

Management of Japanese Quince (*Chaenomeles japonica*) Orchards

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SUMMARY

In this paper, advice for establishment and management of Japanese quince (*Chaenomeles japonica*) orchards is summarised. Japanese quince is a minor fruit crop in Latvia and Lithuania, currently being developed by plant breeding research. Preferences for site and soil are discussed and recommendations for planting and field management are proposed.

INTRODUCTION

Among the four known *Chaenomeles* species native to China, Tibet and Japan, Japanese quince (*Chaenomeles japonica*) is the species best adapted to the North European climate and it has been introduced as a minor fruit crop in Latvia and Lithuania (Rumpunen 2002, Tiits 1989, Tics 1992). At present, we are aware of only one active plant breeding programme that is aimed at improving Japanese quince as a fruit crop. This programme is being jointly conducted by the Department of Plant Biology, Helsinki University, Finland; Dobele Horticultural Plant Breeding Experimental Station, Latvia; the Lithuanian Institute of Horticulture, Lithuania and Balsgård–Department of Horticultural Plant Breeding, Swedish University of Agricultural Sciences, Sweden (Rumpunen 2002). As a first step to improve Japanese quince, phenotypic selection has taken place in orchards in Latvia and Lithuania. Superior selections have been cloned and planted in comparative field trials in Finland, Italy, Latvia, Lithuania and Sweden. Field management trials are in progress and will result in improved recommendations for growing of Japanese quince.

LOCATION

Site selection

For the Japanese quince orchard, a sunny site on a slight slope should be chosen to reduce the risk of frost damage to both flowers and fruits. However, the orchard could if necessary be established on plain ground since the long and abundant flowering of Japanese quince plants reduces the risk of spring frost damage.

Japanese quince plants have a widespread and deep root system. The plants can therefore be grown in rather dry conditions, and Japanese quince have been recommended for cultivation on slopes to prevent soil erosion.

SOIL

Soil preferences and soil preparation

It is important to select a site with proper soil for optimum growth of Japanese quince plants. Well-drained, acid mineral soils with some content of organic material and some clay should be selected. Soil pH should be below 6, since Japanese quince plants are prone to chlorosis. In dry alkaline soils, plant chlorosis is likely to be more pronounced than in alkaline soils with sufficient moisture. In the case of alkaline conditions, elemental sulphur or iron sulphate may be applied for soil acidification before planting.

Japanese quince plants are bad competitors, especially as young plants. Therefore perennial weeds must be eliminated before planting. For this purpose repeated mechanical tillage or, in integrated growing systems, herbicides may be used. Organic material (60–100 t/ha) should be supplied to sandy soils and to poor soils before planting. If manure is used as a fertiliser, additional weed control is often needed.

Before planting, mineral fertilisers and liming materials should be provided according to the soil requirements as indicated by a soil test. Dolomitic limestone (calcium/magnesium carbonate), if necessary, should be applied half a year to a year before planting, whereas phosphorus and potassium may be applied immediately before planting in amounts from 150 to 300 kg/ha. In the case of potassium, potassium sulphate is recommended (which will help to maintain a low pH) instead of potassium chloride.

PLANTING

Planting time

Japanese quince plants can be planted in early spring or in autumn. In areas with unstable snow cover and cold winters (temperatures below -20 °C) spring planting is recommended since young plants are vulnerable to winter frost damage. Spring planting may also be advantageous if the orchard is not fenced and protected against hares and rabbits.

If spring planting is preferred, special attention should be paid to the storage conditions for the plants. Japanese quince plants start to grow very early because of a short period of dormancy. Late spring planting may result in a reduced number of established plants, in particular if irrigation is not possible. It is also necessary to store plants properly (-1 °C) since plants are very susceptible to grey mould (*Botrytis cinerea*).

If planting is done during late autumn, the plants should be mulched using peat, wood chips or sawdust. The mulch layer must be at least 10 cm thick to prevent frost damage to the roots.

Plant material

Throughout the Baltic countries, all commercial plantations with Japanese quince were previously established from seedlings. The mating system and the genetic diversity resulted in large variability in plants for traits such as plant growth, fruit ripening, fruit quality and yield. These traits were not significantly improved, despite repeated mass selection by growers and nurserymen. Therefore, seedlings should no longer be planted. Instead, vegetatively propagated varieties, when available, should be used for establishment of new commercial orchards.

