

swelling and distortion of the stem and floral parts due to hypertrophy and hyperplasia and develop “stag head” structure. Use certified seeds of resistant/tolerant variety. Follow timely sowing of crop. Adopt proper field sanitation. Destroy crop debris particularly stag heads of previous year crop. Avoid water stagnation. Treat the seeds with freshly prepared garlic bulb extract @ 2% (w/v).

Alternaria blight (*Alternaria brassicae*): The disease attacks on the lower leaves as small circular brown necrotic spots which slowly increase in size. Many concentric spots coalesce to cover large patches showing blightening and defoliation in severe cases. Circular to linear, dark brown lesions also develop on stems and pods, which are elongated at later stage. Infected pods produce small, discoloured and shrivelled seeds. Early sowing of well-stored clean certified seed after deep ploughing, clean cultivation, timely weeding and maintenance of optimum plant population, avoidance of water stagnation at flowering and pod formation stages may help to manage the disease. Burning the debris of the crop is a simple but important practice for reducing the incidence of Alternaria blight. Spray of soil isolates of *Trichoderma viride* at 45 and 75 days after sowing can manage Alternaria blight. Botanicals, viz. bulb extract of *Allium sativum* (garlic) has been reported to effectively manage the disease.



Insect management

Aphid (*Brevicoryne brassicae*, *Liaphis* sp): The most serious pest of toria is aphid. Aphids feed on the leaves, stem, flowers and pods of the plant. Though it can feed on the leaves and make crinkling of leaves, it is found aggregated in the stem especially in flower bunches and pod at pod formation time.



Management: Aphids are managed by spraying botanicals like neem extract. Coccinellids and syrphids feed on aphids and

control them. The peak period of aphid activity is stretched of beginning from January to mid- February. Therefore, early sowing of toria and cultivation of short duration varieties should minimize the aphid incidence.

The economic threshold levels (ETLs) for spraying against aphid indicated that spraying of organic pesticides should be initiated when the aphid number is 9-18/plant and when 30% of the plants are infested. Spraying should be repeated when such a level of infestation is noticed again.

Dashparni extract is useful to manage all kind of insect-pests and 5-6 litres of *dashparni* extract is diluted in 250 litres of water for spraying one ha crop area.

Harvesting, threshing and storage

To obtain maximum oil yield, it is essential to harvest the crop at the right time. Seeds attain the highest oil content at yellow pod stage, at which the crop should be harvested. Delay in harvesting may result in loss in oil content. Also if not harvested, seed shredding leads to loss in seed yield. Harvesting should be done in the morning hours to avoid shattering.

The crop should be cut with a sickle, dried on the threshing floor in the sun for 3-4 days and threshed by beating with sticks or trampling with bullocks. Seeds should be separated, cleaned, and sun-dried for 3-4 days so that the moisture content comes down to 8% at which level they can be safely stored.

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Organic Farming of Rainfed Toria in Hills



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Toria (*Brassica rapa* cv. *Toria*) is a major oilseed crop of *rabi* season in the north-western Himalayan (NWH) region. It is known for many of its uses and in various purposes for human consumption. *Toria* seeds and its oil are used for culinary purpose. Young leaves are used for vegetable purpose. Its oil cake is used for feeding cattle. *Rabi* season could be best utilized by growing *toria* under rainfed situation to achieve double cropping and greatly contribute farmers' income due to its small duration. It is cultivated in 8466 ha area in hills of Uttarakhand with the yield level of 5.67 q/ha.

Due to the gap between domestic availability and actual consumption of edible oils, India has to resort to import of edible oils. Besides, it offers higher return with low cost of production and low water requirement. *Toria* is the major source of income, especially even to the marginal and small farmers in rainfed areas. Since, this crop is cultivated mainly in the resource scarce and rainfed regions in the NWH, its contribution to livelihood security of the small and marginal farmers is also very important. Being a major *rabi* oilseed crop and having an advantage of soil moisture conserved during monsoon, it has greater potential to increase the availability of edible oil from the domestic production. By increasing the domestic production, substantial import substitution can be achieved. Due to its low water requirement (80-240 mm), it fits well in the rainfed cropping system.

The minimum support price of *toria* increased 2.5 times during last ten years from 1850 in 2010-11 to 4650 rupees in 2020-21. Hence, production of organic *toria* is highly profitable with addition of small amount of premium price also. The yield of *toria* can be enhanced with following organic management practices.

Climature

The crop requires a fair supply of soil moisture during the growth period and dry period at the time of maturity. Cool temperature, clear dry weather, plentiful of bright sunshine associated with adequate soil moisture increase the oil yield. Temperature of approximately 20-22°C during sowing supports rapid germination for a vigorous crop stand.

Soil

Toria can grow on a wide range of soil condition varying from sandy loam to clay loam soil but is most suitable in light loam soil. Crop cannot tolerate waterlogging and do not grow on heavy soil. Plant can tolerate moderate salinity but a soil having a neutral pH 6-6.5 is ideal for proper growth and development of the crop.

