

This may include one or all of the following:

- Inspection during the previous growing season.
- Plants may be required to grow in sterile media for a specified time prior to export.
- Soil analysis for soil borne pests and diseases. For example: Potato Cyst Nematode.
- An export spray programme may need to be followed.

In conclusion, I would like to say that New Zealand's ability to develop and maintain overseas markets depends on its continued reputation of exporting quality plants and plant products, free from pests and diseases. The whole industry is responsible for maintaining this reputation. As I have only been able to cover both import and export in general principles, I suggest that if you have any further queries that you contact your nearest MAF office.

PRODUCTION OF WASABIA JAPONICA IN JAPAN

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Wasabi (*Wasabia japonica* [syn. *Eutrema japonica*; *E. wasabi*]) is a member of the Cruciferae family, a semi-aquatic native to the montane forest areas of Japan. Wasabi produces a stem, often referred to as a rhizome, in a similar fashion to a small brussel sprout. As the stem grows the lower leaf petioles fall off, and when the stem is about 15 cm long it is harvested. Traditionally, the stem is ground up into paste and used as a condiment with Sashimi (raw fish), Sushi (fish and rice) and Soba (buckwheat noodles). The best quality stems are sold fresh through the wholesale markets. In recent years wasabi has become more popular resulting in both the lower grade stems and leaf petioles being used for processing. At the Tokyo Central Wholesale Market processing wasabi sells for low prices and price premiums can only be obtained for high quality produce.

Wasabi is grown on all major islands of Japan except Hokkaido, and is also grown in Taiwan and North Korea.

In Japan the area planted in wasabi has remained fairly constant in recent years with changes being due mainly to typhoons damaging the wasabi beds. Japan's total yield varies from 2,000 to 3,000 tons/year.

Wasabi requires an equitable climate with optimum growth at

an air temperature between 8 and 18°C, and a high even rainfall. It is produced both as a terrestrial and as an aquatic plant; 72% of the wasabi sold as fresh stems on the Japanese wholesale markets is grown in water with water quality playing an important role in producing crops of a high standard. Wasabi grows best in cool water and in Japan the water for growing wasabi is derived from springs as opposed to water from catchment runoff. The water must also be in constant supply, contain sufficient plant nutrients, and be free of organic contamination.

In Japan it was suggested that the regional geology and soils were significant in producing good wasabi. Quartz and basalt terrains were considered optimum.

Wasabi does not grow well in full light in summer with plants being shaded from April through to August. Shading was provided either naturally using deciduous black alders (*Alnus japonica*) planted evenly throughout the wasabi beds or by using shade cloth.

Propagation. Wasabi is propagated either by seed or by using offshoots from parent plants. Seed is used to eliminate virus build up and where it was not necessary to maintain a selected cultivar. Offshoots were used when it was necessary to maintain a selected cultivar. Propagation by tissue culture had been developed in Japan so that viruses can be eliminated while still maintaining the cultivar.

Seed propagation:

Wasabi flowers and produces seed during spring. Seeds are available for collection in May and June in Japan. They are usually stored until sowing in January and February. Germination normally takes about 2 weeks. Seed is precision sown by hand into carefully prepared nursery beds.

In about August in Japan (February in New Zealand) selected seedlings are lifted, washed, and the adult leaves removed with the petioles cut at about 5 to 10 cm from the stem. This allows for planting in September.

Vegetative propagation:

Offshoots which are broken from the main wasabi plant at harvesting are generally used for vegetative propagation. Harvesting can occur at any time of the year, however the main crop is produced from late spring to early autumn. When the mature wasabi plants are harvested they are lifted from the ground and the roots and lower stem cleaned. The offshoots which develop from the base of the stem are broken from the main stem, trimmed and the main leaves removed. The offshoots are then bundled ready for planting directly into a prepared wasabi bed.

Production Methods. In Japan three production systems were visited: (1.) soil cultivation, (2.) hydroponic production, and (3.) beds formed in and along small streams.

Soil Cultivation.

Approximately half of Japan's wasabi is grown directly in soil. A 30 ha farm in Nagano prefecture was visited to view this form of planting. Here the wasabi was being grown in mountain woodlands. Before planting either offshoots or seedlings the ground was cultivated and mature compost and phosphate fertilizers were applied. Nitrogen was not recommended. Before planting the leaves of the propagation material were removed and used as a mulch around the plants. On this particular property plants were left for up to three years before harvesting. Most of the harvested material from this property and others growing wasabi in soil was sold to the processing industry. Two crops were grown on the same site before the ground was fallowed for three years.

