



Organic Ginger Production Technology in Sikkim Himalayas for Profit Maximization

*Shaon Kumar Das, Sudip Kumar Dutta, Sita Kumari Prasad and Sabina Rai
ICAR Research Complex for NEH Region, Sikkim Centre, Gangtok, Sikkim, India

*Corresponding Author's email: shaon.iari@gmail.com

Ginger, which is widely grown in Sikkim's South, East, and West districts, is the state's most lucrative spice crop, second only to big cardamom. Thriving in warm, humid climates at elevations up to 1500 meters, the crop production relies on organic practices, including the use of farmyard manure, neem cake, and traditional mulching with *Schima wallichii*. The high-yielding Bhaise cultivars yielding up to 9.41 t/ha under organic production systems. Implementing standardized organic protocols, including seed treatment, heavy mulching, and mother rhizome extraction, enhances yields and mitigates disease, offering substantial opportunities for increasing farmer income.

Keywords: Ginger, Sikkim, Bhaise, organic production, yield

Introduction

Ginger (*Zingiber officinale*) is herbaceous perennial crop belong to the family Zingiberaceae. It is one of the important cash crops of Himalayan state of Sikkim and locally known as 'Adua'. It is grown for its rhizome which is a modified stem. Ginger is predominantly cultivated in all the districts of Sikkim in mandarin-ginger, maize-ginger, beans-ginger and various other cropping systems (Nicoll and Henein 2009). It is grown to an elevation of 1500 m above msl and its serves as a source of income for small and marginal farmers in Sikkim. It is used as spice and folk medicine and other range of purposes like confectionery, traditional medicine for stomach ache, food additives, pickles, etc (Bhattacharjee 2001). The pungent taste of ginger is due to non volatile phenyl propanoid and diarylheptanoids. Ginger has been demonstrated to have various pharmacological activities, such as antiemetic, antiulcer, anti-inflammatory, antioxidant, anti-platelet and anticancer activities. It is also used for its manifold medicinal properties in gastritis, sore throats, rheumatism, hypertension, cold and cough (Fageria 2003).

The states that produce the most ginger are Kerala, Assam, Gujarat, Orissa, Sikkim, Meghalaya, Arunachal Pradesh, and Mizoram. Bhaise, Gorubathane, Majhaule, Tange, Patle, and Jorethang are the most well-known ginger cultivars grown in Sikkim, which has its own native cultivars. The Mangalbaria belt, Chakung, Chumbung, Zoom, Tharpu, Malbansey, and Gyalshing in the West District; Turuk, Salghari, Sumbuk, Ratepani, Namthang, Mellidara, Maniram, Namchi, Tarku, Bermiok, and Dong in the South District; Rhenock, Rongli, Rorathang, Pakyong, Pachekhiani, Pandam, Khamdong, Sirwani, Sang, and Nazitam in the East District; and a few areas of Dzongu and Mangan area of the North District. In Sikkim, ginger is marketed as fresh rhizome and processed into different products like ginger candy, ginger paste, ginger powder and ginger oil is primarily used as flavouring agent in confectionary and soft drinks industry. The crop plays a vital role in the state's economy in terms of direct and indirect income/revenue and employment generation (Dedov et al., 2002). There is an ample scope for further improvement of production and productivity of ginger for doubling the incomes of the farming community of the state.

Botany

Ginger is a fragrant herb with an upright stem that can reach a height of 75 cm and an underground rhizome. Green, simple, alternating, sessile, sheathing at the base, acuminate at the apex, glabrous, 15-20 cm long, narrow, linear-lanceolate, with parallel venation and a pronounced midrib. The inflorescence is a spike on a distinctive scape; the flowers are irregular, bisexual, and closely spaced, with a persistent scarious bract subtending each one (Fuhrman et al., 2000). In Sikkim, flowers are a frequent occurrence, although they only bloom under particular weather conditions. Clusters of white and pink flower buds that develop into yellow flowers are produced by ginger (Hu et al., 2008).

Climate

Ginger is a tropical plant that grows best in warm, humid climates. In Sikkim, where the temperature stays higher throughout the growing season, ginger is produced between 300-1500 meters above sea level. It is best to cultivate it throughout the growing season, which runs from April to October, with evenly distributed rain. A good yield of ginger is produced by dry weather with an average temperature range of 28 to 30°C for about a month prior to harvesting. For the duration of the crop, high humidity is required (Bhandari et al., 1998).

