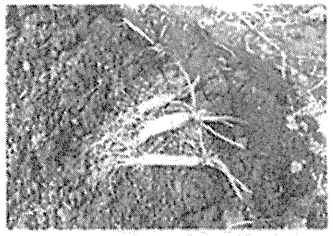
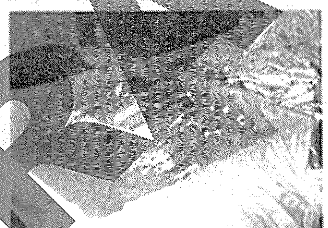


Product

Processed product (White Ginseng)



Processed product (Red Ginseng)

Crude drug
(White Ginseng)

Peony Root

1. Plant name

Peony

Crude drug name: Shakuyaku

Scientific name: *Paeonia lactiflora* Pallas

2. Part used

Root

3. Plant description

Perennial herb in the family Paeoniaceae. Normally cylindrical, fleshy root. Stems grow densely upright with slight branching in the upper parts. Leaves alternate and are bi-ternately compound, leaflets are narrow ovate, lanceolate, or round. Flowers are terminal, with about 10 petals and numerous stamens, about 3 to 5 follicles, each incorporating numerous seeds.

Found from north-eastern, northern, and north-western China to Siberia in the former USSR. Not originally found in Japan.

4. Crude drug characteristics and places of production

1) Characteristics

Peony root is cylindrical, 7 to 20 cm long, 1 to 2.5 cm in diameter, brownish to light gray brown external surface, distinct longitudinal wrinkles, wart-like lateral root scars, and elongated horizontal lenticels. Transverse surface is fine light gray brown, and the xylem has light brown radial lines.

Peony root has a characteristic smell, its taste is initially faintly sweet, then astringent and very slightly bitter.

2) Main places of production

Japan: Hokkaido, Gumma, Nagano, Nara

China: Henan, Shantung, Anhui, Zhejiang, Sichuan, Guizhou

5. Variety characteristics

The Japanese Pharmacopoeia stipulates that the botanical origin of shakuyaku is Peony or its other allied species.

1) Morphological characteristics

The plant types include an erect form and a spreading form. At germination, the bud takes a closed form and is green, red, or magenta. Leaves alternate and are mono-, bi- or tri-ternately compound, terminal leaflets are narrow or round. Flowers are classified into 9 forms according to the pistil/stamen petalody, and petal tips are either round or concave.

2) Biological characteristics

Has wide adaptation, grows in either cool or warm regions, but is classified as a cool climate plant as it is native to cold regions, is subject to little disease damage, and its large rhizomes can be harvested with large machinery.

3) Ingredients

Ingredients include the glycosides paeoniflorin (content between 2% and 6%), albiflorin, oxypaeoniflorin and gallotannin.

4) Regional adaptability and growth characteristics

Prefers a somewhat cold climate.

a) Climate classification

(1) Temperature
- (i) Coldness classification: I to IV
- (ii) Warmth classification: 45 to 100

(2) Sunshine conditions: II to IV

b) Soil classification

(1) Soil type: I to III

(2) Suitable soil

(i) Permeability and water retention condition suitability

Suitable for locations with good permeability and moisture retention

Excessive moisture, and particularly stagnant water, are not favorable.

(ii) Soil properties and texture

Suitable for sandy to clay loams

(iii) Suitability to fertile soil

Suitable for fertile soil

(3) Need for light shielding: None

6 Cultivation

1) Varieties

When categorized by flower type there are 9 broad categories: 1 single, 2 Japanese, 3 anemone, 4 crown, 5 bomb, 6 semi-rose, 7 rose, 8 semi-double, and 9 flat rose. In terms of botanical origins, there are the *Washaku* strain, grown in Japan since the Edo Period; the *Yoshaku* strain, spread from Siberia and China into the West and bred there; and the *Holland Shakuyaku* strain, a strain native

to Europe and improved for horticulture. In recent years, crossing varieties has increased the number of hybrid strains. Japanese Kampo has a history of using *Washaku* and varieties of the *Washaku* strain have been used for medicinal purposes as the ingredients in *Washaku* differ from *Yoshaku* to some extent.

2) Propagation

It has two propagation methods: seedling and division.

3) Cultivation

a) Suitability

Suitable for cold region climate. Suitable for sandy to clay loams in locations with good permeability and moisture retention. Stagnant water is particularly unfavorable, so ground should be prepared to remove depressions.

b) Propagation

When propagating by seedling, rooting is followed by exposure to cold before sprouting. The optimal temperature for rooting is 20°C. It will not root when the temperature reaches 25°C, perhaps due to heat damage. In temperate regions, sowing is best, if sown by mid-November at the latest it will root before year end and sprout after wintering, however, in cold regions, seeds should not be sown directly into seed beds but layered in sand in the first year then selected after sprouting in about July and August then sown in beds. To shorten the seedling raising period, induce rooting by covering the seeds in sand and leaving them for at least 40 days in a warm place, about 20°C, then either expose to low temperature (4°C) for at least 30 days, or bury under snow for sowing in spring. Seedlings will be small in the first year, so using seedlings from the second year yields better growth and harvest.

To obtain plants by division, remove all roots from the harvested rootstock then divide into 30 to 50 g portions then sow.

c) Planting

As rootlets sprout profusely from September to October, planting must occur either during that period, or immediately before, to ensure the plants take root by year end. Select fields that do not have poor permeability or depressions and first apply about 5000 kg of partially cured compost per 10 a. After applying compost, prepare the soil by making 25 to 30 cm deep furrows with a plow, then tilling two or three times with a rotary hoe. Planting rows should be deep and seedlings should be planted facing up, and covered with a thick layer of soil.

Planting density is between 2500 and 4500 rootstocks per 10 a. Sixty-centimeter furrow spacing is optimal for management if harvesting in the third year, while 80 to 90 cm spacing is optimal for harvesting in the fourth year.

d) Fertilizers

The quantities for application (essential elements) per 10 a are 1 to 2 kg nitrogen, 0.5 to 1.5 kg phosphate, and 1 to 2 kg potassium in the first year; 7 to 7.5 kg nitrogen, 3.5 to 5.5 kg phosphate, and 7 to 8.5 kg potassium in the second year; and 11 to 14 kg nitrogen, 9 to 10 kg phosphate, and 10 to 15 kg potassium in the third year. If cultivating for five years, a further 15, 12, and 25 kg respectively are required in the fourth and fifth years. They should be applied twice, once around spring budding and once after blooming.

e) Management

Although it is a plant that prefers sunshine, it has relatively little resistance to drought, so the soil's water-holding capacity and permeability must be constantly maintained. First intertillage is after spring fertilizing, then further tilling and weeding should follow according to subsequent weed growth and reduction of soil looseness. Particular care is required with aging fields as permeability decreases remarkably. Management operations appropriate to peony include disbudding and flower thinning, which assist root enlargement. They are usually picked off when the buds start to swell.

f) Pest and disease damage

Gray mold is the disease that causes the most damage. The leaves develop brown lesions that enlarge before that portion of the leaf dies. Flowers show signs of blossom blight and gray mold develops on the lesions in both, however, disease susceptibility differs among varieties. Other disease damage includes mottle leaf, rust disease, and powdery mildew.

