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Course - **Production Technology of Spices, Medicinal and Aromatic Plants**
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Topic- **Cultivation of Vetiver crop**
Sub-Topic- **Introduction, Medicinal Uses, Major production areas, Methods of Cultivation, Soil, Irrigation, Manuring & Fertilization, Climate, Cultivars, Season of Planting, Intercultural Operations, Method of Planting, Propagation, Harvesting, Plant Protection Measures, Processing, Post Harvest Technology, Yield.**

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Cultivation of Citronella:

Local name: Usirah, Usira, Vira **(Sanskrit**), Khas, Khus **(Hindi);** Khas-khas **(Bengali**).

Botanical name *Vetiveria zizanioides* (Linn))
Family Poaceae)

Introduction:

Vetiver, commonly known as Khus grass is a perennial grass of Indian origin. Vetiver roots contain fragrant essential oil, which is a perfume by itself. Aroma chemicals such as vetriverol, vetriverone and vetriveryl acetate are prepared from this volatile oil. In India it is mainly used in perfumes, cosmetics, and aromatherapy, food and flavouring industries. Since the plant has extensive finely structured fibrous roots, it is useful in both soil and water conservation and the plant itself is drought tolerant. The world production of vetiver oil is around 300 tons per annum of which India contributes about 20-25 tons only. The world major producers are Haiti, India, Java and Reunion. In India it is cultivated in the states of Rajasthan, Uttar Pradesh, Karnataka, Tamil Nadu, Kerala and Andhra Pradesh, with an annual production of about 20 tons of oil. The present consumption of vetiver oil in India is about 100 tonnes and 80% of the domestic consumption is met by export only.

As the internal demand for vetiver oil is very high, concerns are raising over the improved production and quality of raw materials used.

Medicinal Uses

Vetiver has been used for various ailments. Ayurvedic literature mentioned that plant is used as digestive, carminative stomachic, constipating, haematinic, expectorant, antispasmodic, antiasthmatic, antigrowth, anthelmintic, antimicrobial and diuretic. The roots are used for cooling the brain and also used in the treatment of ulcers. In addition to these, the plant is used for anemia, amenorrhea and dysmenorrheal.

The tribals in India use the different parts of vetiver for many of their ailments such as a mouth ulcer, boils, epilepsy, burns, snake bite, scorpion stings, rheumatism, fever, headache, etc.; decoction of the roots has been used as tonic for weakness; the leaf juice as anthelmintic; the root vapor for malarial fever; the root ash is given to patients for acidity.

Vetiver oil owes several beauty benefi ts and emotional effects. It balances the activity of the sebaceous oil glands, has deodorizing properties, and helps normalize oily skin and clear acne. It replenishes

moisture in dry and dehydrated skin and has a rejuvenation effect on mature skin, as well as cuts/wounds/irritated and infl amed skin. When used regularly during pregnancy, vetiver oil reportedly prevents stretch marks

The vetiver oil possesses sedative property and hence it has been traditionally used in aromatherapy. The oil strengthens the central nervous system, and is helpful in overcoming depression, insomnia, anxiety, stress, tension and nervousness. It may be added to sports oil blends and massaged into muscles before and after sports. Vetiver oil is particularly useful for jet lag and for grounding and clarity while travelling. Researchers are exploring the therapeutic potential of this plant as it has more therapeutic properties which are not known.

Major production areas

Vetiver is indigenous to India, Pakistan, Bangladesh, Sri Lanka and Malaysia. Its main producers are Tropical Asia, Africa, Australia, Haiti, Indonesia, Guatemala, India, China and Brazil. Crop is also cultivated in Indonesia, Malaysia, Philippines, Japan, Angola, Belgian Congo, Dominican Republic, Argentina, British Guiana, Jamaica, Mauritius and Honduras. Worldwide production is estimated to about 250 tons per annum. In India, it is seen growing wild throughout Punjab, Uttar Pradesh and Assam. It is systematically cultivated as a crop in the states of Cultivation of Vetiver DMAPR, Rajasthan, Uttar Pradesh, Kerala, Karnataka, Madhya Pradesh and Andhra Pradesh. Anually a 20-25 tonne of oil is produced in India. Uttar Pradesh produces the highest quantity of oil, mainly through wild sources. Vetiver oil produced in North India is of premium quality and fetches a very high price in international market.

Cultivars:

In India, two types of vetiver namely ‘South Indian’ and ‘North Indian’ are generally under cultivation. North Indian type’s yields superior quality oil but its rooting finds to be shallow, especially in damp ground. South Indian types are the cultivated types with a thicker stem, less branching roots and wider leaves. It is non-seeding type, high yielding both in terms of root bio mass and oil. It is reproduced by vegetative propagation and it is the type suitable for erosion control.

