Package of Practices for Medicinal and Aromatic Plants

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1. གོསྙོད། Go-nyod (Carum carvi Linn.)

1.1. Background

Go-nyod (*Carum carvi* Linn.) is a medicinal plant native to Europe and Asia. In Bhutan, Go-nyod is grown in scattered locations under Ligshi Dungkhag, Haa and Paro Dzongkhags. It is an aromatic plant characterized by carminative (calming) properties. It is grown for its seeds as well as for oil from time immemorial. It grows in open areas at an altitudes range of 2500m to 4500 meters above sea level. In Bhutan, Go-nyod is cultivated in Lingshi, Haa, Paro and Bumthang Dzongkhags. Before the domestication intervention by MAP Program, even the straw was used for medicine because of the sparse population. Since 2008, the cultivation of Go-nyod became very successful and has surpassed the demand of the then the Pharmaceutical Research Unit (PRU) under the Institute of Traditional Medicine Services (ITMS), presently renamed as Menjhong Sowrig Pharmaceutical Corporation Limited (MSPCL). The cultivation had to be slowed down due to market issues since then.

1.2. Description

Erect, biennial herb with thick tuberous rootstocks, growing up to 80 cm in height with narrow finely grooved leafy stems. During the first year, Go-nyod produces a rosette of dark green, finely cut, feathery leaves. The leaves are two to three, pinnate with lobes that vary from linear-lanceolate to linear; the flowers are usually white and rarely pink in a somewhat irregular umbel of 5-16 rays bracteoles are absent or few. The seed is ovoid or oblong with tender ribs. The crop requires cold temperatures during the winter months to initiate flowering stems in the second year. It flowers in late spring, and seed is produced 30-35 days after flowering.

Botanical name : *Carum carvi* Linn.

Family : Apiaceae

Common name : Caraway

Transliteration : Go-nyod

Plant parts used : Seeds, stems and roots

Trade name : Fructus Carvi

1.3. Uses

Go-nyod seeds are a fundamental constituent of Bhutanese Traditional Medicine. Seeds are also a prevalent spice, used for flavoring children's medicines, meats & confectionery products; as an antidote to flatulence, antiseptic, vermifuge and aid to digestion; helps in the respiratory, eye and urinary problems, also used in mouthwash and gargle preparations as well as in the perfume industry. Caraway oil is rubbed on the skin to improve complexion. Chopped leaves are added to soups and salads. The root is cooked as a vegetable, essential oil distilled from seeds is used to flavors candy and liquor.

1.4. Soil requirement

Loam and sandy loam with a pH range between 5.8 to 6.5 provide the best conducive growing conditions for healthy Caraway production.

1.5. Nursery preparation

Prepare a fine nursery bed by adding 5-10 tons of well-decomposed leaf mold or well rotten FYM in April and May. Sow seed into moist soil @ 1.3 kg/acre thinly in lines, 1.5 - 2 cm deep and 20-30 cm apart. Thin out the seedlings to a 30-40cm spacing after germination when the plantlets are about 5-6 cm tall and have 6-7 leaves.

1.6. Propagation

Go-nyod is mainly propagated through seeds.

1.7. Seed Rate

About 2-4 kg of good quality caraway seeds with a minimum germination of 70% is required for one acre. The seed germinates within 20-25 days.

1.8. Sowing time

Seeds of Go-nyod is sown in the month of February-March directly on well prepared raised lines in bed at a depth of about 2 cm or raised beds at the same depth in rows 25-30 cm apart.

First Year

Prepare the field by digging and bringing the soil to the right tilt. Incorporate well-decomposed leaf compost or FYM by thoroughly mixing the two. The beds of convenient length and breadth are prepared with a 40-60cm distance between beds to allow for mechanical and cultural operations. Direct sowing of seed is recommended.

Second-year

In the following spring (April), hoe when the plants are about 10 cm tall, apply well-decomposed leaf compost or FYM as a top dressing after a round of weeding. Provide light irrigation when the plant emerges from the ground.

1.9. Weed Management

It is crucial to control weeds in the early stages of crop development, because early competition can adversely affect plant growth and lower crop yields. Weed as and

when required, especially during the tender stage, to limit the competition of weeds. Irrigate every two weeks in dry spells. The plants die over winter and re-emerged next spring. A weed-free crop is the key to success.

1.10. Nutrient Management

Apply well-decomposed farmyard manure (FYM) at the time of the field preparation. Inorganic fertilizer should not be applied since it is meant for medicine production.