Hydroponic Production

Near Hotaka in Nagano Prefecture one grower was experimenting with wasabi in hydroponics. Wasabi was supported by ceramic pellets in a trough. No work had been done on specific nutrient problems; the grower used a standard hydroponic nutrient formula. There was, however, a problem with plants wilting when the temperature got above 20°C.

Beds formed in and along small streams

Stream beds were modified for growing wasabi in one of two ways. In larger braided stream beds, river gravel was mounded into herring bone designs with wasabi being planted on these mounds. In steeper country the stream beds were often terraced to provide growing beds for wasabi.

1. Mounded beds: One of the largest farms using the mounded bed system was situated at Hotaka in Nagano. This 15 ha property produced 300 tones of wasabi per year. The beds were arranged in herring bone fashion and carefully graded to allow for maximum water flow not only through the troughs between the beds but also through the beds, thus allowing for a maximum amount of water to pass around the root zone of the wasabi plant. Because of the small stream bed gradient, wasabi at this site was being grown on raised beds above the water level in order to allow for maximum water flow through the root zone.

At Hotaka the growing season using this system was approximately two years from final planting out of the seedlings. At harvest each seedling produced approximately 15 stems with a total plant weight of around two kilograms. The best stems were packaged for the fresh market but most was used by a thriving local processing industry.

2. Formed beds: The most important feature of the formed bed was that it allowed for water to pass over the bed around the wasabi stem. This allowed for a more even environment resulting in more growth of the crop.

There were three methods of constructing beds:

(a). The Keiryu style was used in situations where there was insufficient spring water to use either of the other two methods. Disadvantages of this system included uneven crop growth and quality and a long growing period. Because of a lack of water to help maintain an even environment this method was restricted to areas that experience cool summers.

(b). The Jizawa style was used in the Abe area of Shizuoka Prefecture. Beds were terraced and filled with small pebbles to a depth of 10 cm. Although water flow across the top of the bed was high thus helping to maintain an even environment, water flow through the bed was restricted resulting in uneven crops.

(c). The Tatimi ishi or "Stone mattress" style was used extensively in the Izu Peninsula area of Shizuoka Prefecture. This method of bed construction resulted in even cropping giving wasabi of very high quality.

The beds were about one metre deep. The drainage of water from the base of the bed was very important and drainage channels were constructed at the base of the bed, or alternatively, drainage pipes or field tiles were used. Boulders up to 60 cm across were laid to a depth of 40 cm with stones and pebbles on top of them with the size of the material decreasing as the height increased. The top 10 to 15 cm of the bed was river sand. Once constructed these beds should last for 15 to 20 years.

A property in Izu Peninsula using the tatami ishi style of bed construction was visited. There were 12 ha of wasabi in several adjoining valleys. Twenty-five people were employed. Spring water which appeared along the cliff face was collected in channels and diverted onto the wasabi beds. After passing through one or two beds water was then channeled to waste. Waste and flood water was collected in a large central channel running down the centre of the valley. Between the collection and flood channels wasabi beds were constructed wherever possible. Water from the collection channels was diverted to the wasabi beds using a range of interconnecting channels and pipes. Harvesting was done in June and July with plants being lifted, cleaned, with the side shoots kept to establish the next crop.

Pests and Diseases

For successful wasabi cultivation the control of diseases was of prime importance. Wasabi, like many other cruciferae, was host to a wide range of diseases which can cause serious crop losses.

The worst diseases were those caused by *Erwinia* spp. and *Phoma* spp. Both diseases affect the stem thus having a severe affect on crop returns. There was also no economic chemical means of controlling these diseases. Thus attention should be paid to maintaining good crop hygiene and a good growing environment for the wasabi.

Caterpillars and aphids were regarded as the worst pests

(aphids because of their role in transmitting virus disease). The Japanese recommend spraying an insecticide 4 times during the summer.

Post Harvest. Wasabi for the fresh market was packed into 2 or 4 kg wooden boxes. The 4 kg boxes were traditional, but there has been a trend in recent years to use 2 kg boxes. Wasabi for the fresh market was transported as flat cargo on trucks to the wholesale markets. Tokyo market receives produce from all over Japan and in some cases this can take up to three days between harvesting and arriving at the market.

Relevance to New Zealand. Fresh wasabi stems have a high profit profile when sold on the wholesale markets in Japan. Although wasabi is a robust plant and will grow in a wide range of environments the conditions necessary to produce a high quality product are specific. The most important factors are an equitable climate and a constant supply of clean cool water. Many areas of New Zealand have both a climate and water supply that would suit wasabi production.

Other factors that should be included but may not be critical include land contour for good drainage, nutrient status of the water and light requirements. These factors can all be modified to suit the crop so should not prove a problem to establishing an industry in New Zealand.

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