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SKUAST-Kashmir

Scientific Cultivation of Kala Zeera in Gurez Valley (Package and Practice)




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ORIGIN AND DISTRIBUTION

Kala zeera (*Bunium persicum* Bioss.) is a low volume, high value ethano-medicinally important herbaceous species widely used for culinary, flowering, perfumery and carminative purposes. It is known by different names in different parts of the world (table 1). Kala zeera is believed to have originated in an area between Central Asia and Northern India (Panwar, 1992). It grows naturally in alpine and sub-alpine habitats of north-western Himalayas.

Figure 1. Kala zeera plant at flowering

In India, its species grow wild in North Himalayan regions, in forests and grasslands, at higher elevations including arid zones ranging from 1800 m to 3300 m amsl. Under Indian Himalayan zone, its wild populations are mostly endemic to high altitude regions (table 2) of Uttarakhand, Kinnaur, Lahaul Spiti, Pang and Bharmour in Himachal Pradesh; Gurez, Tulail and Kishtiwar sectors of Jammu and Kashmir (Panwar *et al*., 1993). In Jammu and Kashmir, the crop species grows mostly in the wild, under natural conditions in forests, open hilly grassy slopes, low alpine and table lands, as sub-populations, mostly across the hilly areas of Gurez, Tulail, Keran, Machil, Tangdar, Kargil, Kishtwar Paddar, Khrew and Char-e-sharief (table 2). The sub-populations across the state represent a great diversity of this plant species. This diversity has been naturally

maintained in the form of germplasm repositories and these natural habitats in the valley may constitute efficient sources of genetic variability that can further be used for genetic improvement of this crop (Gupta *et al.*, 2013).

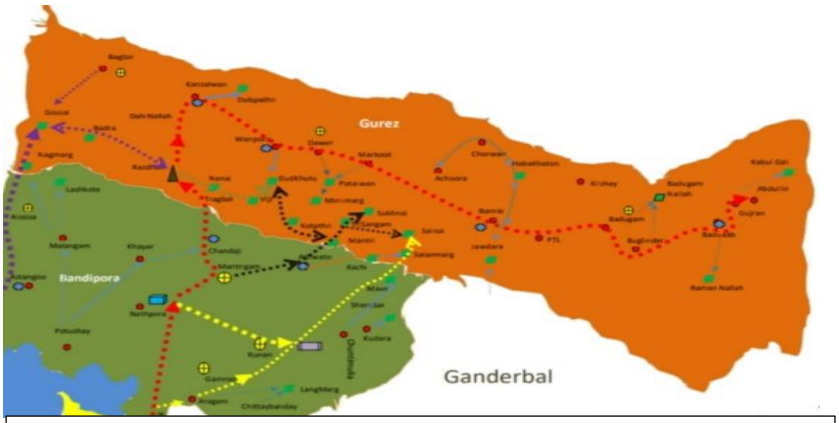

Figure 2. Map of Gurez showing different villages

Table 1. Names of Kala zeera in different

Language	Name
Danish	*Sort kommen*
Dutch	*Zwarte komijin*
English	*Black cumin*
Esperanto	*Nigra kumino*
French	*Cumin noir*
German	*Schwarzer kraizkummel*
Hindi	*Kala zeera, shahi jeera*
Italian	*Cumino nero*
Japanese	*Burakku-kumin*
Kannada	*Shahi jirige*
Kashmiri	*Zeur*
Lithuanian	*Persinis gumbakmynis*
Nepali	*Kalijira, Himali jira*
Persian	*Zireh-e-Irani, Zireh-e-Kuh*
Punjabi	*Kala Jira*
Sanskrit	*Krishna jiira*
Spanish	*Comino negro*
Urdu	*Kala zira*

Table 2. Common Kala zeera growing areas in Northern Hill regions of India

Area	Longitude	Latitude	Altitude (m)
Gurez	34.6494°N	74.7366°E	2,580
Tulail	34.5559°N	75.0544°E	2,750
Kishtiwar	33.3116°N	75.7662°E	1,638
Keran	34.6651°N	73.961°E	1,524
Machil	34.6923°N	74.3592°E	2,450
Tangdhar	34.3975°N	73.8607°E	1,929
Kargil	34.5539°N	76.1349°E	2,676
Paddar	33.2658°N	76.1581°E	2,958
Khrew	34.0209°N	74.9998°E	1,607
Char-e-sharief	33.8629°N	74.7663°E	1,933
Kinnaur	31.6510°N	78.4752°E	4,075
Lahaul Spiti	32.6192°N	77.3784°E	4,883
Pang	30.0409°N	78.8652°E	4,600
Bharmour	32.4411°N	76.5357°E	2,121

PRODUCTION AND PRODUCTIVITY OF J&K

As per the figures of State Forest Department, J&K for the year 1996-97, Kala zeera crop covers approximately an area of 225 ha of forestland with a production of nearly 29,000 kg of seed. The average productivity of kala zeera in the cultivated areas is around 129 kg ha^{-1}, which is quiet low as compared to 350-400 kg ha^{-1}, obtained from annual type of zeera (*Carum carvi* L.).

