E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; SP-7(3): 01-04
Received: 02-12-2023
Accepted: 07-01-2024

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Screening of mulberry germplasm against cutting rot disease

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DOI: https://doi.org/10.33545/2618060X.2024.v7.i3Sa.362

Abstract
Mulberry (*Morus* Spp.) leaf is the sole food for silkworm (*Bombyx mori.* L). Mulberry is propagated through various methods *viz*., grafting, layering, cuttings and through seeds. The propagation through cuttings besides being quick, easy and cheap helps to produceb true to the type plants but one of the drawbacks for this type of propagation is that the cuttings are attacked by a variety of bacterial, viral, nematodal, and fungal pathogens which ultimately reduce their survival after plantation. The wounds inflicted during preparation of cuttings serve as an entry point to various soil borne pathogens causing Cutting rot, Collar rot, Die back diseases etc (Sharma, 2003). The cutting rot disease remains the main obstacle for the production of mulberry plants. The mulberry cuttings planted under the poly house and open field conditions suffer a considerable loss due to this disease caused by some soil borne pathogens and leads to great mortality. Out of the ten mulberry genotypes- Goshoerami, Ichinose, KNG, Kokuso-21, Chineese White, Brantul, Botatul, Ensatakasuke, Rokokuyaso and Kanva-2, three genotypes namely Kanva 2, Kokuso 21 and Rokokayoso showed resistance towards cutting rot pathogen, though the cuttings prepared from the apical portion of shoots of these genotypes showed moderate resistance.

Keywords: Mulberry, cuttings, cutting rot, screening, resistance

Introduction
In India, sericulture has been a traditional industry for centuries. The sericulture is practised throughout the country including the union territory of Jammu and Kashmir. Jammu and Kashmir enjoys a unique status among the traditional states/UTs because it produces bivoltine silk that meets international criteria for silk quality. The mulberry plant production is of utmost importance as its leaf is the sole food for silkworm (*Bombyx mori* L). Under Kashmir climatic conditions, the production of mulberry plants has been a concern because of poor rooting ability of mulberry genotypes otherwise promising in yield and quality attributes. Mulberry has been found prone to various soil-borne fungal infections impacting stem cuttings in nurseries (Gupta *et al.*, 1997; Singh and Chohan, 1984; Sanjappa, 1989, Sukumar *et al.*, 1991, Philip *et al.*, 1996) [9, 24, 25, 20]. Among various nursery diseases, the mulberry cutting rot disease causes a significant loss upto 40-60 percent in production of mulberry plants. The symptoms included mainly bark deterioration, which appeares after around one month of planting of cuttings. Keeping in view the huge loss of plants during propagation due to cutting rot, the present study was undertaken to screen some popular genotypes against this disease.

Materials and Methods
The study was undertaken in the polyhouse at the College of Tmperate Sericulture, Mirgund. The cuttings were prepared and planted in well punctured polytubes in the 1st week of March as per the following details. The experiment was conducted during Spring 2022 and repeated during spring 2023.

1. Name of Genotypes: 10
   Goshoerami
   Ichinose
   KNG
   Kokuso- 21
   Chinese white
   Brentul
   Botatul
   Ensatakusuke
   Rokokuyaso
   Kanva-2

2. Name of positions of shoots taken for cutting prepration: 03
   - Apical
   - Middle
   - Basal
3. Total treatments: 30
4. Replications: 03
5. No. of cuttings/treatments /replication: 10
6. Age of shoots used for cutting prepration: 9 months
7. Design: CRD

The cuttings were planted in 9 inch punctured polytubes containing Sand, Soil and Fym in the ratio of 6:3:1, besides 10 percent w/w inoculum already available. The mortality of the plants was recorded after 60 days of plantation and disease incidence was calculated as:

$$\text{Disease Incidence (\%)} = \frac{\text{Number of infected cuttings}}{\text{Total number of cuttings planted}}$$

Data recorded during the two years of study was pooled to categorize the genotypes into different categories on the basis of the disease scale of Marian *et al*., (2018) [19].

