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CLIMATE CHANGE TRIGGERS EARLY SPROUTING IN MULBERRY (*Morus* sp.)

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ABS**TRACT**
Agriculture is facing many threats now a days but the most immediate environmental threat being feared is the global warming or climate change due to the pumping of large amounts of green house gases into the atmosphere. Global warming has been seen to affect the agro ecological system, cropping patterns and even some shift in the land use pattern. The state of Jammu and Kashmir is not an exception and climate change has been seen to affect some physiological processes of the plant which includes dormancy, bud break and sprouting behavior also. During the last few decades, as a result of climate change there has been fluctuations in the temperature which directly affects the physiology of various plants including mulberry. This change in the temperature during autumn and spring season triggers the plants to undergo early dormancy and to sprout somewhat earlier than the normal schedule. Keeping this thing in mind, the present study was undertaken to find the effect of climate change on the sprouting behavior of mulberry. The present study revealed that as a result of climate change, the average temperature has increased in the last few decades and because of that the bud bursting and the sprouting in the mulberry genotypes under study was advanced by 10 days.

KEY WORDS: Mulberry, Sprouting, Climate change, Global warming, Spring, Autumn.

INTRODUCTION

Sericulture is an agro-based industry, which suits rural people, entrepreneurs and artisans and requires low investment and fetches high returns. It is a two way process involving science of mulberry production and silkworm rearing for harvesting fabulous silk. Sericulture in India has progressed well in tropical regions such as Karnataka, Tamil Nadu, Andhra Pradesh and West Bengal but basically it is traditionally an activity of temperate regions like Jammu & Kashmir. Indian silk industry has registered a phenomenal growth over the years and presently it accounts for more than 18 per cent of the global silk production and is the 2nd largest producer of raw silk after China (Gangopadhyay, 2008). The cocoon and the raw silk production in J & K during 2014-2015 were 1032.4MT and 138 MT respectively (Sahaf *et al*., 2016) which is much less than the capacity and scope of silk production state has. Among various constraints, the adequate quantity of mulberry production comes in the way of improved silk production in the state. On the other hand current global climate change has been reported to affect some agricultural crops including mulberry culture in one or other way posing an environmental threat to the global community (IPCC 4th AR, 2007). While mulberry tree has been seen to have alluring prospects of soil carbon sequestration capacity with the life span of 40-50 years, but its production and propagation is not given due attention in Jammu and Kashmir with the result sericulture also is not progressing the way it should be in view of this fabulous conditions state has to push the sericulture ahead. Agriculture is facing many threats now a days but the most immediate environmental threat being feared is the global warming or climate change due to the pumping of large amounts of green house gases into the atmosphere. Global warming has been seen to affect the agro ecological system, cropping patterns and even some shift in the land use pattern. The state of Jammu and Kashmir is not an exception and climate change has been seen to effect some physiological processes of the plant which includes dormancy, bud break and sprouting behaviour also. The dormancy and bud bursting in plants is associated with the autumn and spring temperatures besides the other factors. It has been seen that climatic change affects the mulberry sprouting behavior and the unprecedented changes in the weather and climate are giving the segos of early sprouting in mulberry because conditions of some rise in the temperature. Cannell and Smith (1984) studied the impact of global warming on bud burst dates in *Picea stchensis* and reported that the onset of bud burst was advanced by 3.5 days because of milder winters and warmer springs. Fitter *et al*. (1995) studied the relationship between first flowering date and temperature in the flora of central England and reported that as a result of climate change, the spring phenology (bud burst and flowering) has advanced by 4.5 days in the past decade. Myneni *et al*. (1997) studied the influence of climate change on plant growth in northern high latitudes from 1981-1991 and concluded that in response to the recent climate change, the spring bud burst and sprouting has advanced by 8 days in 8 years. Menzel and Fabian (1999) studied the extended growing season of plants and reported that climate warming has led to the earlier bud burst in several species. He also observed an increase of 10.8 days in the mean annual growing season of many plants in Europe. Pandey

(2013) studied the impact of climate change on sprouting behaviour of five mulberry varieties in Jammu region viz: C-2038, FYT-99/G4, Suvarma-2,Vishala and S-1635 and observed that FYT-99/G4 sprouted first of all on January 15 i.e. after 33 days of winter pruning which was carried on December 17 followed by Vishala which sprouted 44 days after winter pruning. Although considerable work has been done in India and abroad on the sprouting behavior of the mulberry in response to the climate change, hardly any work has been done on these aspects under temperate climatic conditions of Kashmir. These led to the conception of the idea of studying effect of increased temperature in spring on the bud break and sprouting in mulberry. Therefore, in view of the scanty information available on the subject and with a view to make sericulture more the present investigation was undertaken.