Soils

In Sikkim, ginger is grown in terraces on the slopes of hills. A humus-rich garden soil that is light, loose, friable, has good drainage and aeration, and is at least 30 cm deep is ideal for growing ginger. It thrives in sandy loam soil with a pH of 6-7.5, but slightly acidic soil promotes rhizome growth. Receiving early rain is the first step in preparing the land. To get a fine tilth soil before sowing, two to three plowings are usually advised (Jiang et al., 2006). Sowing takes place in beds that are roughly 75-100 cm wide and raised by 15-20 cm. Water logging in the ginger field is prevented by raised beds with a slight outward slope.

Cultivars

Sikkim has its own native ginger cultivars, the most well-known of which are Bhaise, Gorubathane, Majhaule, Tange, Patle, and Jorethang. Bhaise had the maximum yield under Sikkim conditions (9.41 t/ha), followed by Nadia (7.61 t/ha) and Gorubathane (7.00 t/ha).

Seed rate and sowing

Ginger is propagated by seed rhizomes. Healthy, disease-free seed rhizomes are chosen from the previous season and cut into little pieces that are 2.5-5 cm long, weigh 40-50 g, and have one or two buds. These pieces are then ready to be planted. Sikkim has a very high seed rate because farmers use the entire rhizome, weighing about 150 g, without splitting it. Sowing takes place from the final week of February to the beginning of March and lasts until April. On raised beds, seed rhizomes are planted in shallow rows, covered with a thin layer of soil, and then leveled. The rhizomes of the seeds should be treated with 47°C hot water and biocontrol agents (*Trichoderma viride* @ 2%) for 30 minutes before being drained. They should then be planted at a distance of 30-45 cm between rows and 15-20 cm between plants. When the crop is interplanted with maize, the planting gap between rows is kept between 60-90 cm and maize is planted in between the ginger rows (Shukla and Singh 2007).

Organic nutrient management

Ginger is heavy feeder crop. At the time of planting, well-decomposed farmyard manure or compost @ 40-50 t/ha, neem cake @ 2 t/ha, biofertilizer (*Azospirillum*+PSB) @ 5-6 kg/ha applied in rows at the time of planting helps in reduction of incidence of rhizome rot and increases the yield (Reza, S. K. 2014. *Pers. Communication*). Two months after planting, application of vermicompost + Nalpak @ 5 t/ha to boost up the growth and sustainable production of crop (Ali et al., 2008).

Mulching

Weeds are major problem in Sikkim during rainy season. Mulching is an important intercultural operation in ginger to control weed growth. The best mulching material in Sikkim is *Schima wallichii* (Chilaune) followed by *Artemisia vulgaris* (Titepati) and other suitable organic mulching materials. Mulching is done at the time of planting with dried leaves. Mulch becomes a source of nutrients for the soil during the post-decomposition period, meeting the needs of developing plants.

Irrigation and drainage

Since ginger is grown in Sikkim in rainfed circumstances, irrigation is not required because the soil has ample moisture from frequent rainfall. However, drainage is crucial to preventing the occurrence of diseases like wilt and soft rot caused by water logging. The soil should have enough moisture for sprouting, rhizome initiation, and rhizome development.

Removal of mother rhizome (Mau)

In Sikkim, the ancient practice of extracting mother rhizomes is still carried out today. When the ginger crop reached 60 days of growth by the end of May or June, farmers would remove the mother rhizome, or "mau" as it is known locally, leaving the sprouted portion in the soil. This is done in order to give the growing rhizome enough space and to generate additional revenue during the off-season. Farmers in Sikkim receive nearly similar amounts of whatever is sown, though it is of inferior quality, but being an off-season product, it fetches good market price.

Intercropping and crop rotation

Ginger is grown as a sole crop in majority, and also intercropped with maize, cow pea and soybean. In order to provide better shade and utilize the vacant space up to maximum, farmers cultivate ginger in citrus and guava orchards as well. Crop rotation is a common practice in Sikkim where farmers need not to cultivate ginger continuously year after year in the same field.

Weed management and earthing up

Weeding is done just before manure application and mulching. Depending on the intensity of weed growth 2-3 weeding is required. Weeding is followed by earthing up to cover the exposed rhizome. Proper drainage channels are to be provided to drain off excess and stagnant water. All care should be taken during hoeing or earthing up to prevent damage to the rhizomes that may cause injury or disease incidence.

