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Package of Practices for Organic Onion Cultivation in Sikkim

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Onion is a cool-season bulb vegetable with great economic value that has been produced and domesticated for more than 500 years due to its unique medical, pharmacological, and culinary properties. It is regarded for its distinct flavour and pungency, which are caused by the presence of a volatile oil called allyl propyl-disulphide. It is commonly consumed as a salad and can be prepared in a variety of ways, including curries, frying, baking, pickles, soups and more. Marketing dehydrated onions and onion flakes adds value to onion products. India, USA, Mexico, Turkey and Pakistan are the top onion exporters, whereas Malaysia, United Arab Emirates, Japan and Canada are the top onion importers. Maharashtra is India's top producer of onions, followed by Gujarat and Karnataka. The crop is grown extensively in Orissa, Uttar Pradesh, Andhra Pradesh, Bihar, Tamil Nadu and Rajasthan, accounting for over 90% of the country's total onion production. Maharashtra is predicted to account for around 42.53% of onion output in 2019-2020, totalling 11363.00 tonnes. Among all vegetables, onions generated the highest export earnings, totalling ₹2660.79 crores in 2019 (NHB, 2020). Onions comprise around 89% water, 9% carbohydrate, 4% sugar and 2% fat. Onion bulbs contain high levels of calcium (180 mg/100 g) and phosphorus (50 mg/100 g). The health advantages of onions are largely due to their wide range of bioactive components, including organosulfur compounds, phenolics, saponinsand polysaccharides. These compounds contribute to numerous beneficial effects, such as antioxidant, antimicrobial, anti-inflammatory, anti-obesity, anti-cancer, anti-diabetic, neuroprotective, cardio-protective, respiratory and digestive system protective, liver- and kidney-protective, as well as immunomodulatory activities.The area under organic production in India is very small and only a few states like Sikkim grow organic onion. It is therefore very important to standardise the package of practices (POPs) for the production of organic onions in order to increase the area and production of organic onions. This chapter focuses on onion POPs with respect to Sikkim.

Origin and Distribution

Jones and Mann (1963) proposed that onions originated in the mountainous areas of Central Asia—covering present-day Iran, Afghanistan, Pakistan, Tajikistan, and Uzbekistan—from where they spread to other regions of the world. Western Asia and the Mediterranean region are considered to be the secondary centres of their development.

Classification

The types of onion species grown in Sikkim include:

1. **Common onion (*Allium cepa* var. *cepa*):** Produces single, large bulbs and is propagated by seeds. It is primarily used in salads and curries.
2. **Multiplier or potato onion (*Allium cepa* var. *aggregatum*):** Forms clusters of small bulbs and is propagated using these bulbs. It is mainly added to curries for flavoring.

3. **Shallot (*Allium cepa* var. *ascalonicum*):** Develops clusters of bulbs on the soil surface. This perennial variety is usually propagated through bulbs as it rarely produces seeds.

Organic package of practices

Soil: In Sikkim, onions grow well in deep, friable, sandy loam, and silt loam soil with improved moisture retention. For best results, the soil should be fertile, rich in organic matter, and well-aerated. Regardless of the kind of soil, the ideal pH range is 6.0 to 6.8, while alkaline soils are also acceptable. When the pH drops below 6.0, onions may suffer from micronutrient deficiencies or, at times, toxicity from elements like aluminium or manganese. Onions are severely harmed by water logging conditions. Sandy soils encourage early maturity and need more frequent irrigation while heavy soils, limits bulb development, delay crop maturity, distort bulb shape, and complicate harvesting.

Climate: In Sikkim, onions can be grown across a wide range of climatic conditions. Onions grow best at 12.5° to 25.0°C for seed germination, 12.8° to 21.0°C prior to formation of bulb, and 15.5° to 25.0°C for bulb development. The crop performs poorly when monsoon rainfall exceeds 75–100 cm. While young plants can tolerate freezing conditions, very low temperatures during vegetative growth can trigger bolting. Conversely, an abrupt temperature increase early in the season encourages premature bulb formation, resulting in smaller bulbs. Onions need around 70% relative humidity and at least 20% available soil moisture for good germination. Under Sikkim's winter conditions, low-cost poly tunnels and protective shelters help create a favourable microclimate for bulb production.

Onion Variety: Given below in the table are high yielding onionvarieties which can be used for commercial onion cultivation in Sikkim. The data has been generated through AINRPOG (All India Network Research Project on Onion and Garlic) trials over last three years (2023-2025) in Sikkim.

Sl.No.	Variety	TY (q/ha)	MY (q/ha)	ABW (g)	TSS %	TI	PDI PB	PDI SB
1.	Bhima Shakti	238.41	232.20	38.56	10.45	0.67	0.0.	5.55
2.	Bhima Super	249.22	241.21	39.21	10.78	1.00	0.00	3.89

TY = Total yield, ABW = Average bulb weight, NOC = Number of cloves/bulb, AWC = Average Weight (Based on weight of 50 cloves), TI = Thrips incidence, PDIPB= Plant disease index, Purple blotch, PDISB= Plant disease index Stemphylium blight

Methods of planting: Generally, in Sikkim condition, onions are raised in a nursery bed and then the seedlings are transplanted to the field.

