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A Review on Different Factors of Large Cardamom Decline in Nepal

Amar Bahadur Pun[1*]

[1]Agricultural Research Station, Nepal Agricultural Research Council (NARC), Pakhribas, Dhankuta, P.O.Box 29, Dharan, Sunsari, Nepal.

Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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Review Article

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ABSTRACT

The study aimed to review the current information regarding the major factors of cardamom decline in Nepal to aware the growers and stakeholders. The information on various aspects of cardamom declining factors viz., diseases, insects, cultivars, orchard management, soil fertility and soil moisture were reviewed and discussed in this study. Large cardamom is the most important exportable crop of Nepal. It is widely cultivated in the eastern hill districts such as Ilam, Pachthar, Taplejung, Tehrathum, Sankhuwasava, Dhankuta and Bhojpur. In recent time, cardamom production has been declined due to various biotic and abiotic factors.

Keywords: Large cardamom; virus; biotic and abiotic factors; cultivars; decline; rhizome rot; insects.

1. INTRODUCTION

Large cardamom (*Amomum subulatum* Roxb.), belongs to the family Zingiberaceae is a perennial herbaceous spice crop with subterranean rhizomes with leafy shoots. It is a shade loving plant (Sciophyte) grown in subtropical humid climate of eastern region of

**Corresponding author: E-mail: amarppun@gmail.com;*

Nepal; Bengal, India; and Bhutan [1]. Large cardamom is used as a spice and also in several Ayurvedic preparations [2,1]. It has significant economic importance as being various industrial, medicinal, nutritional, culinary and ornamental uses [3].

In Nepal, it is a high-valued export commodity. Nepal is the worlds' top producer of large cardamom, with annual production exceeding 6,600 metric tons, an equivalent worth NPR 3840 million [4,5]. It is the most important cash crop in the eastern region of Nepal [6]. It is commercially cultivated in Ilam, Panchthar, Taplejung, Dhankuta, Terahthum Sankhuwasabha and Bhojpur districts [7,8,9].

However, biotic and abiotic problems are being serious threat to the rising cardamom industry in Nepal [10,11,12,9]. The productivity of Nepal cardamom has been decreased sharply since 2010 as it was in increasing trend till 2008/09 as it was 590 kg/ha in 2010 and 500 kg/ha in 2013. Currently, cardamom orchards in most districts have been found being collapsed due to viral diseases and wilting. According to GoN [13], the average productivity of large cardamom for Nepal is 450 kg/ha, which is far below than that of India (2000 kg/ha). A heavy decline in large cardamom orchards has been noticed in Ilam district [14,12,9]. The productivity level could easily be increased as high as 800 kg/ha through adoption of appropriate cultivars, proper orchard management, adequate shading, and manuring. Yadav et al. [12] mentioned that the cultivation of Nepal cardamom is still in subsistence level, following traditional practices with very limited use of production inputs.

2. FACTORS OF LARGE CARDAMOM DECLINE

2.1 Climate

Climate in one of the factors that contribute the decline of cardamom production. In Nepal, it grows in eastern region in cool-humid climate under shade of trees at an altitude between 600–2000 m asl with an annual precipitation of 1500–2500 mm and temperature of 8 to 20°C [14]. The crop grows well in moist, well drained loose soil with acidic and rich in organic matter [1,12]. According to Ansari et al. (2055 B.S), cardamom thrives well in cool and humid climates; shady and sloppy areas. Khatiwada et al. [7] and Vijayan et al. [15] mentioned that temperature of 8 to 20 °C is ideal for cardamom cultivation and favorable rainfall is 600 to 5000 mm; however, erratic and low rainfall in recent years caused poor yield of cardamom. Vista et al. [16] stated that the lower altitudes of cooler area and higher altitudes of warmer areas are well suited for its cultivation. Mandal (2063 B.S) said that abundant moisture and shady areas are appropriate for cardamom cultivation. Trees like Utis, Malaejo, Chilaunae and Siris are used to provide shade. Shrestha et al. [10] mentioned that abundant moisture in the soil would be appropriate, but water logging condition should be avoided. Regmi [17] and Shrestha et al. [18] stated that elevation; moisture and shade are the fundamental factors for successful cultivation of cardamom, which are being declined over time causing poor plant growth and development and eventually low yield. ARSP [19] mentioned that generally, it is grown beneath the forest cover on marginal lands in Nepal and frost, hailstorm and snowfall are the major deleterious factors.

2.2 Varieties

In the world, there are 16 cultivars of large cardamom being reported so far. Among them, only limited cultivars of large cardamom is cultivating in Nepal [20,19,21]. The commonly adopted cultivars in Nepal are Ramsai, Golsai, Chibesai, Dambersai, Sawney, and Kanti Daar [14,13,7]. According to Chaudhary et al. [14], cardamom cultivars grown in the eastern part of Nepal are unknown. However, Yadav et al. [12] mentioned that there are over 10 cultivars grown in Nepal; and farmers are currently evaluating new cultivar Salakpur since three year in Ilam that was believed to be resistant against Chirkey and Foorkey viral diseases.