1.11. Post-harvest and storage

Go-nyod is a biennial plant and can be harvested only in the following year when the seed turns brownish (April - May). Special care is required to avoid seed losses since seed falls out quickly. Lower branches ripen first. Cut just below the lowest branch or pull up the plant. We recommend cutting the entire plant at the base early in the morning when dew is still present to avoid seed shattering. Care must be taken not to lose the seeds through shattering. Put up in bundles and begin threshing with the help of a stick to separate the seeds on the plastic sheet, cloth or tarpaulin. Winnow the seed from hairs and clean from foreign matters, and dry them. Assure proper air ventilation during storage to avoid fungus infestation. Good seed with a moisture content of less than 12% can be stored for a year. Store the seeds in an airtight container in cool temperatures.

Chemical Composition

Its fruits contain not less than 3.5 percent of volatile oil

1.12. Pest & diseases

At high altitudes, Mammoths have been observed eating Go-nyod plants. Good fencing is required to deter both domestic and wild animals from damaging the plantations. Waterlogging and not doing earthing up may encourage lodging of plants and rot of the roots.

1.13. Yield

Depending on the care and the climatic conditions, yields vary from 160 to 400 kg of seed/acre.

2. མནུ་པ་ཏྲ། *Manupatra (Inula racemosa Hook. f.)*

2.1. Background

Manupatra is one of the essential high-altitude medicinal plants, widely used in Bhutanese traditional medicine. It is found in the natural temperate forest, mostly in Bumthang and Haa Dzongkhags. The Manupatra was first domesticated at the then Renewable Natural Resources Research and Development Center (RNRRDC), Yusipang, in the early 2000s. It is currently cultivated by the farmers of Thimphu, Paro, Haa and Bumthang and Gasa.

2.2. Description

The plant is a stout shrub, bearing large leaves arranged in a racemose manner. The stem is grooved, and all vegetative parts are scabrid tomentose. Lower leaves are narrowed to a winged leaf stack. Upper leaves are lanceolate and stem-clasping. The abaxial laminal face is densely tomentose. Radical leaves are broad and are elliptic-lanceolate with long petioles. The cauline leaves are smaller, oblong, and semi amplexicaul. The flowers are large, shady yellow daisies produced in mid to late summer. They are borne on an apical spike-like cluster. The fruits, slender achenes, 0.4 cm long, bearded with 0.75 cm long pappus hairs. Rootstock branched; fresh roots are irregularly fusiform. Sometimes several roots are found in the collar zone, though usually few occur in each clump. These roots have dull brownish skin with yellowish color inside. They possess a sweet and somewhat camphoraceous odor and have a bitter taste.

Botanical name : *Inula racemosa* Hook. f.

Family : Asteraceae

Common name : Pushkaramool

Transliteration : Manupatra

Parts used : Roots

Trade name : Poskarmol

Sanskrit : Pushkar mool

Altitude : 1500-3900masl

2.3. Natural Habitat

It is a deciduous perennial herb that grows up to 2 meters high. It has a beautiful yellow color flower, and it flowers in July/August. The plant prefers varied soil types with pH ranging from acid to alkaline and full sun with moderate moisture. It is a vigorous plant, grows at an elevation of 1400 to 3900 meters above sea level.

2.4. Uses

It is used to relieve muscular spasms, cramps or convulsions, lower blood pressure, lowers cholesterol level; treats asthma, bronchial diseases, chest pain, chronic bronchitis, cough, and treatment of fever and pain in the upper body (between the neck and the shoulders). The highly aromatic roots are used for both traditional medicine and incense making.

2.5. Plant parts used

Roots.

2.6. Soil and Climate

Adapts to a wide range of soil (well-drained) with a pH ranging from acidic to alkaline; also found to do well in Sandy loam/humus soil is best for better growth and yield. It requires full sun or partial shade and sun with moderate moisture.

2.7. Propagation

Propagation is done through both sexual and asexual means, i.e., either through seeds or offshoots/ vegetative cuttings taken from the established clumps in early autumn.

2.8. Nursery preparation

In March – April, prepare the nursery by plowing/digging the plot several times and crushing the clods into a fine texture. Add sufficient FYM (minimum 8 tons/acre) before sowing. Prepare nursery bed of 20 cm in height, 1.5m in with and 5m in length. Make furrows of 1-2cm deep at a spacing of 30 cm each (in 1.5m bed. Sow Manupatra seeds thinly in the furrows and gently cover the seeds with fine soils. The seeds take 4 to 5 weeks to germinate and another 4 -6 weeks to reach the transplanting stage. The seed requirement for an acre plantation is about 0.5 kg.

2.9. Transplanting

When plantlets are sufficiently developed (4-5 leave stage), gently uproot and transplant in a well-prepared field. The transplanting should be done when it is raining to improve the survival rate. Transplant the seedlings on a raised beds of 1.5 m breadth and a convenient length at a spacing of 50 x 50 cm or 16,000 plants per acre. Transplanting is recommended from June – July. Water the plants in the first 6 to 7 days

2.10. Manuring

Apply well-decomposed FYM twice (80 qt/acre each) before transplanting during the first year and second year when the plants begin to sprout in spring.