SOIL AND CLIMATE

Kala zeera in Gurez is purely organic. It can successfully be grown under temperate conditions on soils with good organic matter content having high water holding capacity with neutral pH. The excess soil moisture is not favorable for the crop, however, rains during the months of April and May are favourable for vegetative growth, umbel formation and seed set. The crop is highly sensitive to moisture stress at flowering stage. Natural habitats of Kala zeera are rainfed, where

the distribution of rainfall is enough to ensure adequate soil moisture during the crop cycle. However, with domestication the crop may experience drought conditions at critical stages like flowering stage (June) and seed setting stage (July). Appropriate arrangements are to be made to maintain soil moisture at critical stages during drought conditions.

LAND PREPARATION

Well-ploughed field with pulverized soil with the incorporation of crop residue / FYM by deep ploughing using either mechanical or draught power in hilly areas is helpful in making raised-beds in the field for planting Kala zeera crop. Land should be ploughed to a depth of 12-15 cm so that farmyard manure /crop residue/ compost is thoroughly turned under. Subsequently 2-3 ploughings with disc harrow/ soil stirring plough should be given. Raised bed planting is ideal for planting Kala zeera crop to avoid excessive.

NUTRIENT MANAGEMENT

In general, apply compost or well rotten FYM uniformly at the time of first ploughing @ 10-15 t/ha along with Vermicompost @ 10 quintals/ha. This is essential for increasing water retaining capacity of the soil. To maintain soil health following fertilizer schedule is to be followed (in areas where inorganic fertilizers are recommended):

Inorganic fertilizers = N: P2O5: K2O 90: 60:40 kg/ha

i) Nitrogen in the form of Urea @ 145 kg/ha

ii) Phosphorous in the form of DAP @ 130 kg/ha

iii) Potassium in the form of MOP @ 65 kg/ha

Time of application: In general, Kala zeera crop is very responsive to nutrients. The rate of nutrient application depends mainly on soil nutrient status/balance and cropping system. For achieving optimum yields, following schedule of the recommended doses should be followed for enhancing

nutrient use efficiency and better crop performance (in areas where inorganic fertilizers are recommended).

a) P-application: 100% as basal dose at the time of planting
b) K-application: 100% as basal dose at the time of planting
c) N-application: In three splits, including:
    - 20% - as basal dose at the time of planting
    - 50%- at the onset of vegetative phase in 2nd fortnight of March, ensuring availability of moisture.
    - 30% - before flowering in 3rd week of April

PLANTING TIME FOR SEED AND TUBER

Sowing of seed

For raising of vegetative propogules from mature seed sowing of seed from 20th October to 30th November @ 16kg/ha along with application of FYM @ 15 tons/ha and vermicompost 10 q/ha under nursery ensures maximum seed germination up to 92% and subsequent desired tuber recovery from nursery after 4 years of seed sowing. Seed should be sown about 1.0 cm deep to ensure good seedling growth and vigor. Pre chilling requirement is necessary for breaking the dormancy of zeera seed (mericarps).

Tuber harvesting/recovery

Appropriate age of lifting tubers from nursery for their subsequent plantation is 4 years of seed sowing. Fourth year lifting is accompanied with maximum benefit on account of reduced cost of cultivation and high returns. With the advancement in tuber age there is proportional increase in seed recovery. In order to achieve economic yields of Kala zeera, maintenance of appropriate

plant population (approx. 2.5 lakh plants/ ha) is necessary. The recommended plant population is achieved after planting the tubers with row-to-row spacing of 20 cm and plant-to-plant spacing of 20cm.

Sorting of tubers

Tuber size in Kala zeera varies from 2 to 30 g. Tubers weighing upto 2g have limited potential for seed yield. However tubers weighing more than 2g are productive and maximum seed yield ability is shown by tubers weighing more than 10g. Tubers weighing more than 2g, free from injuries and disease lesions are sorted out for planting.