Among South Indian types, Pusa Hybrid-7, Hybrid-8, CIMAPKS-2, Sugandha, KH-8, KH-40 and ODVI3 are varieties available for commercial cultivation. Cultivars Dharini, Gulabi and Kesari released by CIMAP, Lucknow were developed by repeated selection of germplasm collections from different parts of India.

Methods of Cultivation:

Soil

Vetiver can be grown on almost every kind of soil. However, light soils, should be avoided as the roots grown in this soil produce very low percentage of oil. Well drained sandy loam and red lateritic soils rich in organic matter are considered to be ideal for cultivation. It can also be cultivated in clay loam soil but it is better to avoid clayey soil. It can be grown in wide pH range even in saline and alkaline soils with a pH of 8.5 to 10. A flat site is acceptable, but watering must be monitored to avoid water logging, that will stunt the growth of young plantlets. Mature vetiver, however, thrives under waterlogged conditions. It can also absorb dissolved heavy metals from polluted water and can tolerate arsenic, cadmium, chromium, nickel, lead, mercury, selenium and zinc.

Climate

Vetiver is tolerant to a wide range of temperature ranging from -15 °C to +55 °C, depending on growing region. The optimal soil temperature for root growth is 25 °C. Root dormancy occurs when temperature goes below 5 °C. Under frosty conditions, shoots become dormant and purple, or even die, but the underground growing points survive and can regrow quickly if the conditions improve. Shading affects vetiver's growth, but partial shading is acceptable. It is tolerant to drought, flood, and submergence and grows luxuriantly in places having moderately humid climate with annual rainfall of 1000 to 2000 mm. It can also be grown as an irrigated crop in other suitable places with scanty rainfall.

Propagation

Vetiver can be propagated either by seeds or slips, but slips are commonly used. The cultivated accessions which are propagated through vegetative means show limited variation, whereas, seed propagation is used for breeding new varieties. In North Indian types, profuse seeding and natural regeneration occurs from self sown seeds. Seed yield varies between 400-650 kg/ha. Freshly collected spikelet show dormancy and require an after-ripening period of about 3 months. Removal of caryopsis from enclosed husk facilitates germination. Dormancy can also be broken by treating the seeds with gibbrellic acid or potassium nitrate. In South Indian types, most of the spikelet's are not subjected to fertilization and seeds which sometimes produced are very thin and are having a short dormancy period. In these non-seeding types, slips are separated from clumps of previous crops with rhizome portion intact having 15-20 cm of aerial portion is used for propagation. Slips thus obtained should be kept moist and stored in shade. Dry leaves should be removed from slips before transplanting to avoid carryover of pests and diseases.

Planting time

The most suitable time for planting vetiver is **June – August** with the onset of monsoon. In South Indian conditions, where diurnal Cultivation of Vetiver DMAPR, variation in temperature is not significant and monsoon sets in early and the optimum planting time is February-April.

Land preparation

Land is ploughed to a depth of 20-25 cm by 2-3 deep ploughings and removes the perennial weeds. Recommended dose of farm yard manure or compost and fertilizers are applied and mixed well with the soil. In sloppy areas pits are taken across the contour.

Planting

The mother clumps can be divided in two small pieces to give many numbers of slips. Slips are separated from the clump with the rhizome portion intact having 15-20 cm of the shoot portion. While planting slips fibrous roots and leaves should be trimmed off. Ensure planting of slips at the correct time. Slips from healthy and disease free clumps are planted during June-July with the onset of monsoon vertically about 10 cm deep at a spacing of 60×30 cm / 60 × 45 cm / 60 × 60 cm based on soil fertility status, climate, and variety and irrigation facility. Plant population varies from 27,800 to 1, 10,000 plants/ha. If irrigation facilities are available, it is better to plant during March-April, and frequent irrigation will be required. Late planting resulted in the production of coarse roots which yield inferior quality oil.

Crop nutrition

Normally, fertilizer application for vetiver is not practiced in fertile soils. But, on poor soils, 10 tons of FYM along with 25-50 kg/ha each of N, P2 O5 can be applied. Care should be taken to apply N in 2-3 split doses. N: P_2O_5:K_2O dose of 60:22.5:22.5 is recommended in Kerala. Application of 60 kg P2 O5 /ha is suggested for vetiver cultivation in Central Uttar Pradesh.

Irrigation

In the absence of rainfall, soil moisture status should be maintained by irrigation from planting to establishment. In the areas where rainfall is good, well distributed over the year and humidity is high, Cultivation of Vetiver DMAPR, supplementary irrigation is not necessary. However, in dry areas about 8-10 irrigations will be required to get the optimum yield. Apply mulch to conserve soil moisture. Irrigation should be discontinued 7-10 days before harvesting.

Intercultural operation

In case of newly established crop, 2-3 weeding and earthing-up at an interval of one month are needed during initial period of plant growth. Once the crop is established, weeds are kept under check because of vetiver's thick and dense shoot cover. Aerial portion is trimmed at 20-30 cm above ground level thrice during the entire cropping period of two years. First trimming should be done at 4-5 months after planting, second during second year just before flowering and third in second years winter season, about one month before digging of roots.

