Original Research Article

Responsiveness of mulberry plant (*Morus alba* L.) towards the agro-climatic conditions and its influence on growth and yield parameters under sub-tropical conditions of Poonch district of Jammu & Kashmir-India

Abstract

An experiment was undertaken to analyse the impact of fluctuating climate on growth and development of mulberry cuttings (T-1), saplings (T-2), wild tree (T-3) and cultivated tree (control) of the same variety (Chakmajra). Various growth parameters like survivability percentage, rooting percentage, number of sprouted cuttings, fresh and dry weight of leaves and moisture retention capacity (MRC) were studied. Poonch district experienced temperature (temp.) of 3.8 to 15.3 ºC, relative humidity (RH) of 56 to 62%, rainfall 560 to 87mm and snowfall of 213 to 461mm during January to April, 2022. Maximum survivability and rooting percentage of 85.6% in case of T-1 and least 60% in T-3. Whereas, maximum values of longest shoot length and thickest diameter was recorded in T-2 as 16.2 cm and 1.1 cm respectively. T-2 showed more positive results in terms of total no. of available fresh leaves (09), fresh (64g) and dry (16g) weight of the shoots, no. of primary roots (78), MRC (86.2%) and diameter of shoot (1.1cm). Therefore, it can be concluded that farmers should plant saplings directly to save time and resources as it showed better results in terms of various traits under the agro-climatic conditions of Poonch district.

Key words: Mulberry, saplings, cuttings, climate, rooting, moisture

INTRODUCTION

Jammu and Kashmir (J&K) is blessed with the unique range of agro-climatic condition favouring the production of most lustrous bivoltine silk of International Grade [4, 8 & 20]. Tazima; [19] quoted Jammu and Kashmir as the **'World's Silk Heritage'**. Therefore, the agroclimatic conditions of Jammu and Kashmir favours the production of mulberry silk of international grade. Union territory (UT) of Jammu and Kashmir exhibits wide range of climatic zones including temperate (Kashmir valley), sub-temperate (Poonch) to tropics (plains of Jammu) and arid areas

(Ladakh). *Morus* spp. are widely spread throughout all region from tropics to the sub-tropics and from plains to a high altitude of 4000m [5 & 6].

Owing to its perennial nature the plant can be propagated easily either by sexual or vegetative means. The simplest method of propagation of mulberry is by means of cutting or rooting also known as saplings [18]. Although it can be propagated by other means including seeds, grafting or rarely through tissue culture [17]. The North-Western region of the country *Morus indica, Morus alba, Morus laevigata, Morus serrate* are the four most cultivated species of mulberry and all of these are available in Jammu and Kashmir. Approximately 30% (15 lakh trees) of mulberry that exists in Kashmir are of the true types and rest 70% (35 lakh tress) are cultivated/improved/adapted types are available in Jammu and Kashmir. Similarly the sub-tropic zones of Jammu and Kashmir who sustains the sericulture industry with wealth of local mulberry varieties including Sujanpur and Chakmajra belonging to *Morus indica* [6].

Environmental factors play the most significant role as it alone accounts for 37.8% of the total factors involved for success of sericulture [14]. As the climatic conditions favours the luxurious growth of mulberry almost in both regions of Jammu and Kashmir. It can be grown successfully in Poonch district with rainfall range of 9.5ºC to 34ºC having sub-mountain soil with pH range of 5.5 to 8.5 pH [1]. Therefore, keeping in view the significance of mulberry in sericulture industry of Jammu and Kashmir, an attempt has been made to understand the impact of meteorological parameters on survival and growth behaviour of mulberry under the influence of agro-climatic conditions Poonch District of Jammu and Kashmir.

