3	6.0	70.0
		1984		d	35.0	6.0	25.0	12.4	100.0
				f	10.0	2.1	4.4	1.0	34.0
				g	45.0	8.1	29.4	13.4	134.0
				h	66.0	14.1	72.7	19.4	204.0
Peach	-	Janik, 1986	28	a	33.6	7.8	98.2	9.3	4.8

a = removed in fruit
b = incorporated in framework
c = net uptake (a+b)
d = leaf-fall
e = dropping flowers and fruitlets
f = prunings
g = return to soil (d+e+f)
h = gross uptake (c+g)

Plant analysis

Apples - Optimum* leaf analysis values - Macronutrients

Country / Region	Source	Cultivar	Sampled leaf / Sampling time	% of dry matter					
				N	P	K	Mg	Ca	S
Australia	Reuter,	all	mid-3rd / late	2.00-	0.15-	1.20-	0.21-	1.10-	0.20-
	Robinson, 1986		Jan. - mid. Feb.	2.40	0.20	1.50	0.25	2.00	0.40
Brazil Rio Grande Santa Catarina	Basso, 1990	all	mid-3rd / mid.	2.00-	0.15-	1.20-	0.25-	1.10-	-
			+Jan. - mid. Feb.	2.50	0.30	1.50	0.45	1.70	-
Canada Ontario	Cline, 1990	Red & Golden Delicious	mid-3rd / July 15-30	2.20- 2.70	0.15- 0.30	1.40- 2.20	0.25- 0.40	0.80- 1.50	-
Denmark	Vang-Petersen, 1990	all	mid-3rd / Aug. 15-30	2.00- 2.50	0.18- 0.26	1.30- 1.70	0.20- 0.40	0.70- 1.20	-
France Loir et Cher	Gautier, 1975	Golden Delicious	mid-3rd / 70-90 days after bloom	2.30- 2.50	0.16- 0.18	1.80- 2.00	0.22- 0.26	-	-
		Red Delicious		2.40- 2.60	0.17- 0.19	1.60- 1.80	0.25- 0.30	-	-
Germany	Bergmann, 1988	al	mid-3rd / July - August	2.20- 2.80	0.18- 0.30	1.10- 1.50	0.20- 0.35	1.30- 2.20	-
Hungary	Szucs, 1990	all	mid-3rd / July 15-30	2.00- 2.70	0.12- 0.20	1.00- 1.60	0.27- 0.40	1.20- 1.80	-
Italy Trentino	Failla, 1991	Golden Delicious	lower 3rd / late July - early August	2.00- 2.60	0.16- 0.24	1.30- 1.90	0.24- 0.36	1.40- 2.00	-
		Red Delicious		2.10- 2.70	0.16- 0.24	1.10- 1.70	0.27- 0.39	1.10- 1.70	-
Piedmont	Failla, 1990	Canada Reinette	Golden Delicious	1.80- 2.40	0.26- 0.38	1.00- 1.60	0.24- 0.36	1.40- 2.00	-
		Red Delicious		2.10- 2.70	0.12- 0.20	1.20- 1.80	0.20- 0.32	1.00- 1.60	-
Venetia/ Emilia	Lalatta, 1987	Rd & Gldn Delicious	Red Delicious	2.30- 2.90	0.14- 0.22	1.10- 1.70	0.22- 0.34	0.90- 1.50	-
Japan Nagano	Katou, 1990	Ralls	mid-3rd / late	3.40-	0.17-	1.30-	0.27-	0.80-	-
		Janet	July-early Aug.	3.60	0.19	1.50	0.40	1.30	-
Netherlands	Kodde, 1990	Golden Delicious	mid-3rd / mid July- mid Aug	2.21- 2.40	0.16- 0.25	1.36- 1.65	0.18- 0.25	1.81- 2.20	-
		Cox's		2.41- 2.60	0.16- 0.25	1.16- 1.45	0.18- 0.25	1.81- 2.20	-
South Africa	Kotze, 1990	all	mid-3rd / Jan. 31	2.10- 2.80	0.13- 0.19	0.80- 1.60	0.30- 0.50	1.20- 1.60	-
UK	Sharples, 1980	Cox's	mid-3rd / August	2.40- 2.80	0.20- 0.25	1.30- 1.60	0.25- 0.30	1.00- 1.60	-
USA	Childers, 1973	all	mid-3rd / mid-summer	1.90- 2.25	0.20- 0.30	1.20- 1.95	0.24- 0.40	1.50- 2.00	-

Oregon	Righetti, 1989	all	mid-3 rd / August	2.00-2.30	0.14-0.55	1.20-2.00	0.25-0.60	1.10-2.50	0.10-0.20
Washington	Thoenissen, 1989	Red Delicious		1.80-3.00	0.15-0.40	1.30-2.50	0.25-1.00	1.20-2.60	0.12-0.20
U.S.S.R.	Kondakov, 1990	Antonovka & other	mid-3 rd /second half of summer	1.80-2.50	0.13-0.22	1.00-1.50	0.23-0.35	1.00-1.40	-