Although rudimentary, the most effective means of controlling disease damage is to remove diseased foliage from the field and burn it.

Pest damage includes the larvae of the swift moth eating into the stalks and toppling them, and when the root-knot nematode feeds on the roots, they form knots that hinder plant growth.

g) Harvesting

The dry matter weight of the underground part increases until the foliage yellows or withers. However, because the optimal time to plant seedlings is around the time the rootlets emerge, harvest should occur in time with the next planting, if using divided rootstocks.

First, cut off the foliage and ensure it is removed from the field. Then, if digging by hand, use a shovel or hoe starting from one side of the field. If digging with a machine, attach a large digger

to a tractor, determine the depth according to root growth, then dig up very slowly. Gather the dug-up roots in one place, remove the roots from the rootstock (commonly called the root collar), the rootstock to be used for planting, and the root for medicinal use. After breaking them off, sort the roots into large, medium and small then ensure they do not dry out until preparing them in line.

h) Preparation

(1) Semi-drying

Red Peony Root (also called "in-the-skin") is root that has been washed and dried. White Peony Root (also called "skin-off") is root that has been dried after its surface skin is removed. Root with the surface skin is not prone to discoloring, but is difficult to dry, while conversely, root with the skin removed is prone to rot and discoloring, but dries quickly. A peeler is usually used to remove the surface skin. To dry the roots, fix racks in a drying shed, spread the skinned roots sparsely over the racks, and ensure good exposure to airflow, but not the sun. Drying with artificial heating may be required for roots that do not dry sufficiently in the air. High temperature, sun, and tannin are the commonly known causes for discoloring and deterioration, therefore preparation should be done after temperatures fall. On the Pacific Ocean coast, various techniques are employed for drying, shade drying and so on using the cold wintery winds.

(2) Blanched, dried Peony Root

In the past, blanched, dried Peony Root was prepared for export, but it is currently not being produced in Japan. Its preparation methods require high-level skills and depth of experience, and various special techniques had been devised. Basically, preparation involves sorting the roots by size, blanching (at about 100°C for 5 to 10 minutes) either before or after the skin is peeled, then checking that the heat has permeated to the core, before shade drying. The purpose of blanching is to gelatinize the starch thereby improving preservation.

i) Yield

The yield for third year un-processed roots is 1000 to 4000 kg (target yield is at least 3000 kg).

7. Crude Drug Quality Evaluation

1) Japanese Pharmacopoeia test adequacy

a) Crude drug description	As in 4. 1)
b) Total ash	Not more than 6.5%
c) Acid-insoluble ash	Not more than 0.5%

2) Content of main ingredient

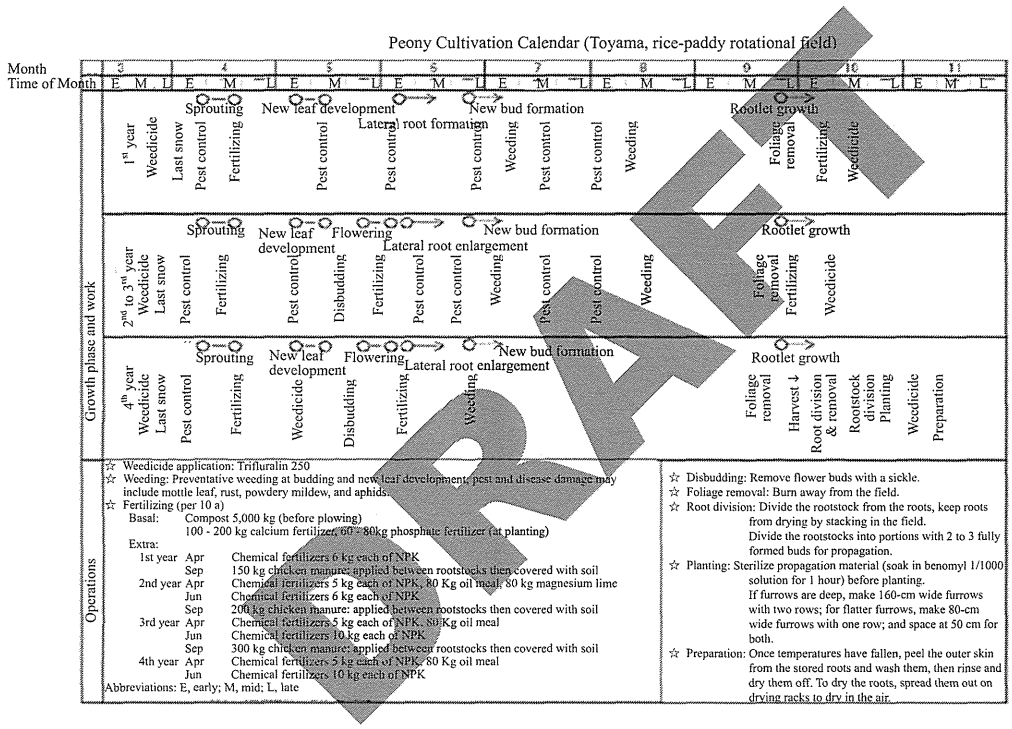
The Japanese Pharmacopoeia, Twelfth Edition describes the liquid chromatography assay for paeoniflorin and puts the content at 2% to 6% (as reference value).