MATERIALS AND METHODS

The current experiment was conducted during spring season (March-May) during the year 2022. Genotype Chakmajra was purposefully chosen as experimental material owing to its adaptability and popularity in the selected study area. Two years old healthy shoots of Chakmajra was used for preparation of cuttings that comprised treatment-1 (T1). The two years old mulberry saplings of the same genotype samplings (T2) was procured from State Sericulture Development Department (SSDD) Jhulas, Poonch. Mulberry trees of the selected genotype growing in wild conditions was selected as T3 and two years old cultivated tree of the same genotype already established in the commercial rearing blocks of Mulberry Germplasm Bank of Department of Sericulture, Poonch Campus was selected as control. The data thus generated was subjected to

stastical analysis (ANOVA) on SPSS software for drawing the comparison and significant results have been obtained.

RESULTS AND DISCUSSION

1. Survivability rate (%)

Growth of the plant is generally divided into three stages i.e. new shoot development, growth and storage of the reserved food materials. Survivability indicates the initiation of acclimatization process for any plant. For the current study, the survivability rate was by the formula:

$$\text{Survivability rate (\%)} = \frac{\text{Total no. of sprouted cuttings/saplings}}{\text{Total no. of cuttings /saplings planted.}} \times 100$$

For the current experiment maximum survival percentage was recorded as 85.6% for mulberry cutting followed by sapling, cultivated tree and wild tree as 78%, 77.6% and 60% resp. (Table-01). In the current experiment, the survivability and rooting percentage was recorded as 85.6% for Treatment 1 (T-1) i.e. Chakmajra cuttings followed by 77% in Chakmajra saplings and 68%, 78% for wild and cultivated trees respectively. Similar observations for survivability percentage have earlier been recorded by Murthy *et al.*, [13] who indicated highest survivability percentage for mulberry cuttings as 93%.

Table-01: Data pertaining various agronomic parameters of selected treatments of mulberry viz; cuttings, saplings, cultivated and wild tree.

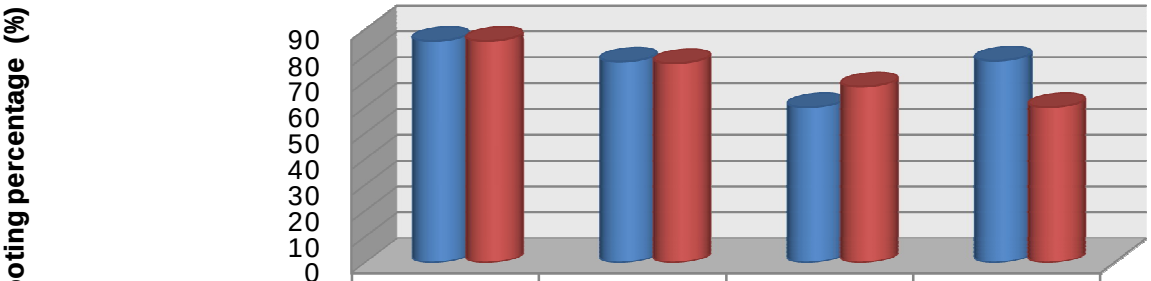
S. No.	Treatment	Name of the Genotype	Survival percentage (%)	Rooting percentage (%)	No. of primary roots	No. of sprouted cuttings (%)	Average no. of sprouts per cutting	Length of longest sprout (cm)	Diameter of the thickest sprout (cm)	No. of leaves in new shoot	Fresh weight of leaves (g)	Dry weight of leaves (g)	Moisture percentage (%)	Moisture retention capacity (%)
01	T-1	Chakmajra cuttings	85.6	85.6	8	83.7	2	1.27	0.24	4	7.1	1.8	74.64	73.3
02	T-2	Chakmajra saplings	77.6	77	78	73.3	10	18.25	1.1	9	7.2	3.3	54.16	86.2
03	T-3	Chakmajra Wild tree	60	68	67	70	9	16.2	0.5	7	6.4	1.5	76.5	76
04	T-4	Chakmajra cultivated tree	78	60	82	65	8	17.4	0.9	6	40.1	2.4	76.23	72.3
Average	-		**75.3 %**	**72.65 %**	**58.75**	**73 %**	**73 %**	**13.28 cm**	**0.685 cm**	**6.5**	**15.2g**	**2.25g**	**85.52**	**76.95 %**
S.D.	-		**10.843**	**11.079**	**34.422**	**7.907**	**7.907**	**8.050**	**0.387**	**2.081**	**16.603**	**0.793**	**-**	**6.631**