Tuber Treatment

In other areas, to protect the Kala zeera from major tuber and soil borne diseases, dip the tubers before sowing for 5-10 minutes in fungicidal solution prepared by dissolving Carbendezim 12% + Mencozeb 63% WP @ 10gm in ten litre of water. Tubers are taken out and spread on a clean cloth and then allowed to dry in shade for another 10 to 15 minutes to drain off excess moisture. Chemical treatments are not recommended for organic areas like Gurez.

Figure 3. Kala zeera seed and tubers

SOWING TIME AND PLANTING GEOMETRY

After the field is ready, tubers weighing more than 2g are planted in October by hand dropping. Tubers once planted at 15 cm depth and proper and position are retained in the field for many years to produce seed yield. The recommended tuber number to achieve the required plant population is 2.5 lakh/ha for maximum seed yield of Kala zeera crop. Line sowing with 20 cm row-to-row and 20cm plant-to-plant distance is recommended for optimal performance of Kala zeera.

Figure 4. Layout of Kala zeera trials at MAR&ES SKUAST-K Gurez

MOISTURE MANAGEMENT

Kala zeera can be successfully grown under rain-fed conditions where the distribution of rainfall is enough to ensure adequate soil moisture during the crop cycle. However, severe drought conditions at any growth stage is undesirable for Kala zeera crop, reproductive stage especially during one week before one week after flowering and seed setting stages are the most critical and therefore good moisture management at this stage is highly indispensable.

INTER-CULTURE OPERATIONS

Weeds compete with crop growth for light, water and nutrient uptake, which may lead to significant yield losses. For management of weed and to reduce weed seed load in the soil, a light hoeing in the month of August/ September, immediately after harvesting of crop and after receiving a rain shower is recommended. A hoeing in the month of May is also recommended to ensure good vegetative and reproductive growth of the crop.

IRRIGATION MANAGEMENT

Natural habitats of Kala zeera are rainfed, where the distribution of rainfall is enough to ensure adequate soil moisture during the crop cycle. However, with domestication the crop may experience drought conditions at critical stages like flowering stage (June) and seed setting stage (July). Appropriate arrangements are to be made to maintain soil moisture at critical stages during drought conditions.

DISEASE AND PEST MANAGEMENT

a) Disease management

(i) Tuber rot *(Fusarium oxysporum/ F. solani)*

This is the most common disease of kala zeera crop. The disease symptoms resemble symptoms of wilt disease. There is yellowing /chlorotic symptoms on the leaves (figure 5). In extreme cases vegetative parts are easily pulled out from the infected tubers. Fungal mass/ ooze may also appear on the infected tubers.

Figure 5. Symptoms of tuber rot on plant

(ii) Damping off *(Pythium spp.)*

Pre-emergence damping off is manifested by seed /tuber rot with drying up of seedlings/ foliage before its emergence from the soil surface (figure 6). The post-emergence damping off can be visualized once the seedlings from the tuber emerge out of the soil, a soft lesion appears near the collar region which causes constriction and results in toppling over of the seedlings.

Figure 6. Damping off in zeera

(iii) Leaf & Umbel blight *(Alternaria burnii)*

Small isolated necrotic lesions appear mostly on the younger leaves and blossom. The disease progress is accompanied with defoliation and hanging of umbels (figure 7). Seed may either not be formed at all or formation of shriveled, dark coloured light or non-viable seed may occur.

Figure 7. Leaf & umbel blight in zeera

Management and control of disease

Application of Shalimar Bioagent-1 @2kg/ kanal along with well decomposed organic manure at the time of planting/ periodic hoeing. Kala zeera tubers can also be treated with Shalimar Bioagent-1 @ 5g (2 x 108 cfu/ g)/ kg of tuber before sowing.

b) Major Insect-Pests and their management

(i) Aphids

Aphids (*Aphis craccivora, Aphis gossypii*) are major pests inflicting injury to kala zeera crop in the field. *Myzus persicae* is also quite common in conjunction with *Hyadaphis*. Early sowing and selection of less susceptible variety will prove a suitable component for the management of aphid. During the flowering stage a population of 55-70 aphids/5 plants could reduce yields by 50%, so crops should be protected just before flowering.