8. Characteristic Classification

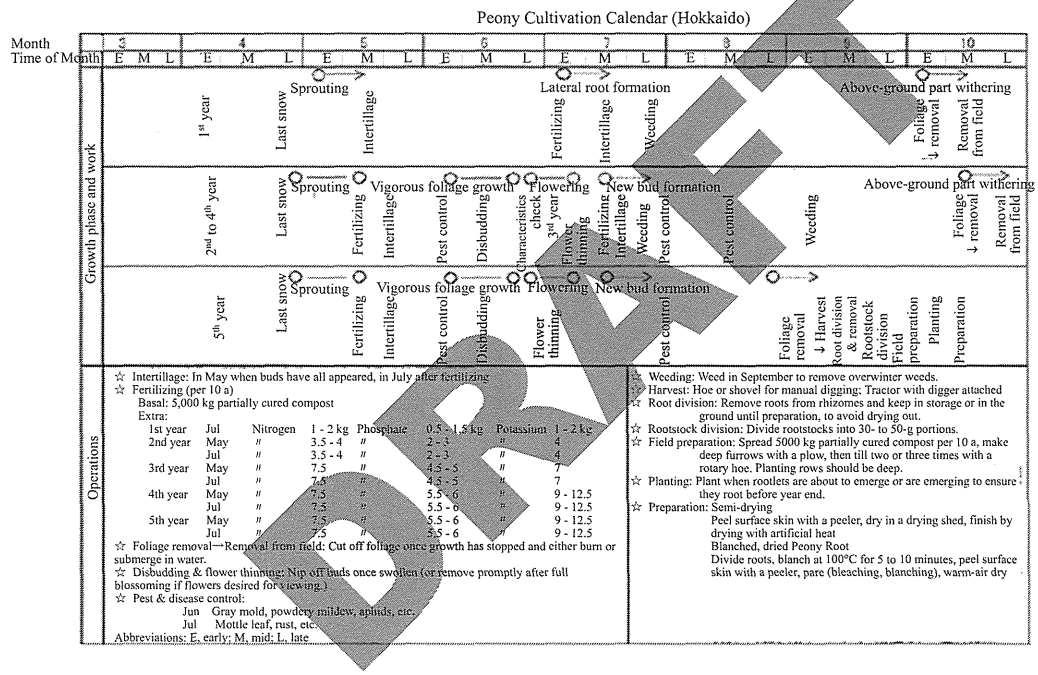
Peony Root Characteristic Classification

Characteristic		Variety or strain name	
Category	Form or quality	Hokkaido improved varieties	(Reference variety) Festiva Maxima
Plant growth	Upright or spreading (Plant growth type at bud coloring)	Upright	Upright
Bud	Closed or open form (Bud form at sprouting)	Closed	Closed
	Bud color (Color of bud stalk at sprouting)	Green	Green
Stem	Stem length (Third year, from ground to directly below flower at full blossom)	Short (72 to 86 cm)	Medium (89 to 99 cm)
	Stem thickness (Third year, from ground to middle of third node)	Thin (4.8 to 7.2 cm)	Medium (6.5 to 9.0 cm)
	Number of stems (Third year, number of stems per rootstock)	Few (9 to 17)	Very few (6 to 12)
Leaf	Number of compound leaves (Third leaf from ground)	Bi-ternate	Bi-ternate
	Leaflet form (Third terminal leaflet from ground)	Lanceolate	Round
	Leaf size (Third leaf from ground)	Medium	Medium
	Leaf apex pendulousness (Extent of leaf blade pendulousness in relation to leaf stalk)	Upwards	Upwards
Flower	Flower forms (1 single, 2 Japanese, 3 anemone, 4 crown, 5 bomb, 6 semi-rose, 7 rose, 8 semi-double, and 9 flat rose)	Single	Crown
	Flower size (Flower diameter at full blossom)	Medium	Medium
	Flower color at full bloom (color at center of outside petals)	White (Green White (green-white)	White (green-white)
	Stigma color (cream, pink, red)	Pink	Red
	Present/absence and extent of ovary hair	Present	Present
	Stem branching (Extent of sprouting lateral buds)	Many	Medium
Root	Root form (cylindrical or fusiform)	Cylindrical	Cylindrical
	Number of roots (Third year, number of roots per rootstock)	Medium (17 to 51)	Medium (21 to 38)
	Length of roots (Third year, length of roots per rootstock)	Medium (3 to 10 m)	Medium (5 to 8 m)
Earliness	Earliness of bud sprouting (third year)	Early	Early to medium
	Earliness of flowering (third year)	Early	Medium
Ingredient	Paeoniflorin content	2.3% to 4.0%	3.1% to 3.8%

(Plants grown at Hokkaido Division, Research Center for Medicinal Plant Resources, National Institute of Biomedical Innovation.)



9. Cultivation Calendar



10. Background Materials

1) Propagation material origins

Peony is listed as a physically strengthening medication in *Shen Nong Ben Cao Jing*, which is well known as a text of the Chinese Jin Dynasty (265 to 420). At the same time, a red and a white strain are described in *Gu Jin Zhu,* another text of the same Jin Dynasty, as being grown in gardens and used as decorative plants.

It is surmised that the plant was brought to Japan in the Nara Period as a crude drug. It is thought that the archaic names *ebisugusa*, *kahoyokusa*, and *kahokusa* were Heian Period names for the plant. In the Muromachi Period, it was used for ikebana and was grown in the gardens of feudal lords. In the Edo Period, many varieties were produced, all under the name *washaku* (Japanese peony). It is likely that one of these varieties was used for medicinal peony root.

The improved Hokkaido variety used for the classification of characteristics is a variety of *Washaku* and is listed as strain No. 4 out of 135 strains selected from the hybrid population by the Hokkaido Division, Research Center for Medicinal Plant Resources, National Institute of Biomedical Innovation in 1969. The Institute has also listed Festiva Maxima as a reference variety. Festiva Maxima is a variety produced by Miallez in 1851 and is currently widely grown in gardens around Japan.

2) Trial cultivation

a) Plot area 12 m^2 (Cultivated for 3 years)
18 m^2 (Cultivated for 4 or more years)

b) No. of trial plants At least 40

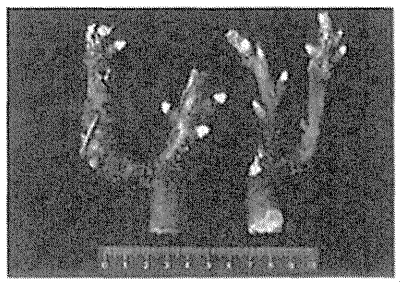
c) No. of repetitions At least 3

3) Usage

Painkiller, anticonvulsive, stypsis

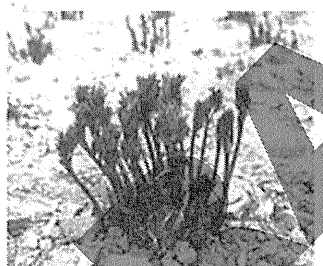
4) Kampo formulae containing Peony Root

Ifuto, unseito, kakkonto, keishito, shimotsuto, shigyakuto, shakuyakukanzoto, tokishakuyakusan, etc.