* ranges in which yield and quality are satisfactory

Apples - Optimum* leaf analysis values - Micronutrients								
Country/Region	Source	Cultivar	Sampled leaf/Sampling time	% of dry matter				
				Fe	Mn	B	Zn	Cu
Australia	Reuter, Robinson, 1986	all	mid-3 rd / late Jan. - mid. Feb.	>100	50-100	21-40	20-50	6-20
Brazil - Rio Grande & Santa Catarina	Basso, 1990	all	mid-3 rd / mid. Jan. - mid. Feb.	50-250	30-130	25-50	20-100	5-30
Canada - Ontario	Cline, 1990	Red & Golden Delicious	mid. - 3 rd / July 15-30	25-200	20-200	20-60	15-100	-
France Loir et Cher	Gautier, 1975	Golden delicious	mid-3 rd / 70-90 days after bloom	-	-	25-35	-	-
		Red Delicious		-	-	30-40	-	-
Germany	Bergmann, 1988	all	mid-3 rd / July - August	-	35-100	25-50	15-50	5-12
Hungary	Szucs, 1990	all	mid-3 rd / July 15-30	100-300	50-200	25-50	25-50	5-20
Italy Trentino	Failla, 1991	Golden delicious	lower 3 rd / late July - early August	40-150	>8	20-40	>15	>1
		Red Delicious		40-150	>8	20-40	>15	>1
		Canada reinette		40-150	>8	20-40	>15	>1
Piedmont	Failla, 1990	Golden Delicious		60-200	>30	15-25	>10	>1
Japan - Nagano	Katou, 1990	Ralls Janet	mid-3 rd / late July - early Aug.	-	50-200	30-50	30-50	10-30
South Africa	Kotze, 1990	all	mid-3 rd / January 31	80-150	20-90	25-40	30-50	5-10
UK	Sharples, 1980	Cox's	mid-3 rd / August	-	31-100	25-30	15-25	5-10
USA	Childers, 1973	all	mid-3 rd / mid-summer	100-300	-	30-40	25-50	5-20
Oregon	Righetti, 1989	all	mid-3 rd / August	50-250	25-150	30-60	15-60	5-15
Washington	Thoenisse	Red		75-150	25-100	35-75	40-80	10-50

	n, 1989	Delicious						
* ranges in which yield and quality are satisfactory								

Pear - Optimum* leaf analysis values - Macronutrients									
Country/re gion	Source	Cultivar	Sampled leaf/ Sampling Time	% of dry matter					
				N	P	K	Mg	Ca	S
Australia	Reuter, & Robinson, 1986	all	mid-3rd / late Jan. - mid Feb.	2.30-2.70	0.14-0.20	1.20-2.00	0.30-0.50	1.50-2.20	0.17-0.26
Brazil - Rio Grande & Santa Catarina	Basso, 1990	all	mid-3rd / mid Jan. - mid Feb.	2.00-2.50	0.15-0.30	1.20-1.50	0.25-0.45	1.10-1.70	-
Canada -Ontario	MOAAF, 1989	all	mid-3rd / July 15-30	2.00-2.60	0.15-0.30	1.30-2.00	>0.20	-	-
Denmark	Vang-Petersen, 1990	all	mid-3rd / August 15-30	2.00-2.50	0.15-0.17	1.30-1.70	0.20-0.40	1.20-1.80	-
France -Loir -et- Cher	Gautier, 1975	Passe-Crassane	mid-3rd / 70-90 days after bloom	1.80-2.00	0.15-0.17	1.60-1.80	0.30-0.35	-	-
		Doyenne du Comice		1.80-2.00	0.16-0.20	1.60-1.80	0.28-0.33	-	-
		Conference		2.00-2.40	0.16-0.20	1.50-1.80	0.25-0.30	-	-
Germany	Bergmann, 1988	all	mid-3rd / July - Augut	2.20-2.80	0.15-0.30	1.20-2.00	0.20-0.35	1.20-1.80	-
Hungary	Szucs, 1990	all	mid-3rd / July 15-30	1.80-2.60	0.17-0.23	1.20-1.60	0.33-0.47	1.20-1.60	-
Japan -Nagano	Katou, 1990	Nijusseiki	mid-3rd / late July-early Aug.	2.50	0.12-0.14	0.80-1.40	0.27-0.40	2.30-3.00	-
Netherlands	Kodde, 1990	all	mid-3rd / mid July - mid Aug.	2.20-2.40	0.16-0.25	1.16-1.45	0.18-0.25	1.81-2.20	-
South Africa	Kotze, 1990	all	mid-3rd / Januaray 31	2.00-2.80	0.10-0.18	1.20-2.00	0.25-0.60	0.80-1.60	-
USA	Childers, 1973	all	mid-3rd / mid-summer	2.00-2.80	0.10-0.20	1.00-2.00	0.30-0.50	1.50-3.50	-
* ranges in which yield and quality are satisfactory									

Pear - Optimum* leaf analysis values - Micronutrients								
Country/Re gion	Source	Cultivar	Sampled leaf/Sampli ng Time	ppm dry matter				
				Fe	Mn	B	Zn	Cu
Australia	Reuter & Robinson, 1986	all	mid-3rd / late Jan.-mid. Feb.	60-200	60-120	20-40	20-50	9-20
Brazil -Rio Grande & Santa Catarina	Basso, 1990	all	mid-3rd / mid Jan. - mid Feb.	50-250	30-130	25-50	20-100	5-30
Denmark	Vang-Petersen,	all	mid-3rd / August 15-	-	30-150	20-50	-	-