Figure 8. Aphids as pests in Kala Zeera

(ii) Predators

Of the natural enemies, *Coccinella septempunctata*, *Brumoides suturalis*, *Menochilus sexmaculatus* and *Adonia* [*Hippodamia*] *variegata*, and the common myna (*Acridothere stristis*) have recorded preying on the aphids. Maggots of Syrphid flies also feed on aphids. The other common predators of aphids are *Chrysoperla carnea*, *Episyrphus balteatus* and *Ischiodons cutellaris.*

(iii) Cut Worm

They are not pests, as they feed on nectar. It measures about 25 mm from the head to the tip of the abdomen and looks dark with some grayish patches on the back and dark streaks on the forewings. Adults live for 7-10 days. Total life cycle takes up to 36 days for them to develop from eggs. Both adult caterpillars become active during night. Caterpillars during day time hide in cracks and crevices in the soil. They attack young plants by severing their stems, pulling all parts of the plant into the ground and devouring them. Plants with severed stems seldom healthy growth.

Figure 9. Cut worm larva in Kala Zeera

This pest can cause serious damage particularly when crops are 25-35 old. Parasitoids and predators are known which are able to control cutworms naturally.

Parasitoids: *Trichogramma spp., Tetrastichus sp, Telenomus sp, Bracon sp, Campoletis sp, Chelonus sp, Ichneumon sp, Carcelia sp*. Predators: Lacewing, ladybird beetle, spider, red ant, dragon fly, robber fly, reduviid bug, praying mantis, King crow.

c) *Management of rodents*

Rodents cause considerable loss to kala zeera crop by damaging the tubers as they are rich source of carbohydrates and sweet in taste. Therefore, extra care needs to be taken for rodent management. Initially live burrows are to be identified and if advised for the area, then 5-10 g aluminum phosphide pouches are placed in these live burrows provided some amount of moisture is present in the burrows. The burrow is immediately packed with soil and left undisturbed.

Figure 10. Rodent damage during offseason (August-March)

Although other traditional techniques like growing garlic around the kala zeera beds and burning plant debris near burrows to create smoke inside the live burrows could also attempted for management of rodents in kala zeera.

HARVESTING OF KALA ZEERA

Timely harvesting of Kala zeera has strong association with the quality seed recovery. Any delay in harvesting causes shattering of seeds which results in yield loss upto 21-25%. The crop is harvested by picking the umbels carefully. Picking is done when plants partially turn yellow, the umbels are recommended for harvesting in the wee hours of the morning if the produce is used for essential oil and also to avoid shattering. For seeds to be used as condiment, it is recommended to harvest umbels at seed moisture content of 13-16% as it leads to best quality Zeera. However, for seed production crop needs to be harvested when the umbels are fully matured with moisture percentage around 10%. Yield potential of Kalazeera under natural population is 225 – 250 kgs/ha, whereas SKAU-KZ-103 (Shalimar Kalazeera-1) yields 410-430 kgs/ha.

Figure 11. Harvesting of Kala Zeera at MAR&ES SKUAST-K Izmarg Gurez

NMHS funded research project entitled, *"Revival of kala zeera cultivation through germplasm conservation and local community based approaches under tribal area conditions of Gurez valley"* is currently in operation under theme Biodiversity Conservation and Management, under which efforts are being made to collect, characterize and to conserve kala zeera in Gurez valley. This is considered as the first report of systematic collection, conservation, morphological and molecular characterization of kala zeera germplasm from North-Western Himalayas.

SUMMARY

The Himalayan region including the high altitude areas of the Union Territory of Jammu and Kashmir is considered natural habitat of kala zeera. In Kashmir valley, kala zeera grows naturally on high hills of Gurez, Machil, Kargil, Drass, Vasturvan, Chrar-e-Sharief, Khrew etc. In the recent past continuous and unscientific ruthless exploitation of this crop by tribal people of these areas for immediate financial gains has led to low productivity and genetic erosion of land races. If this situation is not taken care of, the zeera crop may soon become drastically reduced which may ultimately led to heavy economic losses. Kala zeera seed when harvested before maturity is used as spice, but lacks ability to germinate. Concrete efforts are desired to develop kala zeera

germplasm bank, create community based general public awareness programmes in collaboration with local agencies to give awareness about importance of conservation of landraces and appropriate time of harvest to economize zeera cultivation in the area. Trainings for local population of these areas is also necessary regarding technological interventions for domestication of this crop on scientific lines, know how to conserve its diversity, to economize its cultivation through value addition and identification of kala zeera genotypes/ varieties with high yield potential. The landraces of kala zeera have been collected from different pockets of Gurez valley and their molecular markers based characterization work is presently going on under NMHS funded project on Kala zeera. The study is expected to identify unique landraces that could be preserved in germplasm bank and seed of such elite entries could be submitted to national germplasm conservation authority, NBPGR, New Delhi for registration.

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NMHS Funded Research Project on Kala Zeera

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