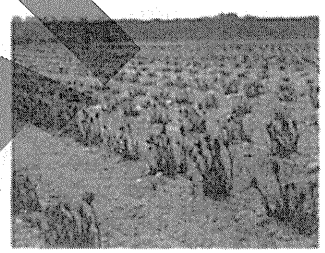


Peony propagation material

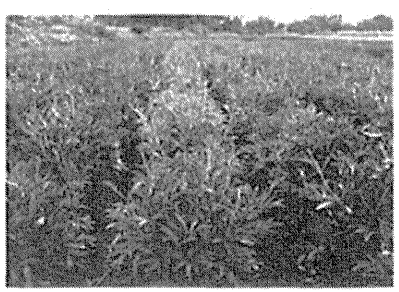
Peony early growth (close view)

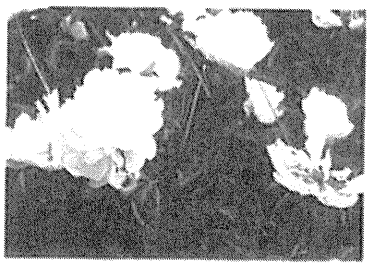


Peony early growth (distant view)



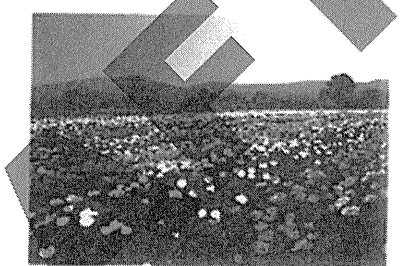
Peony in peak growth



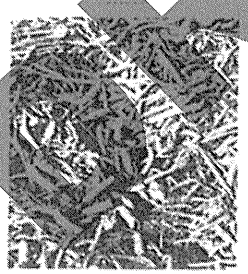


Peony flowers (close view)

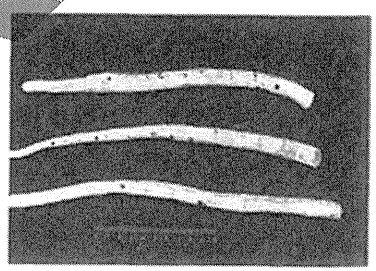
Peony flowers (distant view)



Harvested roots



Crude drug

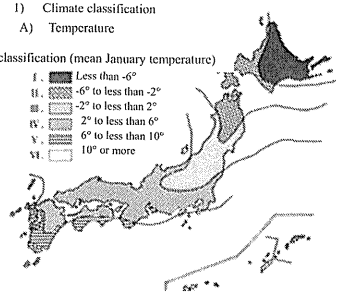


Classification of Regions Suitable to Cultivation

1) Climate classification

A) Temperature

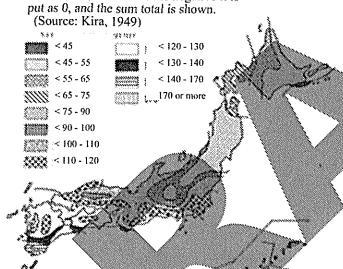
Cold classification (mean January temperature)



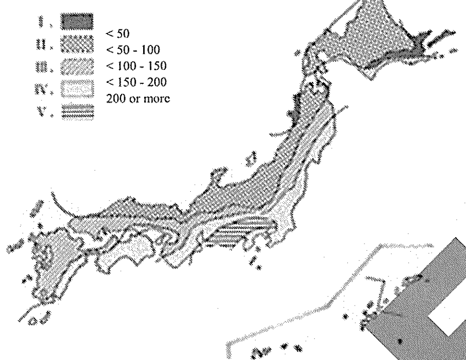
Heat classification (heat index)

To obtain the heat index, 5° are subtracted from the mean temperature for each month, if that value is negative it is *put as 0, and the sum total is* shown.

(Source: Kira, 1949)

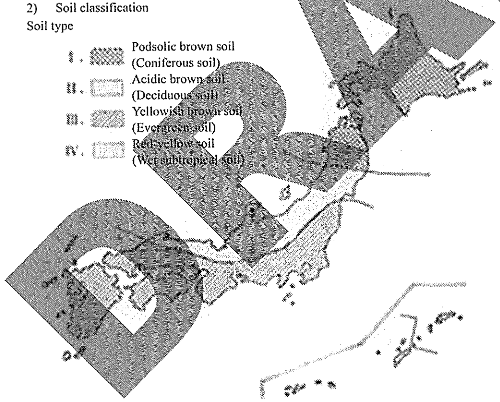


B) Hours of sunshine



2) Soil classification

Soil type



Cnidium Rhizome

1. Plant name

Cnidium rhizome

Crude drug name: Cnidium Rhizome (Senkyu)

Scientific name: *Cnidium officinale* Makino

2. Part used

Rhizome

3. Plant description

Native to China and cultivated extensively in Japan, cnidium officinale is a perenniat herb measuring 30-60 cm in length, with a massive rhizome. Leaves are alternate and bipinnate or tripinnate, and the base of each leaf stalk is sheath-like. Leaflets present an oval-lanceolate shape, cleft or parted, with dentate lobes. In autumn, branches terminate in compound umbellate inflorescence with multiple white florets; these are diploid hybrids with no fructification. The plant is suited to cold regions, and is particularly common in Hokkaido.

4. Crude drug characteristics and places of production

1) Characteristics

Description: Irregular massive rhizome, occasionally cut lengthwise, 5 - 10 cm in length, and 3 – 5 cm in diameter; externally grayish brown to dark brown, with gathered nodes, and with knobbed protrusions on the node; margin of the vertical section irregularly branched; internally grayish white to grayish brown, translucent and occasionally with hollows; dense and hard in texture.

Odor, characteristic; taste, slightly bitter.

Under a microscope, a transverse section reveals cortex and pith with scattered oil canals; in the xylem, thickwalled and lignified xylem fibers appear in groups of various sizes; starch grains usually gelatinized, but rarely remaining as grains of 5 - 25 μm in diameter; crystals of calcium oxalate not observable.

2) Main places of production

Hokkaido, Iwate, Niigata, Nagano

5. Variety characteristics

Pharmacopeia of Japan lists only *Cnidium officinale* Makino.

1) Morphological characteristics

Radical leaves are green from the early growth stage. Foliage is petiolate, and leaves are bipinnate and ternate. The leaf sheath is short. The rhizome is massive, with tuberous roots, and no stem residue is present on its leaves.

