

Untimely snowfalls – An emerging concern for temperate fruit growers in Kashmir valley

The horticulture sector is perceived as the backbone of the Jammu and Kashmir economy as it significantly contributes to Gross State Domestic Production. Around 7 lakh families, comprising 33 lakh people, are directly or indirectly associated with the horticulture sector. During the last few years, the Kashmir fruit growers have suffered a major setback mostly due to climatic variability in particular to the unseasonal heavy snowfall. Based on the time of occurrence, untimely snowfall affect flower parts, pollination process, fruit set, harvesting of late-season varieties, on-farm activities like sorting, grading, packaging, storage, and marketing of produce. In addition, it results in mechanical damage to trees. Furthermore, it can have a significant effect on return bloom by reducing fruit-producing areas on trees. We have no control over the occurrence of pre-and post-winter snowfall but still with the help of some management practices, we can minimize the losses due to untimely snowfall.

THE agro-climatic conditions of the Himalayan region in the country offer tremendous possibility for the production of temperate fruit crops. Accordingly, the area under the temperate fruit crops is growing rapidly and contributing to economic, nutritional, and employment security. Kashmir valley is most suitable for temperate fruit production in particular apple, almond and walnut due to its plain and fertile land, and productivity data also show the same. As per the available data, Jammu and Kashmir is way ahead in productivity of apple (11.43 MT/ha) compared to other major apple-growing states i.e. Himachal Pradesh (3.96 MT/ha), Uttarakhand (2.32 MT/ha). Further, Kashmir enjoys a monopoly in the production of almonds (94.4%), walnut (91.9%), and cherry in India. However, the large portion of temperate fruits crops area of Kashmir is under rainfed conditions. Unlike other temperate regions, Kashmir is devoid of monsoon rains (June-September) and January to May is the rainy season, but a large proportion of precipitation is received in winter in the form of snow. Thus, snowfall plays a crucial role in the successful production of temperate fruit crops. But in the last few years, fruit orchards were hit by heavy and untimely snowfall. Pre-and post-winter snowfall considerably affected the temperate fruit industry of Kashmir.

Post-winter snowfall

March snowfall-2015: During 2015, heavy snowfall happened twice during March (8th and 16th) which resulted in blossom damage in the almond crop. Low temperature followed by snowfall reduced bee activity and consequently resulted in low fruit set.

April snowfall-2017: Untimely snowfall during 6th April 2017 badly affected stone fruits including apricot, peach, plum, and cherry which were in full bloom. Snowfall resulted in a considerable dip in temperature on snowfall days i.e. average temperate was 2°C, compared to 12°C during 2015 and 2016. Moreover, the effect of snowfall on temperature remained for a week. The mean weekly higher, average and low temperature after snowfall during 2017 was 14.71, 8.86 and 2.86 which were respectively 20.57, 13.86, 7.29 and 16, 11.71 and 7.29°C during 2015 and 2016. Usually in mid-December heavy snowfall is witnessed in the entire Kashmir valley and the snow kept the pace unto late February. Though moderate to heavy rains are usually in the early spring season in Kashmir, but the snowfall witnessed on 6th April 2017 is a rare happening. The last time it snowed in April in Kashmir was on 28th April 1978. Due to low temperature, the pollinating agent like bees remained inactive for a week, as their flight stops below 12°C. The pollen grains were washed away as a result of heavy rain on April 5 and snowfall on April 6. The pollen grains that were transferred prior to the snowfall also did not germinate since pollen grains do not germinate below 5°C, and the stigma became non-receptive as a result of the low temperature. In those flowers that were pollinated before the snowfall, the growth of the pollen tube also slowed down because the temperature was below 10°C. All these factors adversely affected the fruit setting. However almond and apple escaped as most of the almond orchards blooming were over or some late varieties bloom was near to completion, whereas apple orchards were at tight cluster to pink bud stage, the two budding stages before



Cherry, peach, plum and late blooming cultivars of almond were badly affected by 6th April 2017 snowfall whereas, apple crop escaped at ICAR-CITH, Srinagar

the apple trees witness full bloom. However, fruit set may have been affected to some extent in apples as cold periods just before flower opening can injure ovule. The cross-pollinating temperate fruit trees like pear and cherry were more severely affected compared to self-pollinating like plum and apricot due to unexpected snowfall and the accompanying chilly conditions. Further, the north Kashmir region was affected more severely as compared to central and south Kashmir as the north Kashmir region witnessed more snow.

Pre-winter snowfall

November snowfall-2018 and 2019: During 2018 (2nd to 4th November) and during 2019 (7th November), the early and unprecedented snowfall caused extensive damage to orchards in particular apples across the Kashmir valley, thousands of trees observed mechanical damage in nearly entire Kashmir. The damage was more severe where fruits in some varieties were not completely harvested from trees. This damage was not confined to 2019 only but has hit apple production in the forthcoming years as well. This is the fifth time since 2000 (2004, 2008, 2009, 2018, and 2019), when Kashmir valley recorded snowfall in the month of November. However, during 2019, Kashmir registered its heaviest snow in November in about 40 years. Snowfall records of the past four decades-monitored by the Meteorological Department showed that 9.6 cm (4 inches) equivalent snowfall was recorded between 6 and 7 November 2019 in Srinagar which is the heaviest 24-hour snowfall recorded in November since 1980. In Kashmir valley, around 1,58,150 hectares of land is under apple cultivation and most of the orchards are on seedling rootstocks and it takes around 10-15 years of investment of a grower to come to full production potential. About 10-40 and 20-50% damage to orchards was seen in a different part of the valley due to November snowfall during 2018 and 2019 respectively. The damage was higher in the

Southern district i.e. Kulgam, Shopian, Pulwama, and Anantnag during 2018.