MATERIAL AND METHODS

The study was carried out at College of Temperate Sericulture, Mirgund, Jammu and Kashmir during spring 2017 & 2018. Eight mulberry genotypes available in the Germplasm Bank of College of Temperate Sericulture, Mirgund viz; SKM-31, Goshoerami, Ichinose, SKM-27, Zust, Mandaliya, Kanva-2 and Local mulberry were screened for their sprouting behaviour. Observations on the sprouting behaviour of these varieties were recorded twice a week from the first week of March up to the second week of April to observe the bud sprouting behaviour of leaf to work out the changes, if any, in normal sprouting pattern of these varieties. Bud burst was observed every other day and the changes in bud colour bud swelling and leaflet formation was recorded. Five stages of sprouting *viz*: dormancy, bud swelling, bud bursting, leaf unfolding and leaf development were observed and recorded.

RESULTS AND DISCUSSION

The results of the experiment showed that among the eight selected mulberry genotypes *viz*: SKM-31, Zust, SKM-27, Mandaliya, Kanva-2, Goshoerami, Local mulberry and Ichinose, SKM 31 sprouted earlier in both the years (2017 & 2018) and the sprouting date was March 24 in the year 2017 and March 21 in the year 2018.This was followed by Zust which sprouted on 24th March and 22nd March in 2017 and 2018 respectively. Ichinose was recorded to sprout somewhat later in both the years i.e. on 2nd April and 1st April in the year 2017 and 2018 respectively. The date of sprouting of other varieties was recorded as 25th March & 22nd March (SKM-27), 25th March & 23rd March (Mandaliya), 27th March & 25th March (Kanva -2), 30th March & 30 March (Goshoerami), 30th March & 27th March (Local mulberry) in the year 2017 and 2018 (Table-1). Therefore, the mulberry varieties under study *viz*: SKM-31, Zust, SKM-27, Mandaliya, Kanva-2, Goshoerami, Local mulberry and Ichinose sprouted 10 days earlier as compared to the normal sprouting pattern which would get extended up to second week of April.

TABLE 1: Date of mulberry sprouting during the year 2017 and 2018

S. No.	Mulberry genotype	Date of sprouting	
		2017	2018
01	SKM-31	24-03-2017	21-03-2018
02	Zust	24-03-2017	22-03-2018
03	SKM-27	25-03-2017	22-03-2018
04	Mandaliya	25-03-2017	23-03-2018
05	Kanva-2	27-03-2017	25-03-2018
06	Goshoerami	30-03-2017	30-03-2018
07	Local mulberry	30-03-2017	27-03-2018
08	Ichinose	02-04-2017	01-04-2018

PLATE 1: Date of sprouting of various mulberry genotypes during spring 2017

PLATE 2: Date of sprouting of various mulberry genotypes during spring 2018

The dormancy and bud bursting in plants is associated with the autumn and spring temperatures besides the other factors. Lower temperature and longer nights during the autumn season helps a plant to fulfill its cold requirements to undergo dormancy. During the last few decades, as a result of climate change, the temperature during the autumn season has been somewhat low from the normal but during spring it has been somewhat higher than the normal temperature. This change in the temperature during autumn and spring a season affect the plants to undergo dormancy somewhat earlier and triggers the plant to break the dormancy somewhat earlier. Cannell *et al.*, 1986 reported that increased spring temperature has a direct effect on the sprouting and bud bursting in some deciduous trees. The early bud break or bud bursting could be attributed to the response of physiology of these varieties to the increased temperature and better sunshine hours during spring season that accelerated the break in dormancy of these varieties and consequently resulted in somewhat earlier bud sprouting as compared to the other varieties of mulberry which sprouted somewhat later. These findings revealed that the eight mulberry varieties *viz*: SKM-31, Zust, SKM-27, Mandaliya, Kanva-2, Goshoerami, Local mulberry and Ichinose sprouted 10 days earlier. Cannell *et al.* (1986) while studying the effect of CO_2 induced climate change and increase in temperature on the bud sprouting behaviour of *Malus pumila* have reported bud sprouting of this plant 18-24 days earlier. The present study also revealed advancement in bud sprouting as well as full bloom by 10 days in mulberry varieties.

CONCLUSION

The present findings concluded that higher temperature and longer sunshine hours in the months of February/March are responsible for triggering the early bud break / dormancy in mulberry varieties under study. Among the various mulberry varieties screened for their sprouting behaviour, SKM-31 and Zust sprouted somewhat earlier in both the years (2017 and 2018) followed by SKM-27 and Mandaliya, Kanva -2, Goshoerami, Local mulberry and Ichinose sprouted somewhat later as compared to other varieties.

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