2) Biological characteristics

This is a typical cool temperate plant, with strong cold resistance and weak heat resistance.

The plant is in a vegetative stage for the first year, where the radical leaves undergo dense growth, and bolting is rare. While all roots bolt and flower from the second year onwards, the plant does not bear fruit due to chromosome desynapsis.

3) Ingredients

Dilute ethanol extract content is 21% to 45%, while ether extract content is 2.1% to 4.6%.

Ligustilide content is 0.7% to 1.0%.

4) Regional adaptability and growth characteristics

Prefers cold and high-altitude climates.

a) Climate classification

(1) Temperature
- (i) Coldness classification: I to III
- (ii) Warmth classification: 45 to 90

(2) Sunshine conditions: II, III

b) Soil classification

(1) Soil type: I to II

(2) Suitable soil

(i) Permeability and water retention condition suitability

Suitable for locations with good permeability and moisture retention

Excessive moisture, and particularly stagnant water, are not favorable.

(ii) Soil properties and texture

Suitable for sandy to clay loams

(iii) Suitability to fertile soil

Suited to fertile land.

(3) Need for light shielding: None

6 Cultivation

1) Varieties

Only the native species is cultivated.

2) Propagation

Seed tubers are used.

3) Cultivation

a) Suitability

Suitable for cool summer regions. High temperatures and humidity in summer cause weakened plants and widespread damage from disease and pests, resulting in a diminished yield. Further, the characteristic rapid enlargement of the rhizome as the temperature drops in the autumn suffers in warm regions, where the aboveground portion of the plant flourishes at the expense of root growth. For these reasons, Hokkaido and the Tohoku region are the most suitable for cultivation in Japan.

Within the suitable regions, fine weather and light wind is desirable for the harvesting and drying periods. As seed tubers are created from the harvest and planted in autumn, heavy autumn rain makes both harvesting and planting extremely difficult. Further, scarce sunlight and high humidity necessitate extra labor for drying using either natural or fire-drying methods, and also cause quality deterioration and an increase in costs.

b) Propagation

Fructification does not occur due to chromosome desynapsis, so propagation is exclusively vegetative. From among the roots harvested in the autumn, healthy roots with large rhizomes are selected to make seed tubers each weighing 20 to 30 g. Rhizomes are comprised of mother and daughter tubers and puberulent tubers. Mother tubers are enlarged seed tubers, and are also known as bases. Daughter tubers are those that have differentiated and grown from the middle and upper nodes of the seed tubers, and are used as the next generation of seed tubers. Puberulent tubers are most often differentiated from the lower node of the seed tubers; their use as the next generation of seed tuber results in the growth of many puberulent tubers and a markedly decreased yield, and thus are not usually used for this purpose.

c) Planting

Planting can take place in either spring or autumn, although spring planting results in delayed germination and growth and a decreased yield, therefore autumn is usually chosen. While potato planters are used for large-scale operations, the desirable planting method is by hand, to ensure the terminal bud faces upwards. This is because side- or downward-facing terminal buds result in a high incidence of puberulent tubers, leading to a decreased yield and lower quality.

Cover soil is kept around 5 cm, as 8 cm or more causes delayed germination and increased puberulent tubers. However, exposure of the seed tubers during the spring germination period can cause delayed or failed germination, in which case reapplying cover soil is recommended.

Increasing planting density produces a high yield, but a reduced per-root rhizome weight. On the other hand, while reducing planting density produces greater per-root rhizome weight and an increased number of daughter tubers, the overall size of the harvest will decrease. Standard practice when large tractors are used for planting management has traditionally been 60 cm row width with 25 cm between roots; approximately 6700 roots planted per 10a. However, the results of planting density trials indicated the greatest total yield is achieved with 40 to 50 cm row width and 16 cm spacing between roots; approximately 12,500 to 15,600 roots planted per 10 a.

Still, this level of density results in smaller rhizomes, and seed tubers are unable to be harvested, so the separate establishment of a propagation farm with around 6000 widely spaced roots is recommended. Seed tubers are traditionally taken from the harvested roots, but there are two advantages to planting a separate propagation farm. The first is that the rhizomes will be large, enabling collection of a high rate of substantial seed tubers. The second is that the duration of the planting and harvesting periods is extended. In the Kitami region of Hokkaido, where tractors are currently used for machine planting, cultivation is carried out with 8000 to 9000 roots planted per 10 a, taking into consideration the possible machine planting width settings. After harvest, a portion of those roots are used for seed tubers.

d) Fertilizers

Eight to 12 kg of nitrogen, 6kg of phosphoric acid, and 6 to 10 kg of potassium are applied per 10 a. Growth begins even under deposited snow, as the effects of the basal fertilizer and spring fertilization are significant; a decision must be made whether to apply half the fertilizer as basal fertilizer and the remainder around the time of germination, or half of the nitrogen and all of the phosphoric acid and potassium at the time of planting with the remainder of the nitrogen added in the spring.

e) Pest and disease damage

Damage from disease includes mildew, leaf blight, black spot, and black root rot. Mildew appears in the leaf blade from around June and continues until around September. It will impact the harvest yield in any quantity, therefore pest control is very important. Pest control undertaken in the early stages is not particularly effective; it has the greatest effect when above ground growth is vigorous.

Black root rot (*Phoma*) causes rotting of seed tubers, and is ubiquitous in cultivation regions. No correlation has been observed between the occurrence of black root rot and the previous crop, and it tends to be more prevalent in dry areas. The best pest control method is to use healthy seed tubers, but the disinfection of seed tubers is also very effective.

Insect damage to the plant is particularly significant from the spider mite, the seed-corn fly, the false melon beetle, and the swallowtail butterfly.

f) Harvesting

The rhizome dry weight will continue to increase until the aboveground sections of the plant

turn yellow or the plant dies. However, seed tubers must be taken from the harvest and planted, and the harvest must be sorted, so the timing should be determined based on the climatic conditions of the area.

(1) Large-scale preparation

The aboveground sections of the plant are harvested with a foliage chopper, while the roots are dug up with a potato digger. The harvested underground parts are transported to a factory for preparation. The preparation process is an assembly-line system whereby the underground parts are first washed with water while moving along a conveyor belt to remove sediment and impurities. They then move through a cutter and sectioned into several pieces, after which they enter a wire gauze cylinder where they are washed again while being brushed (the order of the brushing and cutting processes can be reversed). Items that have not been sufficiently washed are returned to repeat the process from the washing stage.