Plant protection Measures:

Insect pests

Vetiver is a hardy crop and infestation by pests is not a serious concern. However, in dry areas termites are seen damaging the crop.

Grubs of beetle: *Phyllophaga serrata* have also been reportedly infesting vetiver roots. These can be controlled by broadcasting neem cake @ 5 t/ha before final ploughing.

Stem borer: *Chilo sp*. and scale insects are also a threat in some places to the commercially grown vetiver. Remove the leaves and plants severly infested by scales and spraying with neem oil 5% also reduces scale infestation.

Nematode infestation of roots by is also reported. To prevent nematode infestation caused by Heterodera zeae, use nematode free healthy mother stock. High organic matter content of the soil, hot water treatment and application of neem cake @ 5 t/ha are also found effective in controlling nematode.

Diseases

During rainy season the plant is infested by *Fusarium sp*. **Leaf blight** caused by *Curvularia trifolii* is another important disease during rainy season. The infested leaves bear tan to dark spots which turn Cultivation of Vetiver DMAPR, black with age. The roots of affected plants become yellow and gradually dry out. These pathogens can be controlled by 2-3 spraying or drenching of copper oxy chloride 0.3%.

Harvesting

The time of harvesting of vetiver roots is very important as the yield of roots and oil percentage vary with changes in environmental conditions. Roots are harvested after 15-24 months of planting, but to obtain good quality oil it should be harvested at 18 months. Though, early harvesting gives higher essential oil yield, oil will be of low specific gravity which also lack valuable high boiling constituents. If roots stay in ground for over two years, oil quality improves but yield diminishes considerably. Crop is generally harvested during **December - February** by digging out the clumps along with its roots manually. A tractor drawn mould board plough can also be used for digging out roots up to 35 cm depth. Mechanical harvesting gives 15% higher roots recovery over manual harvesting.

Processing

The harvested roots are separated from the aerial parts, washed thoroughly, chopped to shorter lengths of 5-10 cm to facilitate easy drying and then dried under shade for 1-2 days before distillation, which improves the olfactory quality of the essential oil, while prolonged sun drying reduces the oil yield. While drying, roots should be laid out in thin layers and this will prevent the chances of fungal growth that results in decomposition of root. Do not dry the roots on the ground in direct sunlight without close supervision as direct sunlight involves a high risk of degradation of its active principles.

After drying, the oil is extracted from the roots through hydro or steam distillation. In North Indian varieties, distillation process is completed in 12-14 hours, while South Indian varieties require a long duration of 72-96 hours, as it has low volatile oil and high boiling point. Two distinct fractions, one lighter than water and another heavier than water are obtained from vetiver. Heavier the Cultivation of Vetiver DMAPR, oil better is the quality. After distillation is completed these fractions should be collected separately and later mixed together. The oil is then decanted and filtered. The distilled oil is treated with anhydrous sodium sulphate or common salt at the rate of 20 g/liter to remove the moisture. Oil obtained from stored roots is more viscous and posses a slightly better aroma than that obtained from freshly harvested roots. Fresh roots require less time for distillation and gives maximum oil yield.

The vetiver oil is amber brown and rather thick. Its odour is described as deep, sweet, woody, smoky, earthy, amber and balsam. Ageing of the essential oil for a period of six months improves the odour of the oil substantially wherein, the `harsh' `green' and `earthy odour' characters of the freshly distilled oil gets converted in to a fuller, heavier and sweeter odour. The oil should be stored in sealed amber coloured glass bottles or containers made of stainless steel, galvanised tanks, aluminium containers and stored in a cool and dry place. All processing activities should be documented in a diary.

Expected yield

The essential oil yield of vetiver roots varies considerably and it depends on a number of factors such as soil conditions, age of the roots, harvesting time, drying and distillation methods followed etc. On an average the root yield may range from 5-7 tonnes per hectare from a two year old plantation. In sandy and sandy loam soils, root yield is as high as 2-2.5 tonnes /ha whereas; in salt affected areas only 1-1.5 tonnes of roots can be harvested per hectare. The average oil recovery from north Indian variety is between 0.15 to 0.2%, whereas, it is 1% from South Indian variety. Oil recovery from fresh roots is 0.3-0.8% and from dried roots it is 0.5-3.0% depending upon the duration of distillation. On an average the oil recovery is around 1% on dry weight basis and 10-30 kg oil is obtained per hectare per crop.

Yield

On an average, one hectare of vetiver plantation yields 5 to 7 tonnes of roots which on distillation yield 15 to 16 kg of oil. Roots yield 1.0-1.5% of oil on dry weight basis. The colour of oil is light yellow and the oil contains 65-75% **veteverol.**

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