Seed Rate: For rabi-season onion cultivation, a seed rate of 8–10 kg per hectare is advised. *Trichoderma@* 4-5 gms/100 gms should be applied to the seed prior to sowing in order to improve germination, prevent soil-borne diseases, and promote plant growth.

Nursery and Land Preparation: Onion nursery beds are typically 3–4 meters long and about 1.0 meters wide. To prevent water stagnation, raised beds of 10 to 15 cm in height are prepared. In nurseries, line sowing is typicallyfollowed. After the seeds are sown, they should be lightly watered and covered with finely powdered compost or farmyard manure. The bed's surface needs to be flat and smooth with a gentle slope towards the edges. To do intercultural operations, two beds are kept about 50 cm apart. To maintain the necessary temperature and moisture for germination,mulching with dry grass, straw or other organic mulches should be used.

Season of Onion Planting: In Sikkim, onions are typically planted from the first week of November to the first week of December. Delayed planting should be avoided, as it can lead to poor germination, reduction in seedling growth, and early bolting. Planting too early may also trigger premature bolting in the bulbs, which lowers both yield and quality.

Onion Transplanting: Transplanting can be done when the nursery plants are 6–7 weeks old and about 0.6–0.9 cm thick and the recommended spacing for planting is 15 cm × 10 cm in the field.

Organic Nutrient Management: Application of well-decomposed farmyard manure (FYM) or compost @ 15 t/ha along with 200 kg neem cake and 100 kg/ha rock phosphate or vermicompost @ 5 t/ha is recommended through broadcasting and ploughing at the time of land preparation or as basal dressing by spreading over the beds or into the pits at the time of planting. Integrated application of FYM @ 8 t/ha and vermicompost @ 2 t/ha along with 200 kg neem cake and 100 kg rock phosphate/ha is the best option for sustainable onion and garlic production.To maintain soil acidity, lime can be applied at 2 tonnes per hectare once every two years. Organic manure can also be applied along with bio-fertilizers like *Azospirillum* and *Bacillus* (Phosphate Solubilizing Bacteria) for better nutrition to the crop. Besides, Trichoderma viride 5kg/ha mixed with Azotobacter 10kg/ha can also be applied along with organic manure as basal.

Irrigation: Onion is generally cultivated as an irrigated crop, and the irrigation schedule varies according to climate, soil characteristics, irrigation method, and crops age. The water requirement differs across growth stages. Irrigation in the nursery should be done regularly to keep the soil adequately moist and ensure proper seed germination. After transplanting, onions need less amount of water, but their demand gradually rises, reaching its peak just before maturity. During the bulbing stage, the crop requires a considerable amount of moisture, though excess water should be avoided throughout the season. Irrigation must be discontinued about 10–12 days prior to harvest.

Intercultural Operations: Due to various factors the germination of seeds and seedlings gets effected which would lead to decreased germination rates therefore timely gap filling is necessary in the nursery and field. Consistent monitoring of the nursery is important for weeds emergence as it disrupts the establishment and growth of onion. Care should be taken after transplanting in the field as the onion is a poor competitor of weeds. Generally, 1-2 weeding's are required at an interval of 15-20 days. In organic cultivation, weeds are usually controlled through manual hand weeding. Since onions have shallow roots, deep intercultural operations can damage the roots and lower the yield. Typically, two hoeing's are carried out to loosen the soil and light earthing up should be done when the bulb develops.

Harvesting indicesand harvesting: Under Sikkim conditions, onions are usually ready for harvest in about 150–160 days, depending on the variety, soil type, and season. Signs of maturity include yellowing of the leaves and neck fall, or collapsing of the leaves around the neck. Typically, bulbs are considered fit for harvesting when around 50% of the plants show neck fall, but they must be properly cured and dried before storage. Harvesting too early leads to bulbs with thick necks, which have poor keeping quality.

Yield: Onion production differs with variety, seasonal conditions, and soil fertility. Under organic farming practices in Sikkim, the crop yields around **230-260quintals per hectare.**

Curing: The curing process helps onions develop natural dormancy and lose excess moisture. Well-cured bulbs have a dry, shrivelled neck and dry outer layers. The foliage should be cut back to about 2–2.5 cm above the neck, after which the bulbs are left to cure in the shade for about seven to ten days.

Storage: Properly cured onion bulbs can generally be stored for 4–6 months. Before storage, the bulbs should be thoroughly graded, sorted, and cured. They are kept in well-ventilated storage areas, either spread on dry, moisture-free floors or placed on racks. Regular turning of the bulbs and timely removal of any rotten or sprouted ones are crucial for maintaining quality.