	1990		30					
France -Loir-et- Cher	Gautier, 1975	Passe- Crassane	mid-3rd / 70-90 days after bloom	-	-	20-25	-	-
		Doyenne du Comice Conference	-	-	-	20-25	-	-
Germany	Bergmann, 1988	all	mid-3rd /July-Aug.	-	30-100	20-50	15- 50	5-12
Hungary	Szucs, 1990	all	mid-3rd / July 15-30	>40	>30	20-50	15- 20	5-20
Japan -Nagano	Katou, 1990	Nijusseiki	mid-3rd / late July- early Aug.	-	60-200	-	50- 90	10-20
South Africa	Kotze, 1990	all	mid-3rd / January 31	60-240	25-100	22-29	10-35	3-20
USA	Childers, 1973	all	mid-3rd / mid- summer	100-250	20-75	20-50	15-40	4-10
* ranges in which yield and quality are satisfactory								

Peach - Optimum* leaf analysis values - Macronutrients									
Country/Re gion	Source	Cultivar	Sampled leaf/Sampli ng Time	% dry matter					
				N	P	K	Mg	Ca	S
Australia	Reuter & Robinson, 1986	all	mid-3rd / Jan.-Feb.	3.00- 3.50	0.14- 0.25	2.00- 3.00	0.30- 0.80	1.80- 2.70	0.20- 0.40
Brazil -Rio Grande & Santa Catarina	Basso, 1990	all	mid-3rd / 13-15 weeks after blomm	3.26- 4.53	0.15- 0.28	1.31- 2.06	0.52- 0.83	1.64- 2.61	-
Germany	Bergmann, 1988	all	mid-3rd / July-Aug.	2.20- 3.20	0.18- 0.35	1.50- 3.00	0.30- 0.60	1.50- 2.50	-
Hungary	Szucs, 1990	all	mid-3rd / first part Aug.	2.60- 3.60	0.18- 0.26	2.00- 3.00	0.40- 0.60	1.70- 2.40	-
Italy	Faila, 1991	all	lower 3rd / late July- early Aug.						
-Piedmont				3.00- 3.80	0.19- 0.27	2.10- 3.30	0.35- 0.55	1.80- 2.80	-
-Tuscany				3.00- 3.60	0.16- 0.22	1.50- 2.50	0.40- 0.60	1.60- 2.40	-
-Latium Campania	Lalatta, 1987			3.20- 3.60	0.16- 0.21	2.10- 2.80	0.65- 1.00	1.40- 2.00	-
Japan -Nagano	Katou, 1990	Ookubo	mid-3rd / mid June	3.40- 3.50	0.20	1.60- 2.00	0.27- 0.40	-	-
South Africa	Kotze, 1990	all	mid-3rd / January 31	2.20- 3.80	0.12- 0.20	0.80- 3.20	0.35- 1.10	1.20- 3.50	-
USA	Childers, 1973	all	mid-3rd / mid- summer	2.50- 3.36	0.15- 0.30	1.25- 3.00	0.25- 0.54	1.90- 2.50	-
* ranges in which yield and quality are satisfactory									

Peach - Optimum* leaf analysis values - Micronutrients				
Country/Re gion	Source	Cultivar	Sampled leaf/	ppm dry matter

			Sampling Time	Fe	Mn	B	Zn	Cu
Australia	Reuter & Robinson, 1986	all	mid-3rd / late Jan.-Feb.	100-250	40-160	20-60	20-50	5-16
Brazil -Rio Grande & Santa Catarina	Basso, 1990	all	mid-3rd / 1"-14 weeks after bloom	100-230	31-160	34-63	24-37	6-30
Germany	Bergmann, 1988	all	mid-3rd / July-Aug.	-	35-100	20-60	15-50	7-15
Hungary	Szucs, 1990	all	mid-3rd / first part Aug.	120-150	20-140	20-80	15-30	4-12
Italy -Piedmont -Tuscany	Failla, 1991	all	lower 3rd / late July - early aug.	50-250 80-300	30-150 30-200	18-30 22-32	15-50 3-100	3-30 1-16
Japan -Nagano	Katou, 1990	Ookubo	mid-3rd / mid-June	-	50-100	20-70	30-50	5-15
South Africa	Kotze, 1990	all	mid 3rd / January	60-240	30-140	24-45	18-50	3-20
USA	Childers, 1973	all	mid-3rd / mid-summer	124-152	20-142	20-80	15-30	4-12
* ranges in which yield and quality are satisfactory								

