

Hail injury in large cardamom (*Amomum subulatum* Roxb.) at high altitudes of Sikkim

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Abstract

Hail injury as an abiotic stress factor affecting large cardamom (*Amomum subulatum*) in Sikkim during February-May and its implications are described. Hail damage to foliage appeared as bruising, shredding or physical mangling and on the pseudostem as open, ragged-edged wounds. In addition to direct damage caused by hails the wounds also served as infection court for fungal pathogens. Since hail occurred at flowering stage (February-May) of large cardamom, it resulted in physical damage of floral parts too and thus affected the yield.

Keywords: *Amomum subulatum*, hail injury, large cardamom.

The large cardamom (*Amomum subulatum* Roxb.) growing tract in Sikkim and Darjeeling hills of West Bengal, India, is often divided into lower (< 970 m MSL), mid (970-1515 m MSL) and high (> 1515 m MSL) altitudes. The climate of these regions greatly influences crop health, physiology and production. Large cardamom is affected by various biotic and abiotic stresses which are mainly responsible for poor plant health affecting crop production. In this paper, we describe hail injury as an abiotic stress factor affecting large cardamom and its implications.

Manifestations of hail damage on large cardamom was monitored in research farms of Indian Cardamom Research Institute (ICRI) at Pangthang (2160 m MSL), East Sikkim and Kabi (1650 m MSL), North Sikkim during late winter, spring (summer) seasons (February-May) of 2006-07, 2007-08, 2008-09 and 2009-10. The plants under observation were of different

cultivars of varying age groups and visible changes on the plant tissues were documented.

Hail occurred in Pangthang and Kabi every year and was often associated with thunderstorms of high intensity during late winter and spring (Table 1). Five hailstorms occurred in Pangthang during 2007-10 and four in Kabi; all occurred during 2.00 pm to 7.40 pm. Mean (2007-10) duration of hailstorm occurrence at Pangthang was 46 min and at Kabi, it was 11 min. A perusal of the record of previous years also showed the same trend in period of the day and duration of hailstorm occurrence. Hailstones varied in size from 0.5 to 1 cm in diameter but sizes of 2-4 cm were not uncommon (Fig. 1a). Damage caused by the hailstones on plant tissue depended mainly on the size of the hailstones, duration of the storm event and the condition of the plant tissue when the injury occurs. Hail damage to

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Table 1. Record of hail in Pangthang and Kabi areas in Sikkim

Date	Time		Duration (min)
	From	To	
Pangthang, East Sikkim (2160 m MSL)			
20 April 1983	4.00 pm	5.10 pm	70
16 April 1989	2.00 pm	2.25 pm	25
18 April 1989	2.25 pm	3.05 pm	40
24 April 1989	1.50 pm	2.45 pm	55
25 April 1989	1.45 pm	2.30 pm	45
28 April 1989	2.00 pm	3.00 pm	60
29 April 1989	2.45 pm	3.10 pm	25
21 May 1992	4.30 pm	5.10 pm	40
30 January 1994	12.30 pm	1.20 pm	50
24 March 1996	3.05 pm	3.55 pm	50
16 April 1998	3.45 pm	4.25 pm	40
19 March 2001	3.00 pm	4.10 pm	70
21 March 2001	3.15 pm	3.40 pm	25
10 April 2002	2.00 pm	3.00 pm	60
11 April 2003	4.00 pm	4.20 pm	20
20 April 2003	2.00 pm	3.20 pm	80
09 May 2003	3.10 pm	3.55 pm	45
03 April 2005	4.30 pm	5.15 pm	45
14 February 2007	7.00 pm	7.40 pm	40
01 May 2008	5.00 pm	6.10 pm	70
24 April 2009	2.00 pm	2.25 pm	25
26 April 2010	2.30 pm	3.20 pm	50
07 May 2010	4.00 pm	4.45 pm	45
Kabi, North Sikkim (1650 m MSL)			
18 March 1998	5.30 pm	5.45 pm	15
22 March 2006	2.40 pm	2.43 pm	3
14 April 2007	3.00 pm	3.10 pm	10
05 May 2008	4.00 pm	4.08 pm	8
28 April 2009	5.00 pm	5.15 pm	15
13 April 2010	3.55 pm	4.05 pm	10

Previous records on the occurrence of hailstones were obtained from ICRI Regional Station, Tadong.

foliage and pseudostem appeared as bruising, shredding or physical mangling. Large cardamom being a broad leaved plant, the lamina tears parallel to the veins (Fig. 1b). The pseudostem showed open, ragged-edged wounds that are formed on the vertically or obliquely oriented pseudostems depending on the wind direction during the hailstorm. Subsequent sunny days resulted in partial or complete drying of the damaged foliage. Duration of hailstorm event at Kabi was too short as compared to Pangthang due to differences in altitude, location and aspects. Moreover, the size of the hail stones at Kabi measured 10 mm (maximum) and hence the damage was not to that extent as observed at

Pangthang. In addition to direct damage caused by hails, the wounds caused by the impact served as infection court for fungal pathogens (Fig. 1c). The fungi isolated from wounds caused by hail were *Colletotrichum gloeosporioides* (Penz.) Sacc., *Pestalotiopsis* sp. and *Alternaria* sp. The first two pathogens are matter of concern causing blight and leaf streak, respectively. Towards the end of the winter season (March-April), fungal colonization on the hail damaged tissue could be seen as black dots, their fruiting bodies. During the onset of spring and summer rains in April-May, the affected plant parts start decaying and as the monsoon advances, these symptoms could be mistaken for disease in advanced stage.