Physiological Disorders and Their Management

Disorder	Management
Bolting Premature seed stalk formation typically occurs because of drastic temperature variations. Bulbs become lightweight and fibrous, and their storage quality declines.	□ Use cultivars that are resistant to bolting. □ Schedule transplanting so that the crop experiences moderate temperatures during the bulbing stage.
Splitting and doubling of bulbs This problem arises from imbalanced nutrient supply and unfavourable weather conditions. Physical damage during intercultural practices can also lead to bulb splitting.	To prevent bulb splitting and the formation of double bulbs in onions: □ Choose varieties that are less prone to bulb splitting and doubling. □ Keep soil moisture uniform by managing irrigation carefully. □ Supply well-balanced nutrients and avoid high nitrogen levels during bulb development. □ Maintain proper spacing for better bulb development. □ Follow good pest and disease control measures to support healthy bulb formation.

Diseases and Pest

General practices for diseases and pest management:

Cultural Practices:

- Healthy seeds:Use of disease-free seeds for planting.
- Crop rotation: Refrain from cultivating allium crops in the same plot for a minimum of two years to break the life cycle of pests.
- Field sanitation:Clean the field thoroughly by removing and destroying leftover plant materials after harvest.
- Wild grasses and weeds on field bunds and within the field must be cleared, as they serve as sites for pests to lay their eggs.
- Manual control:Handpicking the pests manually and destroying it.
- Physical barrier:Use yellow and blue sticky traps to track and reduce adult thrips populations. Plant double rows of maize around onion fields to act as a protective barrier against thrips.

Biological/Organic Controls:

- Bio-agents: Apply *Trichoderma harzianum* @ 2% to the soil along with neem cake to help suppress anthracnose and blight infections.
- Botanical Pesticides: Utilize neem oil @ 3 ml/L or garlic-based formulations for pest management, and apply *Beauveria bassiana* @ 10 g/Land Spinosad @ 0.5-1ml/L to control cutworms.
- Seed Treatment: Treat seeds with *Trichoderma*-based bio-fungicides before sowing.

Thrips: When thrips populations become high, they feed not only on the outer leaf surfaces but also inside the tightly packed inner leaves near the bulb and beneath leaf folds. Their feeding causes leaf scarring, which is often most severe on green onions. Heavy damage can diminish the plant's effective photosynthetic area and may also open pathways for foliar diseases. Natural predators—such as lacewings, minute pirate bugs, and predatory mites—commonly feed on thrips. These pests are present across all onion-growing regions of Sikkim. For organic management, cultural practices like removing and destroying the affected plant parts to help lower the pest or disease incidence, practicing a two year or longer crop rotation, avoiding planting onions or other *Allium* crops in the same field

consecutively, watering early in the morning so the leaves have several hours to dry in the sun reducing humidity within the crop as the fungus thrives in cool, moist conditions. Sprays like spinosad @ 0.5-1ml/L, azadirachtin @ 3ml/L, or entomopathogenic fungi like *Beauveria bassiana*@ 10 gms/L are approved options for thrips management.

Cutworm: Young cutworm larvae scrape the leaf surface, while the mature larvae which emerge at night feeds on the stems of young plants. They may also feed on bulbs, causing partial damage. To reduce egg-laying, avoid using green manure and apply FYM instead. Apply the entomopathogenic nematode *Steinernema carpocapsae* or the fungus *Beauveria bassiana*@ 10 gms/L when cutworms first appear. Sprays of spinosad @ 0.5-1ml/L to the targeted pests or at the early stages of infestations and neem oil @ 3ml/L every 10-14 days interval as a preventive measure which can help manage the infestation.

Leaf miner: The larvae feed on the leaves, consuming the tissue between the upper and lower epidermis and creating serpentine tunnels that eventually develop into blister-like patches. Affected leaves become distorted, and the mined portions dry out, forming large holes. Management practices for leaf miners are generally the same as those used for controlling cutworms.

Stemphylium blight: The disease begins as small, water-soaked spots on the leaves, which soon develop into white centres. Under favourable conditions, these spots enlarge, merge, form concentric patterns, and spread both upward and downward. In organic farming, the effective control measures are using disease-free seedlings, rotating with non-related crops, spraying of COC @ 0.25% around 45 days after transplanting as a preventive spray before the emergence of the disease or spraying at the early signs of the disease and application of *T. harzianum* @ 2% as a soil application before onset of the disease.

Botrytis blight: The disease begins as tiny white spots on the leaves, which gradually enlarge and lead to tip dieback. In severe cases, the leaf tops can be destroyed within a week, and the infection may spread across the entire field. Blight often develops after plants have already been weakened by insects, diseases, physical injury, or air pollution.Management practices are generally the same as those used for controlling Stemphylium blight.

Summary

Onion production and yield in the North-Eastern region, especially in Sikkim, remain much lower than in many other states. Although Sikkim's soil and climate are suitable for cultivating onion on small to medium scales, several factors limit productivity. Farmers often lack awareness about improved varieties, suitable climatic and soil conditions, proper agronomic practices, pest and disease management, and post-harvest handling. Limited market support further restricts expansion and productivity. ICAR RC NEH Region, Sikkim Centre has promoted two onion varieties in the state—Bhima Shakti and Bhima Super from ICAR-DOGR, Pune. Onion grows well in raised beds and low-cost poly tunnels or shelters, where management becomes easier. Mulching and raised-bed cultivation also help suppress weeds and improve bulb development, offering better economic returns to farmers. Studies indicate strong potential to expand the area and boost onion production in Sikkim.

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