Plums - Optimum* leaf analysis values - Macronutrients								
Country/Region	Source	Cultivar	Sampled leaf/Sampling Time	% of dry matter				
				N	P	K	Mg	Ca
Australia	Reuter & Robinson, 1986	all	mid-3rd / Jan. - Feb.	2.40-3.00	0.14-0.25	1.60-3.00	0.30-0.80	1.50-3.00
Brazil -Rio Grande & Sata Catarina	Basso, 1990	all	mid-3rd / 13-15 weeks after bloom	3.26-4.53	0.15-0.28	1.31-2.06	0.52-0.83	1.64-2.61
Denmark	Vang-Petersen, 1990	all	mid-3rd / Aug. 15-30	2.30-2.80	0.15-0.30	2.20-2.80	0.20-0.40	1.60-2.10
Germany	Bergmann, 1988	all	mid-3rd / July - Aug.	2.20-3.20	0.18-0.35	1.50-2.50	0.30-0.60	1.20-2.50
Hungary	Szucs, 1990	all	mid-3rd / July 15-Aug. 15	2.20-3.20	0.17-0.23	2.00-3.00	0.50-0.70	2.00-2.80
South Africa	Kotze, 1990	all	mid-3rd / january 31	2.30-3.20	0.16-0.25	2.20-3.50	0.36-0.87	1.20-2.30
USA	Childers, 1973	all	mid-3rd /mid-summer	1.80-2.10	0.14-0.25	1.50-250	0.18	2.00-4.00
* ranges in which yield and quality are satisfactory								

Plums - Optimum* leaf analysis values - Micronutrients				
Country/Region	Source	Cultivar	Sampled leaf/sampling Time	ppm dry matter

				Fe	Mn	B	Zn	Cu
Australia	Reuter & Robinson, 1986	all	mid-3rd / Jan.-Feb.	100-250	40-160	25-60	20-50	6-16
Brazil -Rio Grande & Santa Catarina	Basso, 1990	all	mid-3rd / 13-15 weeks after bloom	100-230	31-160	34-63	24-37	6-30
Germany	Bergmann, 1988	all	mid-3rd / July - Aug.	-	25-100	30-60	15-50	5-12
Hungary	Szucs, 1990	all	mid-3rd / July 15- Aug. 15	50-100	50- 90	25-50	30-50	7-10
South Africa	Kotze, 1990	all	mid-3rd / Jan. 31	80-135	22- 85	32-46	17-34	3-20
USA	Childers, 1973	all	mid-3rd / mid-summer	50-100	53- 93	33-50	25-50	7-10

* ranges in which yield and quality are satisfactory

Apricot - Optimum* leaf analysis values - Macronutrients								
Country/Region	Source	Cultivar	Sampled leaf/Sampling Time	% of dry matter				
				N	P	K	Mg	Ca
Australia	Reuter & Robinson, 1986	all	mid-3rd / Jan. -Feb.	2.40-3.00	0.14-0.25	2.00-3.50	0.30-0.80	2.00-4.00
Germany	Bergmann, 1988	all	mid-3rd / July - Aug.	2.20-3.20	0.18-0.35	2.00-3.20	0.30-0.60	1.20-2.50
Hungary	Szucs, 1990	all	mid-3rd/2 nd part of July	2.00-2.70	0.17-0.23	2.20-3.10	0.40-0.60	1.50-2.10
South Africa	Kotze, 1990	all	mid-3rd / Jan. 31	1.80-2.80	0.11-0.20	2.00-3.20	0.25-0.70	1.10-1.80

* ranges in which yield and quality are satisfactory

Apricot - Optimum* Leaf Analysis Values - Micronutrients								
Country/Region	Source	Cultivar	Sampled leaf/Sampling Time	ppm dry matter				
				Fe	Mn	B	Zn	Cu
Australia	Reuter & Robinson, 1986	all	mid-3rd / Jan.-Feb.	100-250	40-160	20-60	20-60	5-16
Germany	Bergmann, 1988	all	mid-3rd / July - Aug.	-	30-100	20-60	15-50	5-12
Hungary	Szucs, 1990	all	mid-3rd / 2 nd part of July	100-200	25-140	25-80	25-40	3-20
South Africa	Kotze, 1990	all	mid-3rd / Jan. 31	60-200	30-100	31-42	30-70	3-20

* ranges in which yield and quality are satisfactory

Sweet Cherry - Optimum* leaf analysis values - Macronutrients								
Country/Region	Source	Cultivar	Sampled leaf/Sampling Time	% of dry matter				
				N	P	K	Mg	Ca
Australia	Reuter & Robinson,	all	mid-3rd / Jan.-Feb.	2.20-260	0.14-0.25	1.60-3.00	0.30-0.80	1.40-2.40

	1986							
Denmark	Vang-Petersen, 1990	all	mid-3rd / Aug. 15-30	2.60-3.20	0.15-0.30	1.40-1.90	0.20-0.40	1.60-2.10
Germany	Bergmann, 1988	all	mid-3rd / June-July	2.60-2.80	0.18-0.30	1.60-2.00	0.30-0.50	1.20-2.00
Hungary	Szucs, 1990	all	mid-3rd / July 1-15 after harvest	2.20-3.20	0.17-0.23	1.40-2.00	0.50-0.80	1.90-2.70
* ranges in which yield and quality are satisfactory								