2.11. Weed Management

Manupatra is very sensitive to weed competition during its early development. Therefore, keep the field weed-free by weeding as and when required. In general, weed the plants until they are large enough to shade out the weeds.

2.12. Harvest & Post-harvest

In November/ December of the second growing season, harvest the Manupatra roots. Brisk irrigation is given to moisten the soil 2 to 3 days before harvest. Grovel, and pickaxe is used to dig the soil around the Manupatra root. Effort must be put in to dig out the entire root. Wash the roots to remove soil. Chop to 1-2 cm slices, spread it on a tarpaulin,

and dry under the shade. After drying to 10 to 15 % moisture content, they are packed in clean airtight plastic bags. All the harvest and post-harvest operations are to be carried out with the best hygienic practices.

2.13. Seed Extraction

Extract the seeds of manupatra in October /November when the seeds are matured. The seeds must be harvested by cutting the inflorescence at the base and threshing them on a tarpaulin sheet. Dry and store them in the container for future use.

2.14. Yield

Depending on soil type, care and climatic conditions, yields can go up to 4 tons of dried roots/acre.

3. རུ་རྟ། Ruta (Saussurea lappa Clarke)

3.1. Background

Ruta (*Saussurea lappa* Clarke), known under the trade names of kuth and costus, is an essential ingredient of traditional medicine formulation and incenses. The high market demand and unsustainable harvesting have critically endangered the plant, and it is now listed in schedule I of the IUCN list of endangered species.

3.2. Description

Tall, stout perennial herb with the annual stem up to 3 meters tall, upperparts pubescent. Basal leaves up to 40cm long, pinnate, terminal with lobe, largest of which is often triangular. Stem leaves up to 30cm long, entire or irregularly toothed: inflorescence capitulum, each surrounded by involucral bracts, borne on stem tops or axils. Flowers scented, purple, hermaphrodite, sub-globose, sessile; fruits small, curved, compressed and brown, borne in a dense rounded terminal corymbose cluster.

Common Name : *Kuth/Costus*

Botanical Name : Saussurea lappa Clarke

Family : Asteraceae

Transliteration : Ruta.

Plant parts used : Roots

Altitude : 1500 – 3900 masl

3.3. Natural Habitat

It is found in the woodland, moist open slopes, and shady places and edges ranging from 2000 to 3300 masl. The plant grows on varied soil types with pH ranging from acid to alkaline and full sun with moderate moisture.

3.4. Plant parts used

Dried roots are harvested, dried and used.

3.5. Uses

It is used as a tonic, used against asthma, Cough, cholera, and bronchitis; It has aphrodisiac and anthelmintic properties, used as insecticide and pesticide; roots are highly aromatic in incense making.

3.6. Soil & Climate

The plant adapts to a wide range of soil (well-drained) with a pH ranging from acidic to alkaline; also found to do well in Sandy loam/humus soil is best for better growth and yield. It requires full sun or partial shade or sun with moderate moisture for optimum performance.

3.7. Propagation

Propagation is done through both sexual and asexual means, i.e., either through seeds or offshoots/ vegetative cuttings taken from the established clumps in early autumn.

3.8. Nursery preparation

In March –April, prepare the nursery by plowing/digging the plot several times and crushing the clods into a fine texture. Add sufficient FYM (minimum 8 tons/acre) before sowing. Prepare nursery bed of 20 cm in height, 1.5m in with and 5m in length. Make furrows of 1-2cm deep at a spacing of 30 cm each (in 1.5m bed. Sow Manu seeds thinly in the furrows and gently cover the seeds with fine soils. The seeds take 4 to 5 weeks to

germinate and another 4-6 weeks for the transplanting stage. The seed requirement for an acre plantation is about 0.5 kg.

3.9. Transplanting

When plantlets are sufficiently developed (4-5 leave stage), gently uproot and transplant in a well-prepared field. The transplanting should be done on a rainy day to ensure 100 % seedling survival. Transplant the seedlings on the raised beds of 1.5 m breadth and convenient length at a spacing of 50 x 50 cm or 16,000 plants per acre. Transplanting is recommended from June to July. Water the tender seedlings for the first 6 to 7 days.

3.10. Manuring

Apply well-decomposed FYM twice (80 qt/acre each) before transplanting during the first year and another in the second year when the plants begin to sprout in spring.

3.11. Weed Management

Ruta is very sensitive to weed competition during its early development. Therefore, keep the field clean by weeding as and when required. In general, continuous weeding should be done until the plants are large enough to shade out the weeds.

3.12. Seed Extraction

The Ruta plantation will remain in field during first year with the addition of several leaves and senescing thereafter (October/November). In the spring of the following year (March/April), leaves will sprout and the plant stump will shoot out bearing flowers by August/ September. By October /November, seeds will mature and the seeds must be harvested by cutting the inflorescence at the base and drying them in containers. Seed must be thrashed and kept for future plantations.