Since Japanese quince is a cross-pollinated crop, at least three different varieties should be planted in the same orchard to ensure sufficient fruit set. For planting, potted plants should be used because they have better survival and start to bear earlier than bare-rooted plants. Field management and harvest are made easier if erect and not too dense varieties are planted. Early varieties are preferable in areas with early autumn frost.

Planting scheme

The planting scheme to be used for Japanese quince depends on the vigour of varieties and on field management practices applied. Usually Japanese quince plants are planted at a distance of 2.5–3 m between the rows and 0.6–0.9 m within the rows.

When only one main variety is planted, a pollinator variety should be planted in every fifth row (Figure 1a). When all varieties are considered equally important, 2–4 rows should be planted of each variety, repeatedly (Figure 1b), to ensure good pollination and fruit set.

FIELD MANAGEMENT

Field management practices should aim at creating proper conditions for the crop development throughout the life span of the orchard, which may be as long as 15–20 years.

Weed control

The ground should be kept free from weeds, at least in a strip 1 m wide within the rows. Between the rows, a cover of grass may be established, which will provide a firm surface for field transport. To reduce competition for water and nutrients during plant establishment, it is recommended that the grass is not sown until the second year.

Mechanical weeding is the common method for controlling weeds in most orchards. For the dwarf and spreading Japanese quince plants, mechanical weeding is less efficient and must be complemented by hand weeding during the first three years. The equipment may also damage fruits during late stages of fruit development, and mechanical weeding cannot be resumed until after harvest.

In an integrated growing system, herbicides may be used to control weeds efficiently until August. At the same time labour costs are reduced compared to mechanical weeding practices. During fruit ripening, weeds must be controlled mechanically and herbicides should be avoided in young orchards since they reduce growth of plants.

For Japanese quince, any mulch tested was superior to herbicides and mechanical weeding in promoting a high yield (unpublished results). This may be partly explained by increased moisture and soil

Figure 1. Recommended planting schemes for Japanese quince when three varieties are used (A, B and C).

a) A being the main variety, B and C being pollen donors

B	A	A	A	A	C	A	A	A	A	B	A	A	A	A	C
B	A	A	A	A	C	A	A	A	A	B	A	A	A	A	C
B	A	A	A	A	C	A	A	A	A	B	A	A	A	A	C
B	A	A	A	A	C	A	A	A	A	B	A	A	A	A	C
B	A	A	A	A	C	A	A	A	A	B	A	A	A	A	C
B	A	A	A	A	C	A	A	A	A	B	A	A	A	A	C

b) Varieties A, B and C planted in equal number

A	A	B	B	C	C	A	A	B	B	C	C	A	A	B	B
A	A	B	B	C	C	A	A	B	B	C	C	A	A	B	B
A	A	B	B	C	C	A	A	B	B	C	C	A	A	B	B
A	A	B	B	C	C	A	A	B	B	C	C	A	A	B	B
A	A	B	B	C	C	A	A	B	B	C	C	A	A	B	B

temperature, and partly by the fact that mechanical weeding and herbicides may negatively influence root growth.

In Japanese quince orchards, mulching with organic material alone does not control perennial weeds. Weeds probably start to grow already at the beginning of the second vegetation period. To prevent germination of annual weeds, 10 cm mulch should be provided in the first year and then 5 cm should be added each year. When wood chips or sawdust are used, nitrogen must be supplied to compensate for losses due to mineralisation.

The best weed control is achieved by synthetic mulches (*e.g.* black plastic and woven plastic), which at the same time promote plant growth and yield (Figure 2). To improve durability, allow for traffic and mechanical harvesting, the synthetic mulch may be covered by gravel or organic mulch. Another advantage provided by the mulch is that the fruits are prevented from contamination by soil. The use of organic synthetic mulches may also reduce infection by fungal diseases.

NUTRIENT MANAGEMENT

Results from fertiliser trials with varieties of Japanese quince plants are not yet available. The preliminary advice for nutrient management is therefore based on fruit contents of macronutrients, yield estimates and experiences from apple and pear. The fertiliser recommendations should be further adjusted according to soil tests in each orchard.