Rooting percentage

Rooting percentage is calculated by the formula:

$$\text{Rooting percentage (\%)} = \frac{\text{No. of cutting/ saplings with roots}}{\text{Total no. of cuttings/saplings stucked}} \times 100$$

Maximum rooting percentage of 85.6% was recorded for mulberry cutting and minimum of 60% for cultivated tree (Table-01 and figure-01). Polat [15] indicated best rooting results from cuttings treated with Indole Butyric Acid (IBA) and Singh, K. K. [16] indicated 80% rooting in case of cuttings.



	Chakmajra cuttings	Chakmajra saplings	Chakmajra Wild tree	Chakmajra cultivated tree
Survival percentage (%)	85.6	77.6	60	78
Rooting percentage (%)	85.6	77	68	60

Fig.-01: Survival and Rooting percentage of different treatments viz; Chakmajra cuttings, saplings, wild tree and cultivated tree.

Number of primary roots

For calculating the primary roots of the treatments 10 cuttings and saplings were deliberately uprooted and the total number of available roots was calculated manually (Table-01). Maximum number of primary roots was recorded as 82 in case of cultivated tree followed by saplings and wild tree as 78 and 67 respectively. Whereas the cutting being the freshly planted material were recorded to be as 8 number of primary roots after one month of plantation (Fig-02). Chakmajra cultivated tree recorded with maximum number of primary roots as 82 while minimum number of primary roots were found in cuttings. Similar experiment was performed by Ahmed *et al.*, [2].

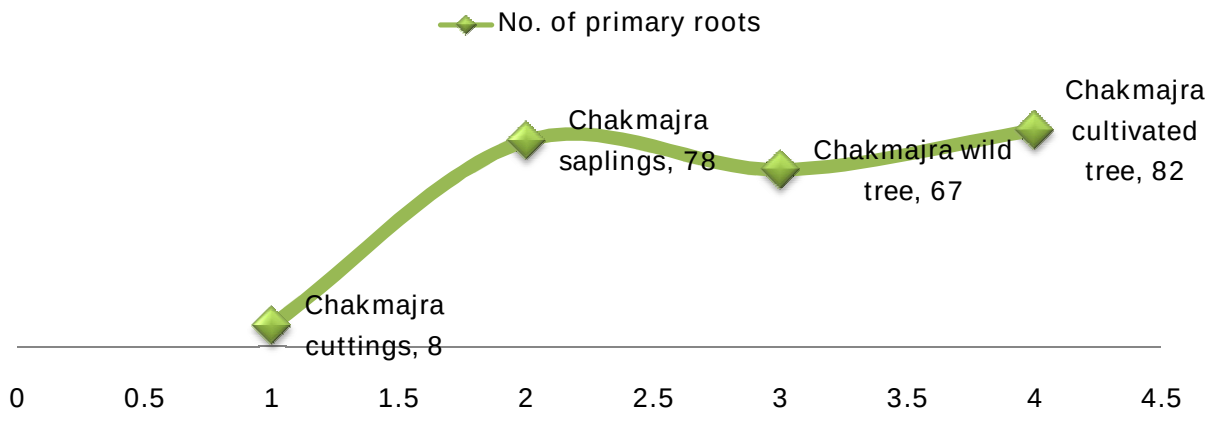


Fig.-02: Number of primary roots in different treatments viz; Chakmajra cuttings, saplings, wild tree and cultivated tree.