Sweet Cherry - Optimum* Leaf Analysis Values - Micronutrients								
Country/Region	Source	Cultivar	Sampled leaf/Sampling Time	ppm dry matter				
				Fe	Mn	B	Zn	Cu
Australia	Reuter & Robinson, 1986	all	mid-3rd / Jan. - Feb.	100-250	40-160	20-60	20-50	5-16
Germany	Bergmann, 1988	all	mid-3rd / June - July	-	30-100	30-60	15-50	5-12
Hungary	Szucs, 1990	all	mid-3rd / July 1-15 after harvest	120-200	40-150	35-55	20-50	8-30
* ranges in which yield and quality are satisfactory								

Sour Cherry - Optimum* leaf analysis values - Macronutrients								
Country/Region	Source	Cultivar	Sampled leaf/Sampling Time	% of dry matter				
				N	P	K	Mg	Ca
Canada -Ontario	MOAAF, 1989	Montmorency	mid-3rd / July 15-30	2.20-3.00	-	1.50-2.10	>0.35	1.60-2.50
Germany	Bergmann, 1988	all	mid-3rd / June - July	2.80-3.20	0.20-0.35	1.60-2.00	0.30-0.50	1.30-2.00
USA	Childers, 1973	Montmorency	mid-3rd / mid-summer	2.33-3.27	0.23-0.32	1.25-1.92	0.49-0.74	1.62-2.60
USSR	Kondakov, 1990	Ljubskaja	mid-3rd / 2 nd half of summer	1.80-2.50	0.13-0.22	1.30-2.00	0.23-0.35	-
* ranges in which yield and quality are satisfactory								

Sour Cherry - Optimum* leaf analysis values - Micronutrients								
Country/Region	Source	Cultivar	Sampled leaf/Sampling Time	ppm dry matter				
				Fe	Mn	B	Zn	Cu
Germany	Bergmann, 1988	all	mid-3rd / June - July	-	35-100	30-60	15-50	5-12
USA	Childers, 1973	Montmorency	mid-3rd / mid-summer	119-203	44-60	38-54	20-50	8-28
USSR	Kondakov, 1990	Ljubskaja	mid-3rd / 2 nd half of summer	-	>10	>15	>6	>10
* ranges in which yield and quality are satisfactory								

Soil test data

Critical soil test values				
Below which, before planting fertilizers should be applied				
Above which, before planting fertilizers need not be applied				
Country/Region	Source	Parameter, analytical methods, critical values		
Brazil -Rio Grande & Santa Catarina	CDFDS, 1989	Organic matter (Walkey & Black):		2 %
		P (Mehlich) in ppm:	clay >55 % clay 40-50 % clay 25-40 % clay 10-25 % clay <10 %	2.1 3.1 4.1 6.1 8.1
		K (Mehlich): Mg (KCl 1 N):		41 ppm 0.5 meq/ml
Canada -Ontario	Cline, 1990	P: 40 ppm K: 180 ppm		
Denmark	Vang- Petersen, 1990	P: 18-27 ppm K: 20-25 ppm Mg: 8-10 ppm		
France	Calvet & Villemain, 1987	Organic matter in %:	clay 1-10 % 2.7-2.2	
		P2O5 (Dyer) in ppm:	clay 10-30 % 2 clay 30-45 % 2-3 CEC 50-150 meq/kg CEC 150-250 meq/kg CEC 250-350 meq/kg	160-250 250-325 325-375
		P2O5 (Joret-Hebert) in ppm:	CEC 50-150 meq/kg	95-150
		K2O (exc.) in ppm:	CEC 150-250 meq/kg CEC 250-350 meq/kg CEC 50-150 meq/kg CEC 150-250 meq/kg CEC 250-350 meq/kg	150-200 200-245 75-225 225-325 325-425
		MgO (exc.) in ppm:	CEC 50-150 meq/kg CEC 150-250 meq/kg CEC 250-350 meq/kg	75-100 100-150 150-200
Greece	Vasilakakis, 1990	P2O5 (Olsen) in ppm:	15-20	
		K2O (NH4Ac) in ppm:	sandy soil 100 other 300	
Hungary	Szucs, 1990	P2O5 (Egner-Riehm) in ppm:	acid soil (pH<6.5)	60- 80
		K2O (Egner-Riehm) in ppm:	neutral soil alkaline soil clay <10 %	80-100 100-120 80-100
			clay 10-15 % clay 15-30 % clay 30-60 % clay >70 %	120 160 200 250
Italy	Goldberg, 1986	P2O5 (Olsen) in ppm:	CEC <10 meq/100 g	40
			CEC 10-20 meq/100 g CEC >20 meq/100 g	60 80
		K (NH4Ac): Mg (NH4Ac):	5 % CEC 10 % CEC	
Japan	Katou, 1990	P2O5 (Truog) in mg/100 g	10-25	