Once washing is complete, the water is drained, and the drying process begins immediately with heat treatment. The heat treatment, known as 'blanching', is a method that involves boiling in hot water for around ten minutes, although some areas now use steaming processes instead to allow more even heat distribution and better overall gelatinization.

(2) Small-scale preparation

With the aboveground parts of the plant still attached, roots are dug up using a potato digger or by hand, sediment is removed, and the roots are then are cut into two to four pieces and either blanched or dried as they are.

A range of techniques are employed when blanching, but the method fundamentally involves boiling the underground parts of the plant until the heat penetrates the center (60 to 80℃, 15 to 20 minutes), then removing them from the hot water and placing them on a drying rack. The timbers of the rack are placed at an east-west orientation at intervals of 25 cm, and eight to ten lines are attached. Roots that have finished the blanching process are placed on these lines pointing south, with the aboveground parts pointing north. Once dry, they are removed from the rack, the stems and leaves are removed, and they are brushed to finish.

g) Yield

From 730 to 800kg.

7. Crude Drug Quality Evaluation

Japanese Pharmacopoeia test adequacy

a) Crude drug description	Identical to 4.1)
b) Total ash	Not more than 6.0%
c) Acid-insoluble ash	Not more than 1.0%

8. Characteristic Classification

Cnidium Rhizome Characteristic Classification

Property		Variety or strain name
Classification	Phenotype	Native cultivar
Grass	Plant height (height reached at the peak of its growth period)	Medium (60 to 85 cm)
Stem	Stem color (presence of anthocyan coloration on stem surface)	Yes
	Degree of stem curvature (stem zigzagging)	No zigzagging
Leaf	Leaf color in early growth period (color of leaf blade surface)	Green
	Leaf color at peak of growth period (color of leaf blade surface)	Deep green
	Presence of petioles (presence on leaves at center of flower stalk)	Yes
	Leaf sheath length (length of leaf sheath at center of flower stalk)	Short (1.1 to 2.6 cm)
	Compound leaf frequency (foliage at peak of growth period)	Bipinnate, ternate
	Serration of terminal leaflet (foliage at peak of growth period)	Shallow to medium depth
Rhizome	Rhizome shape (in autumn of first year roots)	Massive
	Rhizome weight (in Fall of first year roots, per root)	Heavy (250 to 330 g)
Flower	Size of inflorescence (maximum diameter of multiple inflorescence on bolting second year roots at peak of blooming period)	Large (7.9 to 11.2 cm)
	Number of florets (number of florets on each multiple terminal inflorescence)	Medium (25 florets)
	Number of involucral leaves (number of involucral leaves on multiple terminal inflorescence)	Many (4 to 5 leaves)
Bolting	Relative difficulty of bolting (proportion of inflorescence formation in first year autumn)	Difficult
Earliness	Earliness of blooming (timing of blooming of second year bolting roots)	Early
Environmental tolerance	Tolerance to cold (determined from level of germination in second year)	Strong
	Tolerance to heat (level of leaf blight in first year Summer)	Weak
Ingredient	Ether extract content (processed dried rhizome)	Medium (3.0% to 5.9%)
	Ligustilide content (processed dried rhizome)	Medium (0.5% to 1.0%)

10. Background Materials

1) Propagation material origins

The botanical origin of Cnidium Rhizome currently produced in Japan is a species of the *Cnidium officinale* cultivar.

Cnidium rhizome was brought into Nagasaki during the Kan'ei era (1624-1643) and popularly cultivated in Yamato (now Nara prefecture). By 1840, Cnidium Rhizome production centers also included Bungo, Tango, Oushu, Ushu, Ishu, and Seshu.

The plant was introduced to its present main production center of Hokkaido during the Meiji era from Sendai and Yamagata and gradually spread. It is thought that the seeds and seedlings provided to other prefectures cultivating the plant now come from Hokkaido.

2) Trial cultivation

a) Area per land plot — 4 m² or more, row width 60～70 cm, Root spacing 20～25 cm

b) Number of samples — 30 or more

c) Number of repetitions — 4 or more

3) Usage

Blood replenishment, as a tonic or sedative, or analgesic.

4) Kampo formulae containing peony root

Kyuki-choketsuin, shichimotsukokato, shimotsu-to, sesshoin, tokishakuyakusan.

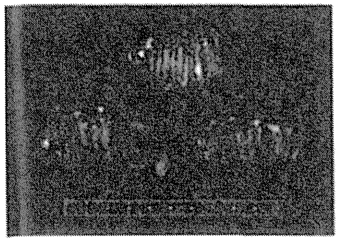
9. Cultivation calendar

Cnidium Rhizome Cultivation Calendar

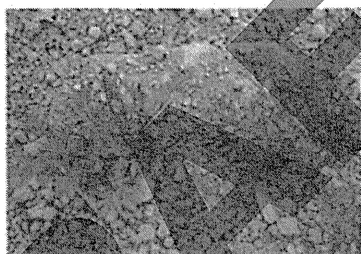
Month	10			4			5			6			7			8			9			10		
Time of Month	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L
Growth phase and work	Planting			Germination			Last snow			First foliage			Secondary foliage Heavy growth period Bulblet formation						Rhizome enlargement					
							Intertillage Supplementary fertilizer			Intertillage/weeding Pest control			Intertillage/weeding Pest control			Pest control						Yellowing of above-ground parts Harvesting Digging up tubers Making tubers		
Operations	☆Planting (per 10a) Usually 8000-9000 roots ☆Basal fertilizer (per 10a) Nitrogen: 4-6kg Phosphoric acid: 3kg Potassium: 3-5kg Row fertilizer application									☆Supplementary fertilizer (per 10a) Nitrogen: 4-6kg Phosphoric acid: 3kg Potassium: 3-5kg Row application to rootstock sides ☆Major pests Mildew False melon beetle Swallowtail butterfly larvae			☆Harvest Large-scale preparation: remove foliage and dig up Small-scale preparation: dig up by hand or by machine with foliage still attached ☆Preparation Large-scale preparation: transport to factory Small-scale preparation: wash with water, blanch (60-80℃, 15-20min), then dry on a rack. Remove stems, and brush. ☆Digging up of mother tubers When establishing a propagation farm ☆Making seed tubers 20-30 g each, must be disinfected								