Number of sprouted cuttings and average number of sprouts per cutting

In mulberry sprouting is a genetic parameters and generally the tropical varieties shows sprouting from 13 January onwards whereas the temperate varieties being late sprouting start sprouting from 20 February onwards [2]. Among all the treatments, maximum number of sprouts was recorded as 83.7% for cuttings with 10 no. of sprouts and least of 65% in cultivated tree with 02 sprouts on an average. Sprouting was recorded as 83.75%, 73.3%, 70% and 65% in cuttings, saplings, wild and cultivated resp. Khan *et al.,* [9] demonstrated the sprouting percentage of 95% in Tr-8, Tr-12 and S-1708 mulberry cuttings thus validating the current results. Mehraj *et al.,* [11] explained early dormancy and early sprouting behaviour due to change in temperature. Elcure *et al.,* [7] studied effect of hormone treatment and recorded maximum sprouted leaf bud, stake with roots and length of the roots showing that peeling the stake and cutting at an angle of 45°C gives higher percentage of sprouted leaf bud (100 and 92) than the hormone and control treatment. In present experiment cutting too showed maximum number of sprouts.

Length of longest sprout and diameter of thickest sprout

For calculating the length of longest shoot in current study, 10 cuttings and saplings of the treatments were selected randomly and measured with measuring scale to find out the length of largest one. Maximum length was recorded as 18.25 cm in Chakmajra sapling and cutting recorded smallest sprout length of 1.27cm (Table-01). Similarly, diameter of thickest shoot was measured with the help of measuring scale and maximum value was recorded in chakmajra

saplings (1.1 cm) and minimum in cuttings (0.24cm) (Fig. 03). On the same hand longest sprout was recorded in chakmajra saplings as 18.25 cm, followed by cultivated tree as 17 cm and wild tree, was recorded in 16 cm. Thus, the current record lies in close confirmation to that of Mirazaeva *et al.,* [12] who recorded maximum length of the central point of the buds as 20.92 cm. Similarly the diameter of thickest sprout under agro-climatic conditions of Poonch district was recorded to be 0.24cm in case of Chakmajra cuttings, 1.1cm in case of saplings, 0.5cm and 0.9cm diameter of wild and cultivated respectively. Similar work has been done by Mirazaeva *et al.,* [12] who indicated the length of the central point of the sprout as 2.92 cm.

Number of leaves in new shoot:

Among the selected treatments 10 shoots were randomly selected and total no. of available fresh leaves was counted manually and maximum 9 leaves have been recorded in saplings and least of 4 leaves were recorded in cutting. Among the selected treatment number of leaves in new shoots in cutting, saplings, cultivated and wild tree was recorded as 4, 9, 6 and 7 respectively. Thus the current findings for chakmajra variety lie in close confirmation with that of the Mahes *et al.,* [10] and concluded that mulberry leaf yield and quality depends on soil and agro climatic conditions.