- Nagano		dry soil: K ₂ O (NH ₄ Ac): apple & pear: peach: MgO (NH ₄ Ac): apple & pear: peach: CaO (NH ₄ Ac): apple & pear: peach:	CEC <10 meq/100 g CEC 10-20 meq/100 g CEC >20 meq/100 g CEC <10 meq/100 g CEC 10-20 meq/100 g CEC >20 meq/100 g CEC <10 meq/100 g CEC 10-20 meq/100 g CEC >20 meq/100 g CEC <10 meq/100 g CEC 10-20 meq/100 g CEC >20 meq/100 g CEC <10 meq/100 g CEC 10-20 meq/100 g CEC >20 meq/100 g CEC <10 meq/100 g CEC 10-20 meq/100 g CEC >20 meq/100 g	5 % CEC 5 % CEC 3-5 % CEC 3-5 % CEC 3 % CEC 2-3 % CEC 20-23 % CEC 20 % CEC 15-20 % CEC 15-20 % CEC 15 % CEC 13-15 % CEC 55-72 % CEC 55 % CEC 42-55 % CEC 42-55 % CEC 42 % CEC 35-42 % CEC
South Africa	Kotze, 1990	P (Bray II ext.) in ppm: K (Bray II ext.) in ppm:	sandy soil loamy soil clay soil	30 30- 50 50- 70 70-100
Switzerland	CRDF, 1985	Organic matter in %: P ₂ O ₅ (Dirks-Scheffer mod.): K ₂ O (Dirks-Scheffer mod.) in mg/100 g: Mg (Schachtschabel) in mg/100 g:	clay <15 % clay 15-25 % clay >25 % clay <15 % clay 15-25 % clay >25 % clay <15 % clay 15-25 % clay >25 % clay <15 % clay 15-25 % clay >25 %	1.2-1.5 1.8-2.5 2.5-3 16-24 x 0.0356 mg/100 g 8-16 x 0.0356 mg/100 g 6-9 x 0.0356 mg/100 g 3-6 2-4 1.2-2 5-7.5 7-10.5 12-18
USSR	Kondakov, 1990	Chernozem soil: P ₂ O ₅ (Chiricov) in ppm: K ₂ O (Kirsanov) in ppm: Chernozem soil: P ₂ O ₅ (Machigin) in ppm: K ₂ O (Machigin) in ppm: Red soil and subtropic podzolic soil: P ₂ O ₅ (Oniani) in ppm: K ₂ O (Oniani) in ppm:	sandy-loam soil sandy-clay soil clay-loam soil sandy-loam soil sandy-clay soil clay-loam soil sandy-loam soil sandy-clay soil clay-loam soil	150 80 120 180 40 200 300 400 400 150 200 300

Fertilizer recommendation

Available organic manures should be applied and well incorporated in soil (80-100 cm depth) before planting, especially if soil organic matter is low. If necessary, soil pH should be raised to 6.5 by liming.

P and K fertilizers should be applied before planting to reach the critical soil values, and to provide a nutrient reserve on which the trees can draw during their life. In young orchards, N, P and K fertilizers should be always applied, both to increase vegetative growth and to accelerate the onset of fruiting.

In mature orchards, applications of N, P, K, Mg and micronutrients should be based on yield, vegetative growth, leaf and soil analysis and visual symptoms of deficiency.

N should be applied just before bud-break in a single dressing or, on sandy soil, in two to three dressings; the later applications should be made about 30-60 days after the first. P and K fertilizers should be applied during the winter rest period. Micronutrients may also be applied as foliar sprays.

Preferred nutrient forms

The choice between nitrate, ammonium and urea forms of N should be made on the basis of meteorological and soil conditions. P must be water-soluble and K preferably in sulphate form.

Fertilizer recommendations: Before planting		
Country/Region	Source	Recommendations
All fruit trees		
France	Agenes & Terenne, 1988	P and K fertilizers are applied to reach the critical soil test values and to provide in the soil the whole amount that will be removed by the crop during its life.
Germany	Quast, 1990	Up to 200-300 kg/ha P ₂ O ₅ and up to 400-600 kg/ha K ₂ O based on soil analysis.
Greece	Vasilakakis, 1990	Organic matter: 30-40 t/ha when organic matter in soil is below 2 %. P ₂ O ₅ based on soil analysis from 0 to 300 kg/ha. K ₂ O based on soil analysis from 0 to 900 kg/ha
Hungary	Szucs, 1990	Organic matter based on soil analysis: from 40 to 100 t/ha. P ₂ O ₅ based on soil analysis: from 9.3 (neutral or acid sandy soil) to 34.4 (alkaline clay soil) kg/ha x mg/kg soil to increase; up to 700 (sandy soil), 1400 (loamy soil) and 1800 (clay soil).* K ₂ O based on soil analysis: from 9.3 (neutral or acid sandy soil) to 23.3 (alkaline clay soil) kg/ha x mg/kg soil to increase.*
Italy	Failla, 1990	Organic matter based on soil analysis 60-80 t/ha in relation to C/N ratio (max. 250 kg/ha N). P ₂ O ₅ : 0 - 300 kg/ha, K ₂ O: 0-600 kg/ha, based on soil analysis.
South Africa	Kotze, 1990	P ₂ O ₅ , K ₂ O and lime to reach the analytical soil standards.
USSR	Kondakov, 1990	20-60 kg/ha N, 60-180 kg/ha P ₂ O ₅ and 60-180 kg/ha K ₂ O.
Apple & Other		
Canada, Ontario	Cline, 1990	Liming to pH 6.5 up to 20 t/ha; 0-140 kg/ha P ₂ O ₅ and 0-130 kg/ha K ₂ O based on soil analysis.
Denmark	Vang-Petersen, 1990	P ₂ O ₅ based on soil analysis: 170 kg/ha x mg/kg soil to increase.* K ₂ O based on soil analysis: 30 kg/ha x mg/kg soil to increase.* Mg based on soil analysis: 42 kg/ha x mg/kg soil to increase.*
Apple & Pear		
Brazil, Rio Grande & Santa Catarina	CDFDS, 1989	Liming to pH 6 to 40 cm depth 0 - 320 kg/ha P ₂ O ₅ and 0-200 kg/ha K ₂ O based on soil analysis. 30 kg/ha of borax
Peach		
France	Agenes & Terenne, 1988	P and K fertilizers are applied to reach the critical soil test values and to provide in the soil the whole amount that will be removed by the