Why untimely snowfall is harmful to trees or how it affect fruit growers?

Mechanical damage: Leaves were still on trees at the time of snowfall during the first week of November as in apple, pear, peach, cherry, plum, apricot, *etc.* Leaf senescence process starts in the second half of November and by the first week of December, trees shed their leaves. With leaves still on trees, every snowflake accumulate on leaves and put weight on branches-thus severely damaging them. Furthermore, this unexpected snowfall was heavier than normal snowfall which resulted in more destruction. Trees were uprooted, developed major cracks in stem and several trees suffered broken branches. Being an evergreen fruit crop, olive suffered the most drastic damage whereas, the leaf senescence process was already started in almond and walnut and most of the trees had shedded around 60% of leaves. But because of the brittle nature of wood and dense canopy (pruning not started), almond observed severe damage next to olive in ICAR-CITH, Srinagar. However, due to the strong nature of wood and spare canopy, walnut escaped from any major mechanical damage. The two-year-old feathered nursery plants of apple were also severely damaged/uprooted due to untimely November snowfall.

Loss of fruit: The fruit of some apple varieties was still on trees at the time of snowfall. Snowfall not only damaged apples that were on trees but led to severe fruit drop. Most of the apple growers lost crop of late cultivars 'Maharaji', Granny Smith and Golden Delicious and Red Delicious. Over-mature fruits on the trees developed watercore disorder.

Loss of harvested apple: Most of the apple growers deserted their harvested fruit in orchards, lying on the floor, and there was also damage to the packed fruits



Watercore in Granny Smith (left) and Coe Red Fuji (right)
- Breakdown of cells around vascular bundles and core and accumulation of sorbitol, induced when over-mature fruits were exposed to cold after 7th November 2019 snowfall at ICAR-CITH, Srinagar

boxes in piles, which led to bruising and injury to the packaged fruit.

Transport: This untimely snowfall affected transportation of fruit from the valley to different

mandis of the country, and the fruit from these *mandis* to neighbouring countries as well. Thousands of apple-laden trunks got stranded on the Srinagar-Jammu highway due to the closure of the NH-44 by the heavy snowfall. The fruit boxes in stranded trucks on the highway caused massive losses to apple growers as well as traders due to the rotting of fruit inside boxes.

Effect on production in forthcoming years

Loss of trees in orchards: Direct loss to the temperate fruit industry.

Loss of branches on trees: In apple trees, fruit is borne on spurs. Spurs are short, strong, stubby, compressed stems and are produced on more than two years old wood and maybe grow a quarter inch each year and produce quality fruit for 5-6 years and remain productive for 8-10 years. Like apples, most temperate fruit crops produce fruits on spur. The fruiting area was also reduced on the tree due to mechanical damage. In trees, lots of fruiting spurs are damaged and loss of spur ultimately means loss of fruit. Loss of branches and complete trees will affect temperate fruit production during the coming years.



Apple



Almond



Peach



Plum



Apricot



Cherry

Mechanical damage to different temperate fruit crops at ICAR-CITH, Srinagar due to untimely snowfall on 7th November 2019



Mechanical damage to feathered nursery plants of apple at ICAR-CITH, Srinagar due to untimely snowfall on 7th November 2019



Fruit drop in apple after snowfall during 7th November 2019

Suggestions to mitigate the effect of untimely snowfall

Flowering time

- After the snowfall, induce more bee colonies in the orchard to ensure sufficient pollination in the remaining flowers.
- Spray of plant growth regulators and micronutrients in particular GA₃, B, Zn, *etc.* can improve fruit set under adverse climatic conditions.

November snowfall

Before snowfall

- If snowfall is predicted in November, complete of harvesting of late-maturing apple cultivars and spray of 5-10% urea on the tree to accelerate the leaf senescence process should be done.
- Some minimal pruning can also be done to remove overcrowded, intermingled weak branches. The old

plants should be preferably pruned on priority.

During snowfall

- Do not allow snow to accumulate on the tree. Manually remove accumulating snow from trees recurrently to minimize damage (Fig. A).
- Remove large limbs from the tilted tree and give proper support with the bamboo sticks or other convenient material to prevent them from falling/uprooting.
- If possible, harvest fruits from trees.

After snowfall

- Harvest fruit as soon as possible.
- Remove accumulated snow from trees manually by shaking branches or by a wooden stick. Do not shake the tree (Fig. B).



A



B

- Severely prune uprooted/fallen tree on the ground itself and upright it. Use some dry soil and compact the soil around the crown. Finally, give proper support to the tree with the bamboo sticks or other convenient material (Fig. C). The tree will get re-establish in the next season (Fig. D).



- If damage to the limb is severe, then remove the limb with a smooth and clean-cut and apply chaubattia or any other copper containing paste on the cut surface (Fig. E).



- If damage to limb or major branches is not severe, then tie it properly by joining the cambium layer by tying with other branches on trees and wrap with wide grafting/budding polythene (Fig. F). Healing will take place in the next season (Fig. G).



- Management of broken primary or secondary branches on a mature tree:* Reduce load from the branch by pruning. Clean the broken area and join the cambium layer by tying the branch with other branches on the tree with the use of sutali or other convenient material. Use nails/nut bolt (size depends on branch diameter) to fix the joint and wrap properly with wide grafting/budding polythene then support the branch from the lower side (Fig. H). Healing will take place in the next season (Fig. I)

Management of broken branches



Healed branch

- Remove small broken branches with a smooth cut to outward-facing bud or branch and apply chaubattia or any other copper containing paste on cut surface (Fig. J).



- Provide proper drainage in orchards to drain excess water accumulated by the melting of snow.

For further interaction, please write to:

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