Field preparation

A fine seedbed is required for a good germination of this crop. The land should be well-prepared by one ploughing followed by 2-3 harrowings. Each ploughing should be followed by planking to make the soil well pulverized and levelled. Firm, moist and uniform seedbed should be prepared as it will help in uniform germination of seed. *Toria* requires a fairly moist seedbed for

good germination, but too moist seedbed impairs its germination. Since *toria* is grown as a rainfed crop, hence, proper mulching should be done to conserve soil moisture.

Level of organic manure and treatment

Application of 16-20 tons per hectare well decomposed farmyard manure (FYM) (3.2-4 quintals per *nali*) is recommended for *toria* crop. The FYM should be broadcast and mixed thoroughly in the soil. 2.5 kg of *Trichoderma* powder should be mixed thoroughly with 2 quintals well decomposed farmyard manure or any compost 10-15 days before application. This inoculated heap of FYM or compost should be covered through jute sack or straws to keep it air tight. This inoculated FYM should be uniformly spread over one hectare area before sowing. The diseases caused by fungus can be effectively controlled by using *Trichoderma*. Application of 250 kg per hectare of *ghanjeevamrit* (prepared from indigenous cow dung, jaggery, pulse flour, indigenous cow urine and undisturbed soil from forest) at the time of sowing enhances the soil health and yield.

High yielding variety suitable for organic farming

VPKAS, Almora has developed a high yielding variety, i.e. VL Toria 3 suitable for cultivation under rainfed organic farming in the NWH.

Sowing Time

The best time for planting *toria* varies from early September to mid-October. Generally, the land is occupied by *kharif* crop in the month of September in the NWH. Hence, it must be sown in the first fortnight of October to utilize the residual soil moisture of monsoon rain. *Toria* sown in early October suffer less from aphids while November sown crops suffer the most from aphids and saw flies.

Seed rate, spacing and depth of sowing

Since, *toria* is sensitive to weather variation, establishment of optimum stand of 2.2-3 lakh plants/ha or 25-30 plants/m² often becomes a problem. Allowing a large margin for poor seed germination due to various factors, the seed rate of 4 kg/ha is recommended. The plant spacing of 30 cm × 10 cm is recommended for *toria* in the NWH. Thinning is done three weeks after sowing to maintain a plant to plant distance of 10 centimetre. If optimum soil moisture is not available during sowing, then the seed rate can be increased up to 5-6 kg/ha. The seeds should be sown in rows at a depth of 2.5-3.0 cm. When, *toria* is sown as mixed or intercrop, 1.5 to 2.0 kg seed per hectare is sufficient. This could be done either by using a seed drill or by seeding behind *desi* (country) plough.

Seed treatment

Moisten the recommended amount of seed (4 kg for one hectare) with minimum amount of water. Mix thoroughly one packet (200 g) each of *Azotobacter*, phosphate solubilizing bacteria

(*Pseudomonas fragii*) and plant growth promoting rhizo-bacteria (PGPR) (PGRS17) with it. The *beejamrit* (prepared from indigenous cow dung, lime, undisturbed soils from forest and indigenous cow urine) can also be used as seed treatment. Allow the treated seeds to dry in shade. Sow the seed within one hour after inoculation.

Method of Sowing

Most of the farmers broadcast *toria* seeds during sowing. Germination of seed is very poor in broadcasting. The plant density is not uniform also. Line-sowing is preferred for optimum and uniform plant density to broadcasting method. North-south row orientation is generally beneficial over east-west orientation, because there is better interception of light in crop rows in the former orientation.

Crop management

Generally, *toria* is intercropped and mixedcropped with wheat, barley, lentil, potato, etc. Growing of *toria* crop in rotation with leguminous crops (soybean, black soybean, horsegram, pigeonpea, etc.) enhances the seed yield. Spraying of *jeevamrit* (prepared from cow dung, cow urine, jaggery, chickpea flour and undisturbed forest soil) @ 500 litres per ha twice a month enhances the yield. Spraying of 3% *panchagavya* and vermishash during preflowering and flowering stages enhances the soil health and grain yield.

Weed control

Weeds in *toria* crop cause about 20-30% reduction in yield. The most common weeds, which grow in *toria* are *Chenopodium album* (*bathua*), *Lathyrus aphaca* (*chatri matri*), *Fumaria parvijlora* (*gajri*) and *Cyperus rotundus* (*motha*). Care should be taken to remove all weeds in the early stages of crop growth to avoid competition on the reserve of soil moisture. One interculture operation with hand hoe is beneficial. This, besides creating soil mulch and thus reducing moisture losses through evaporation helps in better growth and development of crop plants. Thinning operation should be accompanied with interculture to provide the proper spacing to the plants within the rows.

Disease management

White rust (*Albugo candida*): Both local and systemic infections are observed. In case of local infection, white creamy yellow raised pustules appear on the leaves which later coalesce to form patches. In systemic infection and during humid weather, mixed infection of white rust and downy mildew cause