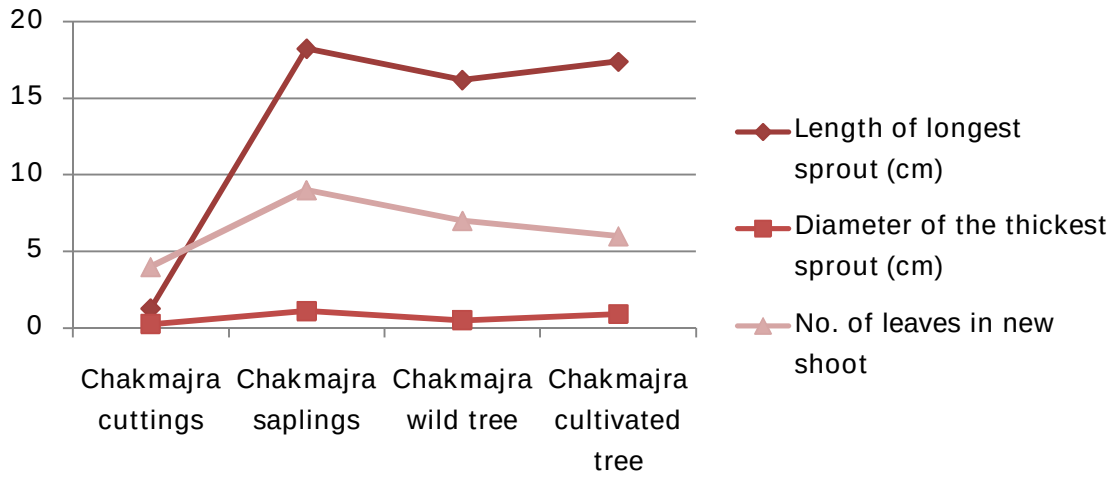


Fig.-03: Length, diameter and no. of new leaves sprout per cutting in different treatments viz; Chakmajra cuttings, saplings, wild tree and cultivated tree.

Fresh & dry weight of shoots and diameter of shoots

10 shoots of the selected treatments was randomly selected on the basis of visual appearance generally the healthier ones and were collected for measuring the fresh and dry shoot weight with the help of electronic weighing balance. Maximum values was recorded in saplings (64g) followed by wild tree (63g), cultivated tree (55g) and least in cuttings (40g). The same samples were oven dried for a period of 6 hrs with 2hrs interval until the constant weight was achieved. Maximum value for dry weight was recorded in case of saplings as 16g followed by wild tree, cultivated tree and cuttings as 14g, 11g and 10g resp. (Fig.04). Diameter of shoot was measured with the help of measuring scale and widest diameter of shoot was recorded for chakmajra sapling as 1.1cm followed by cultivated tree, wild tree and cuttings as 0.9cm, 0.5cm and 0.3cm respectively (Fig.05). Again, Chakmajra saplings showed maximum fresh weight of shoot i.e. 64g and cutting showed minimum fresh weight of shoot i.e. 40gm. Ahmed *et al.*, [2] reported maximum shoot weight in case of mulberry shoots developed on saplings. The reason for higher weight in saplings is the absorption and translocation of available nutrient by the deep root system of sapling [2].

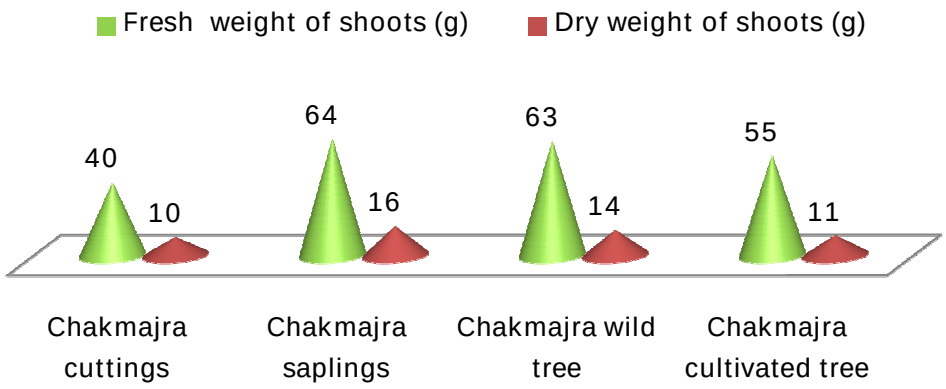


Fig.-04: Fresh and dry shoot weight of different treatments viz; Chakmajra cuttings, saplings, wild tree and cultivated tree.