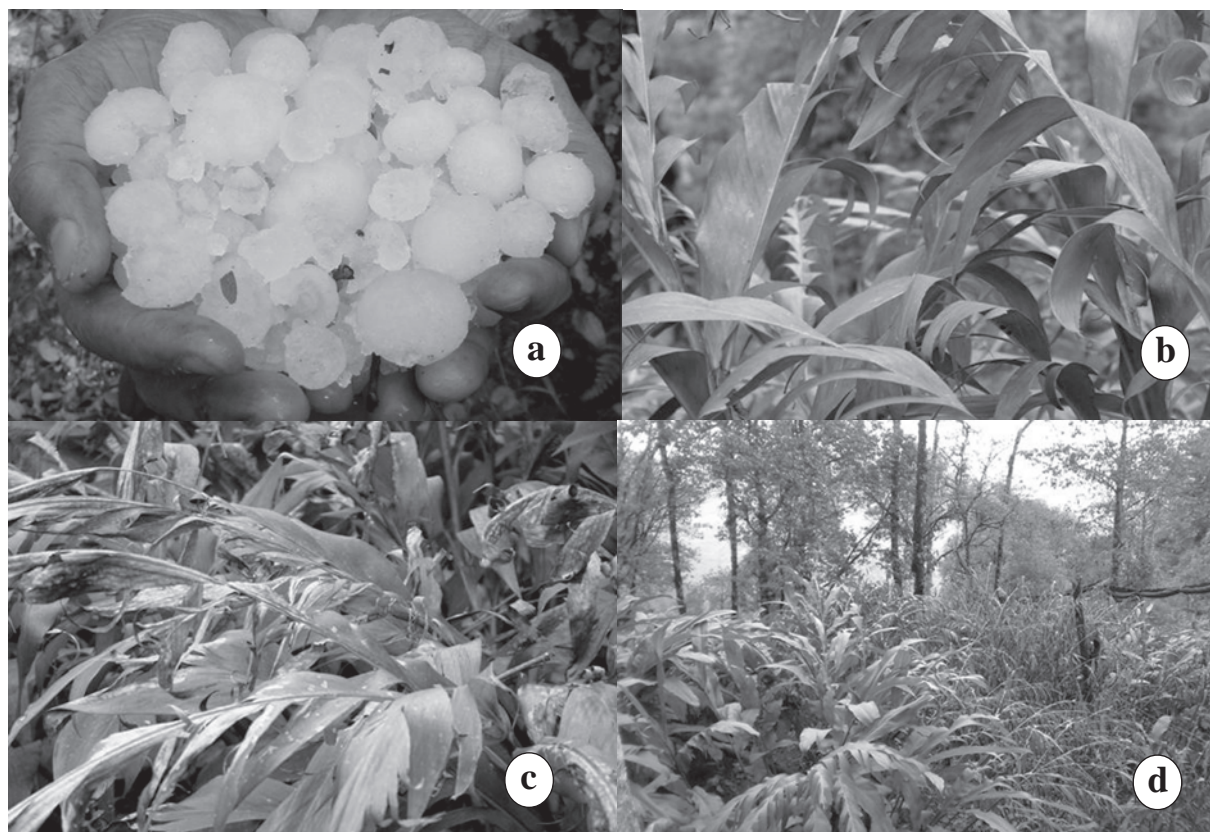


Fig 1. Hail damage to large cardamom

a. Hailstones collected during April 2010; b. Torn leaves due to hail; c. Damaged leaves showing drying and secondary infections of fungi; d. Protected (by agro shade net) and unprotected plants.

Extensive damage could be seen on leaves in the exposed areas without shade trees. Hail injury was comparatively less in protected areas with agro-shade net and under shade trees having spread out canopies (Fig. 1d).

Agrios (2006) classified the damage to crops from hail as small, intermediate, or complete; in the latter case, all the plants are destroyed by the hail. In large cardamom, complete damage occurred in exposed areas and plants under the shade trees were partially affected. Physical damage to floral parts due to hail occurred at the flowering stage (February-May) and depending on the extent of damage the yield of the plant was also affected in the subsequent crop season. However, accurate estimates on crop reduction are not available.

Hail injury of large cardamom is a regular phenomenon, especially at high altitudes in Sikkim that has not been documented. Dev

(1992) recorded the pattern of thunderstorms, hailstorms and snow fall in Sikkim; however, their effect on large cardamom has not been studied. In this regard, our observations would help in assessing the impact of hail on crop production and its physiological adaptation along the large cardamom tract in Sikkim.

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References

- Agrios G N 2006 Plant Pathology, 5th Edn., Elsevier, New Delhi.
- Dev S 1992 A study of thunderstorm, hailstorm and snowfall in Sikkim. J. Hill Res. 5: 35-40.