		crop during its life, e.g.: P2O5: 400-600 kg/ha K2O: from 0 in sandy soil to 600-700 kg/ha in clay soil.
Peach & Plum		
Brazil, Rio Grande & Santa Catarina	CDFDS, 1989	Liming to pH 6 to 40 cm depth. P2O5: 0-120 kg/ha, K2O: 0-130 kg/ha, based on soil analysis.
Pear ---> Apple & Pear		
Plum ---> Peach & Plum		
* " P2O5, 34 kg/ha x mg/kg soil to increase" means: 34 kg/ha of P2O5 for each mg of available P2O5 per kg of soil intended to be increased; e.g.: soil analysis indicates 30 mg/kg of available P2O5, intended value is 35 mg/kg, consequently 34 x 5 = 170 kg of P2O5 have to be applied.		

Fertilizer recommendations: First years after planting		
Country/Region	Source	Recommendations
All fruit trees		
Italy	Failla, 1990	N: 100, 150-200, 200-250 g/tree in the 1st, 2nd and 3rd years respectively, up to 250 kg/ha in several dressings during the vegetative period.
South Africa	Kotze, 1990	N: 8.5, 17 and 25.5 g/tree/month in the 1st, 2nd and 3rd years respectively. K2O only in sandy soil and loam with over 50 % stones: 9, 18 and 27 g/tree/month in the 1st, 2nd and 3rd years respectively.
Apple		
Japan, Nagano	Katou, 1990	g/tree N P2O5 K2O 1 year old trees 60 24 48 5 year old trees 300 120 240 10 year old trees 600 240 180 15 year old trees 900 360 720 20 year old trees 1200 480 960 dwarfed trees: 1-2 year old trees 30 kg/ha N 3-4 year old trees 60 kg/ha N
Apple/9		
France	Decroux & Boulay, 1988	N: 30-40 and 30-70 g/tree in the 1st and 2nd year respectively.
Apple/MM106		
France	Decroux & Boulay, 1988	N: 0-50, 20-50 g/tree and 50-70 kg/ha in the 1st, 2nd and 3rd years respectively
Apple & Pear		
Brazil, Rio Grande & Santa Catarina	CDFDS, 1989	N: 15, 20 and 25 kg/ha in the 1st, 2nd and 3rd years respectively.
Peach		
France	Agenes & Terenne, 1988	N: 0-30 and 10-50 g/tree in the 1st and 2nd years respectively.
Peach & Plums		
Brazil, Rio Grande & Santa Catarina	CDFDS, 1989	N: 30, 60 and 90 g/tree in the 1st, 2nd and 3rd years respectively.
Pear ---> Apple & Pear		
Plums ---> Peach & Plums		

Fertilizer recommendations: Annually in mature orchards		
Country/Region	Source	Recommendations
All fruit trees		
USSR	Kondakov, 1990	Depending on leaf analysis, vegetative growth and yield. Standard rates in kg/ha: N = 0; P2O5 = 0-120; K2O = 0-120.
Apple		
Canada, Onatrio	Cline, 1990	Based on leaf analysis, growth, yield, fruit colour and storage life. Rates of N are based on tree age and tree population: Max. 35 g N/year of tree age when less than 500 trees/ha, e.g.: 8 year old trees, 800 trees/ha = 200 g/tree = 84 kg/ha; 8 year old trees, 1000 trees/ha = 125 g/tree = 125 kg/ha. Rates of P2O5: no P2O5 recommended for trees, 20 kg/ha P2O5 for