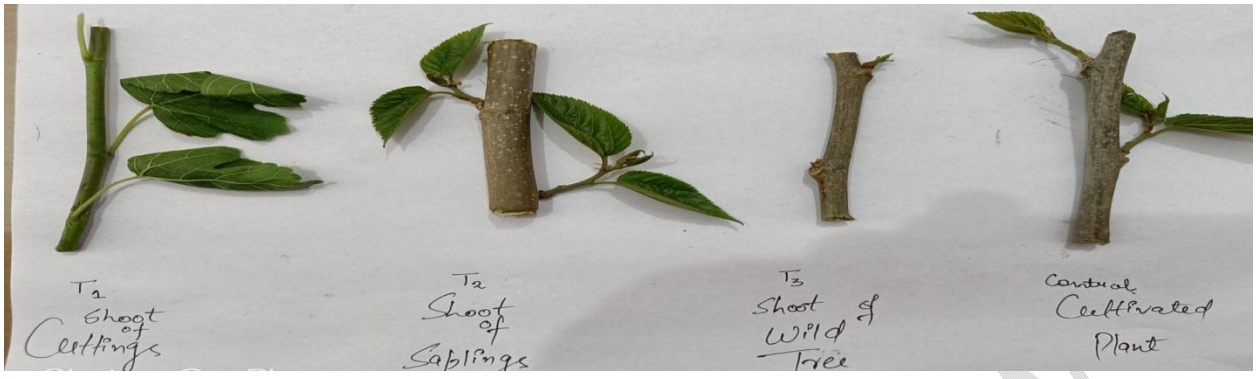


Fig.05: Diameter of thickest shoot of mulberry in T-1, T-2, T-3 & Control

Fresh & dry weight of leaves:

For calculation of fresh leaf weight 10 healthy leaves of selected treatments were randomly selected and the samples were weighted on electronic weighing balance. Maximum fresh weight was recorded in cultivated tree as 40.1g and minimum in wild tree as 6.4g as shown in Table no.01. The sample were oven dried for 6 hours at 60°C temperature which break of 2 hours interval for recording different reading and finally dry weight was calculated at 6 hours as given in the Table no.01. The lowest value for dry weight of leaves was recorded in wild tree samples as 1.5g and highest in saplings as 3.3g. Maximum values recorded for fresh leaf weight as 10.1g and minimum as 6.4g in cultivated tree and wild tree respectively. Whereas, highest MRC value of 86.2% was recorded in saplings, followed by cuttings (76%) and least (72.3%) in case of cultivated tree.

Moisture retention capacity

For estimation of moisture retention capacity in selected cuttings and saplings the oven dried samples were recorded for moisture loss after every 2 hours interval until the constant weight was attained. For calculation of MRC in mulberry leaves, percent age of water loss and moisture retention capacity of the different mulberry varieties was determined using the following formula.

$$\text{Moisture \%} = \frac{W1 - W3}{W1} \times 100$$

$$\text{Moisture loss \%} = \frac{W1 - W2}{W1} \times 100$$

Moisture Retention Capacity (MRC) = 100 – Moisture loss. The highest value for MRC was recorded in mulberry leaves of saplings as 86.2 per cent followed by wild tree, cuttings and cultivated tree as 76%, 73.3% and 72.3% respectively (Table-01). Chanotra *et al.*, [3] studied 44 different mulberry genotypes for their fresh and dry weight. Among studied genotypes, chakmajra was recorded with fresh leaf weight of 14.7g and dry weight as 4.4g and MRC as 70 to 80% for chakmajra saplings and cuttings thus validating the present results.