When the mineral composition of Japanese quince fruits was analysed for fruit flesh and seeds (Table 1), it was observed that the composition of macronutrients was close to that of pear. Thus, the estimated nitrogen requirement seems to be 2–3 times higher than for apple, mainly because of the high content of seeds (with proteins) in the Japanese quince fruit. Rather high amounts of potassium, calcium and magnesium were also detected in the fruit flesh. To compensate for yield losses alone at a yield of 10 tons per ha, 80 kg N, 15 kg P, 120 kg K, 12 kg Ca and 6 kg Mg should be provided (Table 2). Thus, depending on the results of the soil analysis and expected yield, it may be recommended to supply 100–



Figure 2. Black plastic is an efficient mulch for control of weeds in Japanese quince (*C. japonica*) orchards. Furthermore, plant growth and yield are increased and fruits are not contaminated by soil.

Table 1. The range and average (based on three genotypes) in composition of macronutrients in Japanese quince (*C. japonica*) fruit flesh and seeds. The fruit flesh and seeds constitute approximately 90 and 10%, respectively, of the fruit fresh weight.

Nutrient	Range (kg/ton)	Average (kg/ton)
Fruit flesh		
Nitrogen, N	4.0–6.4	5.0
Phosphorus, P	0.7–1.5	1.0
Potassium, K	12.0–13.0	12.5
Calcium, Ca	0.9–1.6	1.2
Magnesium, Mg	0.3–0.5	0.4
Seeds		
Nitrogen, N	2.8–4.3	35.0
Phosphorus, P	4.7–6.1	5.4
Potassium, K	8.2–9.0	8.6
Calcium, Ca	1.4–1.5	1.4
Magnesium, Mg	2.1–2.5	2.3

Table 2. The amount of macronutrients to be applied to Japanese quince (*C. japonica*) plants to compensate for yield losses at various yield levels.

Yield (ton/ha)	N (kg/ha)	P (kg/ha)	K (kg/ha)	Ca (kg/ha)	Mg (kg/ha)
1.0	8.0	1.4	12.1	1.2	0.6
5.0	40.0	7.2	60.3	6.2	3.0
10.0	80.0	14.4	120.6	12.4	5.9
15.0	120.0	21.6	180.9	18.6	8.9
20.0	160.0	28.8	241.2	24.8	11.8

180 kg of nitrogen and 140–260 kg potassium (using non-chloride fertilizer) annually. In the case of slightly alkaline conditions, the use of ammonium sulphate as the nitrogen source will help to maintain a low soil pH. In sandy, acid soils (at a pH below 5.5), deficiency of Mg may appear and additional Mg should be provided as dolomitic limestone. Deficiency of Mg can also be induced by too high amounts of potassium fertiliser. In alkaline soils deficiency of iron may be compensated for by repeated foliar application of iron chelates, since soil application of iron chelates is not economically viable in practice.

PESTS AND DISEASES

There are only few reports of pests and diseases on chaenomeles plants (for references see Norin & Rumpunen 2003). Among pests and diseases, fungal diseases appear to predominate. Symptoms of several fungi, causing leaf spot (e.g. *Septoria cydoniae*, *Phoma pomorum*, *Alternaria alternata* and *Ramularia* sp.), fruit spot (e.g. *Septoria cydoniae*, *Phlyctema vagabunda*, *Alternaria alternata* and *Phoma exigua*), and storage damage to fruits (*Botrytis cinerea*, *Phlyctema vagabunda* and *Penicillium expansum*) have been recorded, but none is currently considered severe, unless fruits are stored for a longer period. Furthermore, since fruits are not consumed fresh but processed, some damage to the skin may be tolerable. Japanese quince is thus considered a comparatively healthy plant, amenable to organic growing systems.

HARVEST

There are still no precise criteria for ripening, except that the skin turns yellow, the seed coat turns dark brown, the skin gets sticky and the fruit becomes fragrant. In spite of the very firm fruit flesh, the fruit skin is very sensitive to mechanical damage. Fruits should therefore be handled carefully during harvest, if they are not immediately processed or frozen. If carefully stored in *e.g.* 12–15 kg boxes, the fruits could be stored for 2 months at 1 °C in a relative humidity of at least 85%.

LITERATURE

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