Chaudhary and Subedi [14] reported that cultivar Ramshai was found more adapted to high hill regions (above 1400 m asl), while cultivar Golshai is popularly cultivated in most areas in the eastern region. Likewise, cultivars Jirmale, Salakpure and Pakhe alaichi were cultivated in lower altitude of Ilam district for their drought tolerant nature. Small-capsule type cultivar Chiveshai was also preferably grown for tolerance to soil moisture stress. Besides, GoN [13] reported that cultivar Salakpure has been considered as disease resistance; however it needs to be further research and be verified.

Nevertheless, there were several reports of haphazard plantation without proper knowledge of variety and their climatic requirements resulting sterility problems in most cardamom

growing areas [18,10]. Similary, Yadav et al. [12] and Regmi [17] identified the cardamom declining problem due to the lacking of altitude specific and wider adaptable varieties to different agro-eco-zones. Furthermore, varietal option for drought and disease tolerance are also lacking in the Nepalese cardamom cultivation, which are the problems for the cardamom declining in Nepal. Chaudhary et al. [21] recommended the cultivars for the specific altitude as following: Ramsahi and Ramala for high altitude (1500-2300 m asl); Bharlange and Saune for mid altitude (800-1800 m asl); and Golsahi, Chibesahi, Girmale, Dambarsahi and Seremna for lower altitude (600-1200 m asl).

Vijayan [1] observed that the economic life span of large cardamom was calculated to be 15 years. However, in practice the life span of the crop was coming down seven to eight years irrespective of cultivars that the life span of high yielding variety Varlangey was reduced to five-six years only. Despite the fact that most cardamom orchards were found to be very old over 20 years with poor productive aptitude. On the other hand, healthy planting materials are seriously lacking for cardamom cultivation that most of the nursery planting materials is propagated through rhizome splitting [21] from which viral diseases spread through rhizome propagating planting materials from infected are to healthy one. The investigation of Yadav et al. [12] showed that there is seriously lacking of reliable and certified source of quality planting materials. Therefore, the healthy planting material adequately of required cultivars was found serious problem of cardamom decline in Nepal.

2.3 Orchard Management

The agronomical practices including earthing up, irrigation, manuring, and weeding are still traditional for cardamom cultivation in Nepal that farmers' negligence to the orchards is a serious issue for cardamom decline in Nepal [21]. Absence of shade tree management adequately has been observed in most of the cardamom growing areas. Currently, farmers are dependent on shade of Alnus nepalensis (Uttis) [9]. Dependence on the aged-old shading plants planted long back for cardamom shade management is another important factor of decline [13].

The observation of Gudade et al. [2] revealed that the declining productivity of large cardamom in the recent time is attributed to the declining soil fertility and moisture deficit in India as well as in Nepal. Among the several factors of cardamom decline, the role of plant nutrients especially macro and micronutrients is of paramount importance [13]. The study revealed that manure is hardly used for the cardamom production, while use of chemical fertilizers is none in most of the cardamom growing areas in the eastern region of Nepal [17]. Similarly, the cardamom orchards in most areas lack irrigation facility, letting rain-fed condition. Most cardamom growing farmers lack the knowledge of soil fertility status, and manure and fertilizer use for the cardamom cultivation [3,11].

Khatiwada and Subba [22] suspected Mn toxicity in large cardamom that could be the possible factors for the cardamom decline. In this regards, Vista et al. [16] carried out experiment on effect of liming on large cardamom growing soils and reported that soil reaction increased in soil treated with lime and also showed positive effect on available P, K, organic matter and N content [19,14,21]. Poor and declining soil moisture in the cardamom orchards has been serious. Vijayan [1] has determined that the change of rainfall pattern, water sources, and reduction of soil fertility status are the driving factors of cardamom declining over time. Similar report [13] has been observed that drying out of water sources is the main reason of cardamom decline. Yadav et al. [12] suggested that soil health and management of mineral nutrition should be given high priority to have better yield of cardamom; and adequate irrigation during summer is required for proper orchard establishment and higher productivity. Constant maintenance of optimum soil moisture level ensures early fruit bearing [21]. Khatiwada and Subba [22] reported that mulching of large cardamom rhizome can also enhances productivity of large cardamom.

2.4 Viral and Fungal Diseases

Diseases and pests are among the major biotic factors of cardamom decline in Nepal that the survey study revealed that the diseases and pests have been prioritized as the worst problem in Illam, Panchthar and Taplejung [13,10,11]. Currently, Chirkey, Foorkey and Rhizome rot are identified as the major diseases in most cardamom growing districts [19,13,17]. Similarly, stem borer and leaf eating caterpillar are the most frequently reported insects in large cardamom orchards [23,12]. Shrestha et al. [18] identified two viral, eight fungal and one algal disease and seven insect pests in Ilam,

Panchthar and Taplejng districts during 2012 in a field study. In another study [7], eleven fungi were identified from the laboratory diagnosis of disease samples collected from Ilam, Panchthar, Dhankuta and Shakhuwasabha districts.