Abbreviations: E, early; M, mid; L, late

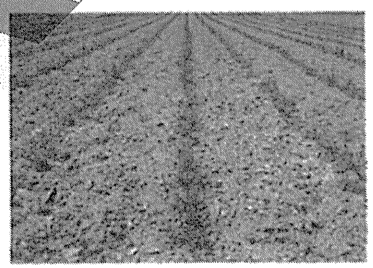
Cnidium Rhizome seed tubers



Cnidium Rhizome early growth period

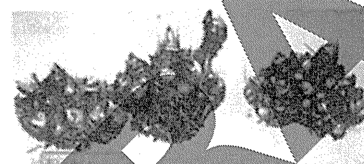


Cnidium Rhizome early growth period



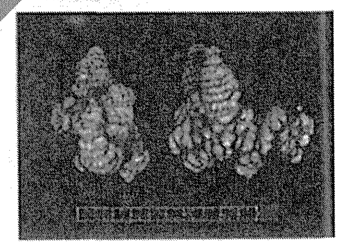
Cnidium rhizome peak growth period

Cnidium rhizome flowers



Harvest

Crude drug



Japanese Angelica Root

1. Plant name

Japanese Angelica Root

Crude drug name: Toki

Scientific name: *Angelica acutiloba* Kitagawa

2. Part used

Root

3. Plant description

Perennial herb that has been grown in vegetable gardens throughout Japan. Glabrous stems 40 to 90 cm high with a reddish violet color, mono- or bi-pinnately trifoliolate leaves are alternately arranged, leaflets bi- or tripartite. Leaf lobes are lanceolate with dentate incisions. Leaf upper surfaces are lustrous deep green. Terminal compound umbels sprout in August to October opening into multiple white florets. Oblong cremocarps are 5 to 6.5 mm long.

4. Crude drug characteristics and places of production

1) Characteristics

Japanese angelica has a thick, short main root and multiple branching roots that are almost fusiform, it is 10 to 25 cm long, the outer surface is dark brown to red brown with longitudinal wrinkles and scars from multiple fine rootlets forming horizontal protrusions. The root crown retains a little leaf sheath. Fracture surface is dark brown to yellow brown and even.

Japanese angelica root has a characteristic smell and the taste is very slightly sweet with a slightly spicy aftertaste.

Microscopic examination of a transverse section reveals 4 to 10 cork layers then a number of collenchyma layers inside. The cortex has numerous oil canals surrounded by secretory cells and often has large hollows. There is a clear boundary between the cortex and the xylem, which is comprised of many vessels alternating with medullary rays. Outer vessels appear singly or in slightly dense cuneiform groupings. Central region vessels are very sparse.

2) Main places of production

a) *Angelica acutiloba* Kitagawa — Nara, Toyama

b) *Angelica acutiloba* Kitagawa var. *sugiyamae* Hikino — Hokkaido

5. Variety characteristics

Angelica acutiloba Kitagawa and *Angelica acutiloba* Kitagawa var. *sugiyamae* Hikino are in cultivation.

1) Morphological characteristics

Third year *A. acutiloba* Kitagawa plants are up to approximately 60 cm, while *A. acutiloba* Kitagawa var. *sugiyamae* Hikino plants are at least 120 cm.

Petioles are deep purple-green, colored by anthocyan, in *A. acutiloba* Kitagawa, but yellow-green in *A. acutiloba* Kitagawa var. *sugiyamae* Hikino.

Dentation of apical folioles is deep in *A. acutiloba* Kitagawa but somewhat shallower in *A. acutiloba* Kitagawa var. *sugiyamae* Hikino.

There are many root branches in *A. acutiloba* Kitagawa but few in *A. acutiloba* Kitagawa var. *sugiyamae* Hikino.

There are many florets per single umbel, a terminal inflorescence, in *A. acutiloba* Kitagawa var. *sugiyamae* Hikino but few in *A. acutiloba* Kitagawa.

2) Biological characteristics

A. acutiloba Kitagawa var. *sugiyamae* Hikino has stronger resistance to cold than *A. acutiloba* Kitagawa.

3) Ingredients

Dilute ethanol extract content is high in *A. acutiloba* Kitagawa but somewhat low in *A. acutiloba* Kitagawa var. *sugiyamae* Hikino. Ligustilide content is between 0.05 and 0.1% in both varieties.

4) Regional adaptability and growth characteristics

Both varieties prefer a cool cold climate.

a) Climate classification

(1) Temperature	(i) Coldness classification	II to V
	(ii) Warmth classification	55 to 120
(2) Sunshine conditions		II to IV

b) Soil classification

(1) Soil type	I to III

(2) Suitable soil

(i) Permeability and water retention condition suitability

Suitable for locations with good permeability

(ii) Soil properties and texture

Suitable for clay loam to clay

(iii) Suitability to fertile soil

Suitable for fertile soil

(3) Need for light shielding None

6. Cultivation

1) Varieties

Two kinds of *Angelica acutiloba* are cultivated, *Angelica acutiloba* Kitagawa and the variety *Angelica acutiloba* Kitagawa var. *sugiyamae* Hikino.

2) Propagation

Propagate by seeds.

3) Cultivation

a) Suitability

Suitable for regions with somewhat cool climate. Suitable for somewhat soft and permeable clay loam with a deep plow layer. Does not grow adequately in locations where the groundwater level is high: well-drained soils are preferable. Light soils such as volcanic soils lead to profuse fine rootlets, and conversely, root growth is poor in heavy, clayey soils.

b) Propagation

Seed propagation

c) Seedling raising

Preparing the seedbed involves drill rows and strips. Make the row width for the drill rows 100 to 120 cm, make the length of the furrows suitable for a seedbed in a strip shape, and sow 1 *dl* of seed per 3.3m^2. Scatter the seed as evenly as possible, cover with a thin layer of soil, then shade the seedbed by covering with wheat straw or rice husks. Seeds germinate in approximately 20 days. After germination, thin out denser patches of seedlings from time to time, similarly to weeding. Seedlings that have grown large where there is a lot of fertilizer are not suitable because they bolt soon after planting.

The optimal time for sowing is from mid or late March to mid April for Honshu (the main island of Japan), and from late April to late May for Hokkaido. Approximately 5 *dl* of seed are required per 10 a of field.

d) Field planting

There are two times for field planting: spring and autumn. Spring is best because seedlings tend to bolt when planted in autumn. Spring planting is best done as soon as possible in the spring following sowing, and is permissible up to early April except in Hokkaido. Make the row width

50 to 60 cm with spacing at 20 to 25 cm. For planting, plow deep furrows, lay pre-selected seedlings in the furrow one at a time, ensure the root crown is facing upward by pressing down with the foot as far as the middle of the seedling, then carefully cover it in soil from both sides making sure it is not above the ground. Selection of seedlings is important for cultivation of Japanese Angelica Root. They are sorted into three sizes, large, medium and small. Large seedlings thicker than a fountain pen are prone to bolting, while conversely, small seedlings are too thin and provide low yield. Select medium size seedlings up to 0.8 cm diameter at the root crown and avoid larger seedlings whenever possible.