Organic plant protection measures

Pests	Symptoms	Organic Control
Shoot borer	Larvae feed on developing shoots by boring into the pseudo stem, causing the infected shoots to dry out and turn yellow.	Spinosad is sprayed at a rate of 0.3 ml/L every month from July until October.
Leaf roller	Defoliate the leaves from their tips and margins by rolling them and staying inside the roll.	Azadirachtin 1500 ppm in 5 ml/L of water sprayed every three days from July to October
Diseases		
Soft rot or rhizome rot	The collar area is rotting, and the rhizome and roots are also affected. Yellowing signs appear on leaves.	- Choose disease-free, healthy seed rhizomes and make sure there is adequate drainage. - Treat seed rhizomes with Trichoderma @ 4-6g/kg before planting. - Apply dolomite to raise the soil pH - Apply neem cake @ 2 t/ha as a basal dressing.
Bacterial wilt	Affected pseudo stem or rhizome shows ooze on gentle pressing.	- Use disease free planting material. - Soil drenching by application of Trichoderma or bacillus @ 10g /L. - Treat seed rhizomes with Trichoderma @ 4-6 g/kg before planting.

Harvesting

About seven to eight months after planting, the crop is ready for harvesting when the leaves begin to progressively dry out and turn yellow. When using a spade to delicately dig mature rhizomes, care must be taken to avoid breaking or bruising fingers. Considering the market's current price and demand, early harvesting is another option. Following excavation, rhizomes should be dried in the shade and kept in pits with a 20 cm layer of sand between every 30 cm layer of rhizomes. To shield the rhizomes from sunlight, rain, and water, these trenches should be excavated behind a thatched canopy.

Yield

The average yield of fresh ginger varies from 12-15t/ha but the recovery of dry ginger is only 20-25%.

Conclusion

Ginger, locally referred to as "Adua," is an important cash and spice crop in Sikkim. It supports the state's overall organic farming objective, boosts the rural economy by giving small and marginal farmers a source of income, and has significant traditional and medicinal significance. In Sikkim, ginger is a major cash crop that is crucial to farmers' livelihood security in the face of climate change. It can be used for a variety of industrial, medical, culinary, nutritional, and decorative purposes. Improved agronomic management techniques are desperately needed for the cultivation of this versatile crop in order to boost sustainable output, productivity, and profitability.

References

1. Ali BH, Blunden G, Tanira MO. Some phytochemical, pharmacological and toxicological properties of ginger (*Zingiber officinale* Roscoe): A review of recent research. Food and Chemical Toxicology. 2008; 46:409-420
2. Bhandari U, Sharma JN, Zafar R. The protective action of ethanolic ginger (*Zingiber officinale*) extract in cholesterol fed rabbits. Journal of Ethno pharmacology. 1998; 61:167-171
3. Bhattacharjee, S.K. 2001. Handbook of Medicinal plants. pp- 381-382.
4. Dedov VN, Tran VH, Duke CC, Connor M, Christie MJ, Mandadi S. Gingerols: A novel class of vanilloid receptor (VR1) agonists. British Journal of Pharmacology. 2002; 137:793-798
5. Fageria, M.S. 2003. Vegetable crops. pp. 232-255
6. Fuhrman B, Rosenbat M, Hayek T, Coleman R, Aviram M. Ginger extract consumption reduces plasma cholesterol, inhibits LDL oxidation and attenuates development of atherosclerosis in atherosclerotic, apolipoprotein E-deficient mice. The Journal of Nutrition. 2000; 130:124-131
7. Hu WY, Zhang RP, Tang LP, Liu G. Research progress in the chemical constituents and pharmacology of ginger. Chinese Journal Ethnobiol Ethnomed Pharmacology. 2008; 9:10-14
8. Jiang H, Xie Z, Koo HJ, McLaughlin SP, Timmermann BN, Gang DR. Metabolic profiling and phylogenetic analysis of medicinal *Zingiber* species: Tools for authentication of ginger (*Zingiber officinale* Rosc). Phytochemistry. 2006; 67:232-244
9. Nicoll R, Henein MY. Ginger (*Zingiber officinale* roscoe): A hot remedy for cardiovascular disease. International Journal of Cardiology. 2009; 131:408-409
10. Shukla Y, Singh M. Cancer preventive properties of ginger: A brief review. Food and Chemical Toxicology. 2007;45:683-690