DETAILS OF WEATHER REPORT OF POONCH DISTRICT OF JAMMU & KASHMIR FOR THE MONTH OF JANUARY TO APRIL-2022

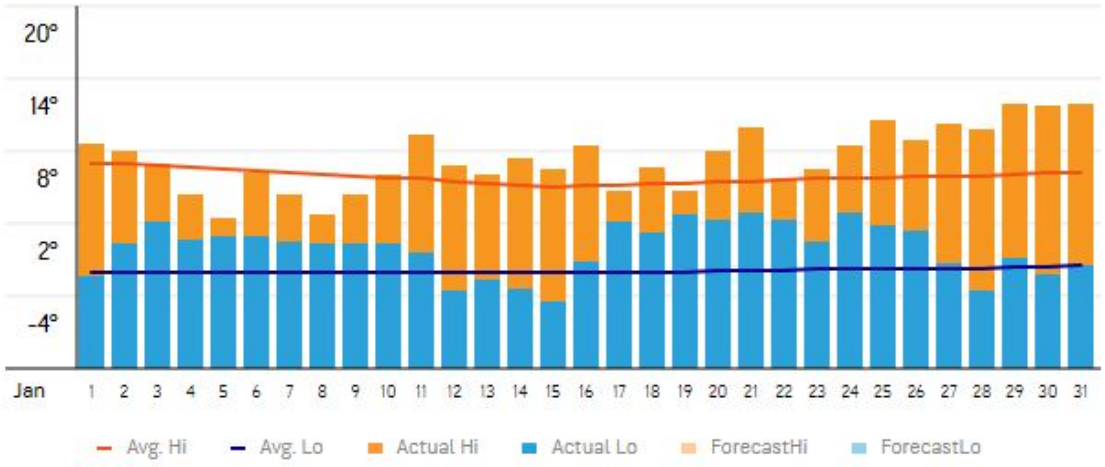


Fig.-06: Temperature graph of Poonch District of Jammu & Kashmir for the Month of January-2022

Fig.-07: Temperature graph of Poonch District of Jammu & Kashmir for the Month of Feburary-2022

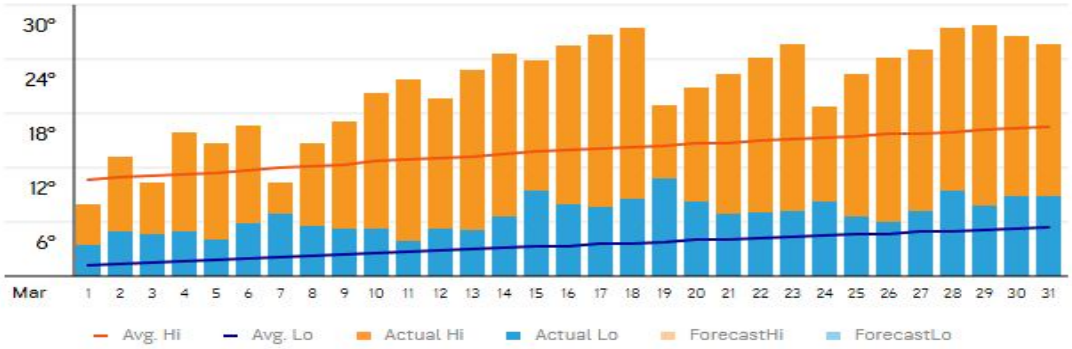


Fig.-08: Temperature graph of Poonch District of Jammu & Kashmir for the Month of March-2022

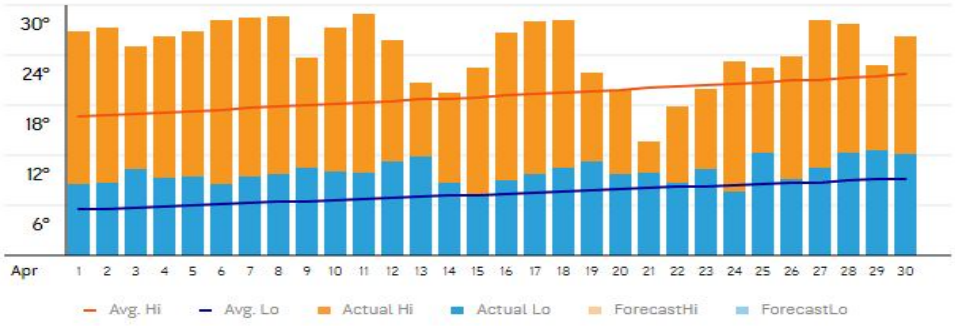


Fig.-09: Temperature graph of Poonch District of Jammu & Kashmir for the Month of April-2022

Table no-02: Details of Weather Report of Poonch District of Jammu & Kashmir for the Month of January to April-2022