		cover crops. Rates of K ₂ O: also based on tree population and tree size (cross section). Example: 5 cm cross section, 300 trees/ha = 40 kg/ha 5 cm cross section, 1000 trees/ha = 60 kg/ha 20 cm cross section, 300 trees/ha = 200 kg/ha 20 cm cross section, 1000 trees/ha = 300 kg/ha Lime: if pH below 5.6, 1-20 t/ha depending on pH and buffer pH.
France	Boulay & Decroux & Diris, 1984	Based on yield, growth and leaf analysis. Examples in kg/ha: Cultivar: "Golden Delicious": N = 80 - 120; P ₂ O ₅ = 50-100; K ₂ O = 100-250
	Decroux & Boulay, 1988	Cultivar: "Granny Smith" (50 t/ha yield): N = 60-100; P ₂ O ₅ = 50-100; K ₂ O = 100-250 Cultivar: "Red Delicious" (50 t/ha yield): N = 60-100; P ₂ O ₅ = 50-100; K ₂ O = 100-250.
Germany	Quast, 1990	Based on yield, growth and leaf analysis. Example in kg/ha: N = 0-90; K ₂ O = 0-100; Mg and lime if necessary.
Greece	Vasilakakis, 1990	N = 1 kg/tree up to 350 kg/ha; P ₂ O ₅ = 0-1 kg/tree up to 350 kg/ha in 2 years; K ₂ O = 0-3 kg/tree up to 700 kg/ha in 2 years.
Apple		
Italy	Failla, 1990	Depending on leaf analysis, vegetative growth and yield. Example in kg/ha: N = 0-70; P ₂ O ₅ = 0-25; K ₂ O = 0-100.
Japan, Nagano	Katou, 1990	Depending on soil fertility rates in kg/ha: N = 120-200; P ₂ O ₅ = 40-60; K ₂ O = 100-140.
Apple & Pear		
Netherlands	Kodde, 1990	Depending on leaf analysis, vegetative growth and yield; advised rates in kg/ha: N = 0-100; P ₂ O ₅ = 0-40; K ₂ O = 0-300.
Apple, Pear & Peach		
South Africa	Kotze, 1990	Depending on yield, growth (N), soil (P ₂ O ₅ and K ₂ O) and leaf (P) analysis; minimum and maximum rates in kg/ha: N = 35-185; P ₂ O ₅ = 0-115; K ₂ O = 0-360.
Apple, Pear & Plum		
Denmark	Vang-Petersen, 1990	According to leaf analysis; standard rates in kg/ha when soil is kept clean: N = 0; P ₂ O ₅ = 0; K ₂ O = 120 and MgO = 12.
Apricot		
South Africa	Kotze, 1990	Depending on yield, growth (N), soil (P ₂ O ₅ and K ₂ O) and leaf (P) analysis; minimum and maximum rates in kg/ha: N = 15-140; P ₂ O ₅ = 0-90; K ₂ O = 0-290.
Apricot, Plum & Cherry		
Italy	Failla, 1990	Depending on leaf analysis, vegetative growth and yield; example in kg/ha: N = 50-150; P ₂ O ₅ = 0-50; K ₂ O = 0-150.
Peach		
France	Agenes & Terenne, 1988	Based on yield, growth and leaf analysis; example in kg/ha: N = 50-100; P ₂ O ₅ = 50-100; K ₂ O = 100-250.
Italy	Failla, 1990	Depending on leaf analysis, vegetative growth and yield; example in kg/ha: N = 50-150; P ₂ O ₅ = 0-50; K ₂ O = 0-200.
Japan, Nagano	Katou, 1990	Depending on soil fertility; rates in kg/ha: N = 140-180; P ₂ O ₅ = 60-80; K ₂ O = 100-120.
---> see also: Apple, Pear & Peach		
Pear		
France	Boulay, Decroux & Diris, 1984 Decroux & Boulay, 1988	Based on yield, growth and leaf analysis; example in kg/ha: Summer cultivars: N = 130-150; P ₂ O ₅ = 50-100; K ₂ O = 100-250
Pear		
Italy	Failla, 1990	Depending on leaf analysis, vegetative growth and yield; example in kg/ha: N = 0-100; P ₂ O ₅ = 0-25; K ₂ O = 0-100.

Japan, Nagano	Katou, 1990	Depending on soil fertility; rates in kg/ha: N = 160-200; P ₂ O ₅ = 60-80; K ₂ O = 120-160.
---> see also: Apple & Pear, Apple, Pear & Peach, Apple, Pear & Plum		
Plum		
France	Cordier, Huguët & Tabardon, 1988	Based on yield, growth and leaf analysis; example in kg/ha: N = 70-120; P ₂ O ₅ = 80-120; K ₂ O = 160-220.
South Africa	Kotze, 1990	Depending on leaf analysis, vegetative growth and yield; example in kg/ha: N = 25-137; P ₂ O ₅ = 0-115; K ₂ O = 0-360.
---> see also: Apple, Pear & Plum; Apricot, Plum & Cherry		
Sour Cherry		
Denmark	Vang-Petersen, 1990	According to leaf analysis; standard rates in kg/ha when soil is kept clean: Cultivar "Montmorency": N = 0; P ₂ O ₅ = 0; K ₂ O = 120; MgO = 20 Cultivar "Dard": N = 110; P ₂ O ₅ = 0; K ₂ O = 120; MgO = 20
Germany	Quast, 1990	Based on yield, growth and leaf analysis; example in kg/ha: N = 140-150; P ₂ O ₅ = 80; K ₂ O = 160-170.
Sweet Cherry		
Denmark	Vang-Petersen, 1990	According to leaf analysis; standard rates in kg/ha when soil is kept clean: N = 100; P ₂ O ₅ = 0; K ₂ O = 120; MgO = 20.
Germany	Quast, 1990	Based on yield, growth and leaf analysis; example in kg/ha: N = 100-120; P ₂ O ₅ = 80; K ₂ O = 160-200.
---> see also: Apricot, Plum & Cherry		

Further reading

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