There is a method of planting large *A. acutiloba* Kitagawa seedlings by first hollowing out buds, however, it is more reliable to employ this technique after extensive practice as it requires significant technical expertise. The technique involves hollowing out the center of the bud with an implement like a sharpened bamboo spatula before planting, so as to prevent any large seedlings that have been planted from bolting in or around June. After hollowing out the bud, the seedlings are covered with soil and left for approximately 10 days at which time 4 to 5 small buds emerge from the outside of the hollowed out part. Small seedlings are called "double seedlings" as they are planted in twos.

e) Fertilizers

Of the three elements, nitrogen is the most important, for which ammonium sulfate or oil meal is used. For each 10 a, 6 to 8 kg of nitrogen, 8 to 14 kg of phosphate, and 6 to 7 kg of potassium should be applied, however, quantities vary according to the soil and climatic conditions. The nitrogen should be divided into basal and extra applications. For the extra fertilizer, a readily available nitrogenous fertilizer should be applied around early September, but in Hokkaido between late June and early July.

If a large quantity of nitrogenous fertilizer is applied in the initial stages of growth, the above ground part will flourish but root growth will be poor and the plant will tend to bolt. The roots of bolted plants become woody, which precludes their use as a crude drug, so care should be taken.

f) Management

Intertillage weeding should be carried out several times after the seedlings have taken root.

g) Pest and disease damage

Japanese angelica may be affected by downy mildew or stem rot. If affected by downy mildew, the underside of the leaf may reveal on close inspection a white, gray, or light purple mold while the upper side of the leaf begins to yellow around August, which if left untreated may spread and stunt growth.

Pests include spider mite, codling moth larvae, aphids, cutworm, and swallowtail butterfly larvae.

h) Harvesting and Preparation

Dig up the plants on a clear day once the foliage has started turning yellow (early to mid October in Hokkaido, early November to late February in Nara) and line them up on the ground to dry for 2 to 3 days then tap off the soil. Tie 5 to 6 plants together by the foliage into small bunches and hang over horizontal poles to dry. Take them down once they are approximately eight tenths dried, submerge them in hot water, then once the rootlets have softened, remove the soil while arranging the roots in lines. After drying again, cut off the foliage and carefully stack the roots for packing, ensuring no foliage or soil is included. In Hokkaido, after digging up the plants, hang them over horizontal poles to dry, take them down once the moisture content reaches 18 to 20%, remove the foliage, finish off the drying with artificial heat, then remove any soil or extraneous material with a polisher.

i) Yield

A. acutiloba Kitagawa: 180 to 250 kg; *A. acutiloba* Kitagawa var. *sugiyamae* Hikino: 240 to 300 kg

7. Crude Drug Quality Evaluation

Japanese Pharmacopoeia test adequacy

a) Crude drug description As in 4.1)

b) Purity test

(1) Leaf sheath — The amount of leaf sheath does not exceed 3.0%.

(2) Foreign matter — Other than leaf sheath, the amount of foreign matter does not exceed 1.0%.

c) Total ash — Not more than 7.0%

d) Acid-insoluble ash — Not more than 1.0%

e) Dilute ethanol extract content — Not less than 35.0%

8. Characteristic Classification

Japanese Angelica Root Characteristic Classification

Characteristic		Variety or strain name	
Category	Form or quality	*A. acutiloba* Kitagawa	*A. acutiloba* Kitagawa var. *sugiyamae* Hikino
Plant height	Height of third year bolted rootstock in summer	Short (Up to 60 cm)	Tall (At least 120 cm)
Leaf	Length of seed leaf (Length when second true leaves have developed)	Medium (1.6 to 2.0 cm)	Long (At least 2.6 cm)
	Petiole color (Color when second true leaves have developed)	Medium (Slightly dark)	Light (Light color)
	Length of leaf blade (Largest leaf at middle stage of growth)	Medium (30 to 50 cm)	Long (At least 70 cm)
	Leaf color (Color of leaf blade upper side)	Deep green	Yellow green
	Petiole color (Largest leaf at middle stage of growth)	Deep green tinged with reddish purple	Yellow green
	Leaf lobation (Depth of lobation in leaf margin of terminal leaflet)	Deep	Shallow
Root	Root form (Second year, branching in autumn)	Much branching	Little branching
Flower	Inflorescence size (Diameter of the terminal inflorescence, compound umbel)	Medium (10 to 20 cm)	Large (At least 30 cm)
Fruit	Fruit length (Third year, terminal inflorescence mericarp at maturity)	Medium (4.0 to 5.5 cm)	Long (5.6 to 7.0 cm)
	Kernel weight (Weight of 100 mericarps at maturity, third year)	Medium (100 to 200 mg)	Heavy (300 to 400 mg)
Bolting habit	Bolting tendency (Second year rootstock, degree of bolting)	High (Tends to bolt)	Medium (Somewhat lower tendency to bolt)
Blooming	Blooming earliness/lateness	Medium	Early
Ingredient	Dilute ethanol extract content (Second year, dried root)	Somewhat high (36% to 40%)	Medium (30% to 35%)

10. Background Materials

1) Propagation material origins

a) *A. acutiloba* Kitagawa

A. acutiloba Kitagawa has been cultivated in the Obuka district, in the southwest of the Nara Basin and has been known as Yamato toki since the Edo Period. Crossbreeding with *A. acutiloba* Kitagawa var. *sugiyamae* Hikino after the World War II eliminated almost all the pure *A. acutiloba* Kitagawa, but it was preserved by forward-thinking farmers in that district.

b) *A. acutiloba* Kitagawa var. *sugiyamae* Hikino

It has been reported that this variety is the result of improvement through crossbreeding with *Angelica anomala* Lallemant by a Mr. Sugiyama of Kitami, Hokkaido in the Taisho era.

2) Trial cultivation

a) Plot area — At least 4 m^2 — Rows 70 cm wide; Plants spaced at 25 cm

b) No. trial plants — At least 20

c) No. repetitions — At least 2

3) Usage

Tonify blood, tonic, circulatory disorders, painkiller, sedative

4) Kampo formulae containing Japanese Angelica Root

Tokishakuyakusan, tokishigyakuto, shiunko, etc.

9. Cultivation Calendar

Japanese Angelica Cultivation Calendar