3.13. Harvest & Post-harvest

Harvest the Manu in January or February of the second growing season. Brisk irrigation is given to moisten the soil 2 to 3 days before harvest to ease the harvest/digging. Grovel and pickaxe is used to dig the soil around the Ruta root. Effort must be put in to dig out the entire root. Wash the roots to remove soil. Chop to 1-2 cm slices, spread it on a tarpaulin, and dry under the shade. After drying to 10 to 15 % moisture content, they are packed in clean airtight

plastic bags. All the harvest and post-harvest operations are to be carried out with the best hygienic practices.

3.14. Pest & Diseases

Not much problem is noticed over the years but earthing up, and regular weeding is best to control measures to avoid rotting of roots and rodents' attacks

3.15. Yield

Depending on soil type, care and climatic conditions, yields can go up to 4 tons of dried roots/acre.

4. ཏི་ཡང་ཁུ / Ti-yangkhu (Dracocephalum tanguticum)

4.1. Background

Ti-yangkhu (*Dracocephalum tanguticum*) is an important medicinal plant native to the Qinghai - Tibetan Plateau. It is not found in Bhutan in the wild. The Traditional Medicine Service used to import the plant from Tibet for medicine production in Bhutan. In the 1990s, this species was introduced and cultivated in Soe and Lingsh, Thimphu, Haa and Bumthang. Since then, the DTMS demand is met from the cultivation source. The Renewable Natural Resources Research and Development Center (RNRRDC), Yusipang promoted cultivation programs in the early 2000s in Thimphu, Paro, Haa and Bumthang and Gasa.

4.2. Description

Glabrous, erect perennial herb, 30 to 45 cm tall, blue flowers, root with tubers, bearing narrow, ovate and aromatic leaves of 2 to 8 cm long. It is said to grow naturally in the wheat field, trail sides, gardens in the Tibetan plateaus and Himalayan region at an altitude of 3000-4200 m above sea level.

Botanical name : *Dracocephalum tanguticum*

Family : Lamiaceae

Common name : Dragon's head

Transliteration : Ti-yangkhu

Parts used : Flowers stem and leaves.

4.3. Habitat

Stony slopes of mountain streams, pebbles, and sometimes on sandy mountain slopes; in wheat fields, alongside trails as well as gardens in Tibet & the Himalayan regions

4.4. Uses

Traditionally, it is used for stomach ache, liver and lung ailments, improving blood, healing wounds, and occasionally flavouring meat curries.

4.1. Propagation

Propagation can be done through both seeds and cutting. Cuttings of 5 to 8 inches with few buds are prepared from the stems and the healthy-looking branches in June and July. These are planted 10 - 20 cm deep in finely prepared soil and planted in rows at 6 cm plant to plant and 6 cm row to row. These will root by the end of September and are ready for transplanting in September.

4.2. Nursery preparation

Prepare nursery in February and March by digging the soil by bringing it to a good tilt. Sow the seeds on the raised nursery bed of 1 m width and convenient length at 1 to 1.5 cm underneath the soil surface. The line sowing is recommended. The seedling takes about 15 to 20 days to germinate.

4.3. Seed Rate

1.5 kg per acre

4.4. Transplanting

The seedlings should be transplanted in May and June when they attain a 5 to 6 leaf stage. Maintain row to row and plant to plant distance of 20 cm. Watering the transplanted plants for a week are essential if there are no rains.

4.5. Manuring

Farmyard manure (FYM) and forest compost should be used to improve the crop yield and performance. The use of chemical fertilizers is not recommended.

4.6. Weed Management

Weeding and hoeing must be done to promote vegetative growth and to keep the field clean.

4.7. Harvest and Post-Harvest

Harvesting time will differ according to altitude climate of the place. In June or July when the plants are in 50 % in bloom or just before they begin to dis-colour, the whole aerial parts (i.e., shoot, branches, leaves and flowers) are harvested by cutting 4 to 5 cm above the ground. Care should be taken not to contaminate the plant material with soil and other weeds. The harvested plants are then bundled at the base with a string and hung dry under the roof. Alternatively, it can be dried in the shade by spreading thinly on a tarpaulin. Dry in a cool and shady place (not in sun, smoke, heat). When it is dry it is very brittle, so pack them up in good packing bags so that small pieces are not lost.

After harvest, earth up soil and add FYM @ 2 kgs per plant base. Under optimum moisture and soil fertility conditions, there can be a second harvest (in much reduced quantity) in October - November. If there is sufficient moisture over the winter, the harvested stumps will regenerate in the following spring, and the harvesting procedure can be repeated annually.

4.8. Yield

A total of 580 kg dry Tiyangkhu straw can be harvested from an acre of land.