Furthermore, the orchards infected with viral diseases like Chirkey and Foorkey are likely to be collapsed. However, farmers in the most cardamom growing areas are unknown about the diseases and their management. Recently, outbreak of minor diseases and insects has been reported [18,10,12,9]. The study [10] revealed that the maximum occurrence of aphids observed at 1500 m or below altitudes in Kolbung, Ramphok and Fikkal of Ilam district; and farmers were found indifferent to diseases and pests management.

Cardamom bushy dwarf virus (Nanoviridie virus) or cardamom clump virus is a serious disease of large cardamom in Nepal. The virus belongs to the genus Nanovirus and family Nanoviridae [15, 1]. Under disease infected clump, small under-developed leafy structure appears at the place of inflorescence, which is called Foorkey in Nepali. It is not transmitted by seed, soil or mechanical means, but through aphid vectors, viz; banana black aphid (Pentalonia nigronervosa), Micromyzus kalimpongensis in a persistent manner [18,1]. This is serious viral disease becoming threat to the cardamom production in Nepal.

A new virus species Large Cardamom Chirke Virus (LCCV) under the genus Macluravirus, family Potyviridae has been characterized [15]. It is transmitted in nature by aphid vector, viz., Ropalosiphum maidis, R. padi, Brachycaudus helichrisi and Silobion aveneae. The primary spread of the disease is through infected rhizomes as well as by sap inoculation; further spread in the plantation is through aphid vectors. The disease is seen on the plants as mosaic with pale streak like spots on the unfolding leaves. These spots slowly turn pale brown resulting in leaf drying and withering of plants [15,1]. Flowering and fruit setting are greatly affected due to this disease. The yield reduction is about 85 percent within three years after infection.

The Rhizome rot caused by Fusarium oxysporum, Cephalosporium sp. and Verticillium solani, showing whole shoot burning symptoms, has been reported to be problematic in the eastern region of Nepal [14,21,12]. It causes rotting at the collar region, turning into soft and brown, and finally falling of aerial shoots. The leaf blight caused by Colletotrichum fungal species has become a major disease to almost all large cardamom growing areas due to the congenial atmosphere for the fungal spore formation that spread rapidly [1]. The disease generally appears after onset of the rainy season. Flowers produced in severely affected plants fail to set capsules. The lesions on the leaf turn yellowish brown to orange-red colour with a necrotic center, which subsequently withers off. In the advanced stages of disease development, more number of lesions developed on both young as well as old leaves which eventually dries up and gives a burnt appearance to the affected plants. With increase in severity of the disease, weight of the capsule also decreases [6,5,15].

2.5 Insect Pests

Stem borer (*Glyphipterix sp*.), shoot fly (*Merochlorops dimorphus*) and leaf eating caterpillar (*Artona chorista*) are the commonly reported insects of the cardamom in Nepal. Leaf eating caterpillar was the major pest of large cardamom among them till one decade back in Nepal [15]. The pest causes crop loss due to voraciously feeding on leaves [19]. However, other minor pests such as stem borer (Glyphopterix spp), shoot fly (Merochlorops dimorphus Cherian), and white grub (Holotrichia spp) have been appeared as the major pests in recent time. Besides, the occurrence of lace wing bug, aphid, mealy bug, hairy caterpillar, scale insects, grass hopper, rhizome weevil and thrips were also recorded [15]. Recently, white grub have become problem in cardamom orchard as it was a major pest of other crops [17,10].

3. CONCLUSION

Large cardamom sector is in alarming situation since past seven years. Majority of orchards are declining due to various biotic and abiotic factors. Haphazard cultivation ignoring cultivars with agro-climatic suitability is the prime factor of cardamom decline in Nepal. Thus, there is need to identify suitable cultivars specific to agro-eco zones, including diseases and insect tolerant. Chirkey and Foorkey viral disease are the big problems of cardamom enterprise. However, rhizome rot, and leaf blight are equally challenging to the cardamom cultivation. The spread of the diseases complex in the eastern hills is mainly due to use of rhizome from diseased plantation to new areas. Thus effective

quarantine system from district to districts may play role for checking spread of disease via seedlings. Replantation of old orchards is required for all the old orchards. In this regards healthy plants suitable for specific domain should be taken into consideration. Similarly, survey reports revealed that stem borer, and leaf eating caterpillar are important insects of cardamom. Declining soil fertility and soil moisture are the important abiotic factors of cardamom decline in Nepal. Poorly managed and neglected orchards with very old plantation are reported as the factor of cardamom decline.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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