Particulars	**January**	**February**	**March**	**April**
Temperature (°C)	3.8	5.3	10.2	15.3
RH (%)	56	62	59	56
Rainfall (mm)	560 mm	87 mm	560 mm	560 mm
Snowfall (mm)	213 mm (9.5 days)	461 mm (6.3 days)	461 mm (21.9 days)	461 mm (10.2 days)
Day light (h)	10.2 h	11 h	12 h	13 h

Sunshine (h)	6.3 h	8 h	8 h	10.1 h

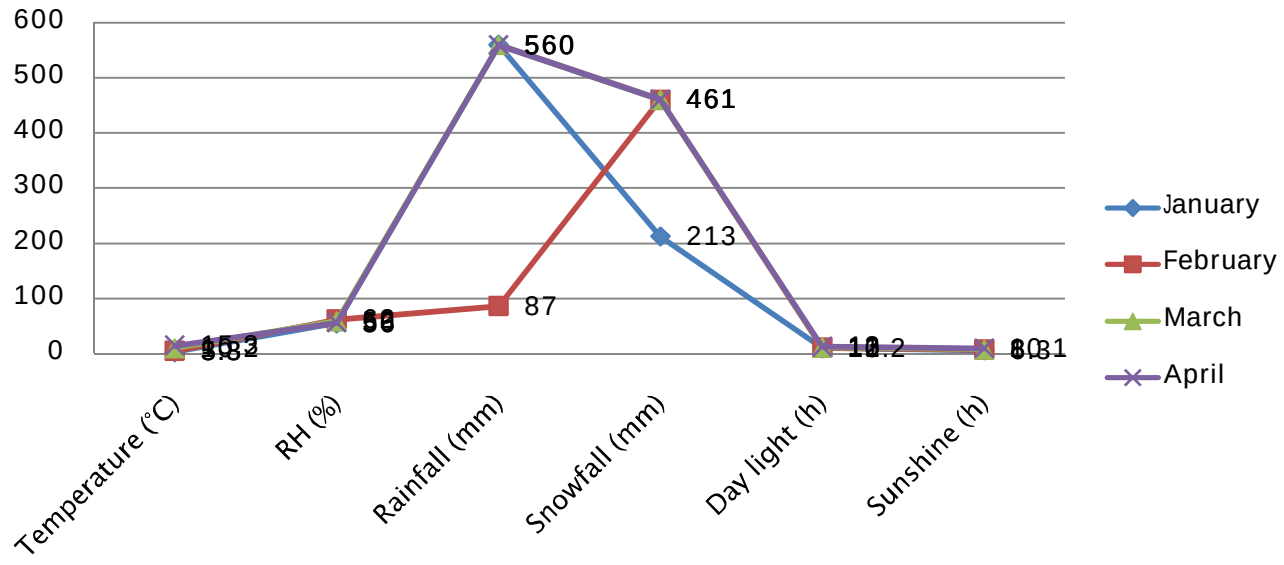


Fig.-10: Weather Report of Poonch District of Jammu & Kashmir for the Month of January to April-202

CONCLUSION

Poonch district of UT of J&K enjoys moderate climate with an annual rainfall of 600 mm to 700 mm with mean temp. of 32°C and about 40% RH. Thus, offers most congenial climatic conditions for growth and development of mulberry plant. For the month of January 2022; temp. have been recorded as 18-20°C with frequent rain showers and moderate rate of snowfall which indicated the relatively cooler nature of the meteorological aspects in Poonch district. As it is a well established fact that mulberry cannot grow below 13°C and above 30°C. Temp. and rainfall range indicated the suitability of agro-climatic conditions for mulberry growth under Poonch district. Thus, it is suggested that farmers of Poonch district should adopt mulberry cultivation by planting saplings directly that could save time and resources. It further offers opportunities to mulberry breeders to develop desired hybrids with acclimatized variety like chakmajra for improvement of the genus *Morus.* More importantly, the current study can be utilized for optimizing suitable ranges of rainfall, temp., RH and various environmental factors for developing region and season specific varieties under specific conditions for strengthening the sericulture industry in Jammu and Kashmir.

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