Scale	Rotted cuttings (%)	Disease Response
0	<1%	Highly resistant
1	1-1-<26%	Resistant
2	26 - <51%	Moderately resistant
3	51 - <76%	Moderately Susceptible
4	76 - <90%	Susceptible
5	>90%	Highly susceptible

Results

The observations on disease incidence recorded in the study were compiled and are furnished as under:

Apical portion cuttings: The disease incidence in the cuttings prepared from the apical portion of shoot of the genotypes showed variable response towards cutting rot (Table 1). The cuttings of the genotypes Kokuso 21, Kanva 2 and Rokokayoso were found to be moderately resistant against mulberry cutting rot. Rokokayoso recorded mean disease incidence of 36 percent, Kokuso 21 recorded 41.80 percent whereas as the Kanva 2 had a mean disease incidence of 49.50 percent The cuttings prepared from apical portion of mulberry shoots of Ensatakasuke, Bottul and Chinese white recorded 51.50, 69.65 and 73.30 disease incidence, respectively and were found moderately susceptible against this disease. The genotypes v.i.z., KNG, Ichinose, Gosheorami and Brentul recorded mean disease incidence of 76.50, 79.50, 83.0 and 88.15 percent, respectively and were categorized as susceptible.

Table 1: Response of cuttings prepared from apical portion of shoots shoots of mulberry genotypes against cutting rot disease

Genotype	Disease Incidence (%)	Disease Reaction
Ichinose	79.50	Susceptible
Goshoerami	83.00	Susceptible
KNG	76.50	Susceptible
Kokuso-21	41.80	Moderately resistant
Kanva-2	49.50	Moderately resistant
Ensatakusuke	69.65	Moderately susceptible
Botatul	73.30	Moderately susceptible
Rokokayaso	36.00	Moderately resistant
Chinese White	51.50	Moderately susceptible
Brentul	88.15	Susceptible

Middle portion cuttings: The cuttings prepared from the middle portion of mulberry shoots of Rokokayoso, Kokuso 21 and Kanva 2 exhibited resistantce towards the disease. Kanva 2 recorded mean disease incidence of 19.80 percent, Kokuso 21 exhibited 21.50 percent whereas, Rokokayoso recorded 24.80 percent disease incidence. On the other hand, the mulberry genotypes -Botatul, Chinese white, Goshoerami, Ichinose, Ensatakasuke, KNG, and Brentul were moderately susceptible with the mean disease incidence of 51.20, 56.65, 58.0, 59.50, 59.50, 61.50 and 69.17 percent respectively (Table-2).

Table 2: Response of cuttings prepared from middleportion of shoots shoots of mulberry genotypes against cutting rot disease

Genotype	Disease Incidence (%)	Disease Reaction
Ichinose	59.50	Moderately susceptible
Goshoerami	58.00	Moderately susceptible
KNG	61.50	Moderately susceptible
Kokuso-21	21.50	Resistant
Kanva-2	19.80	Resistant
Ensatakusuke	59.50	Moderately susceptible
Botatul	51.20	Moderately susceptible
Rokokayaso	24.80	Resistant
Chinese White	56.65	Moderately susceptible
Brentul	69.17	Moderately susceptible

Basal portion cuttings

The cuttings prepared from the basal portion of mulberry shoots of Kokuso-21, Kanva- 2 and Rokokayoso recorded mean disease incidence of 5.50, 8.15 and 18.50 percent, respectively and thus, were categorized as resistant. On the other hand, the cuttings prepared of Chinese white, Ensatakasuke, Botatul and Brentul were moderately resistant with the disease incidence of 26.65, 28.0, 31.50 and 35.67 percent, respectively. The basal cuttings in case of KNG, Goshoerami and Ichinose showed moderate susceptibility having the disease invcidence values of 41.80, 51.25 and 51.50 percent, respectively.

Table 3: Response of cuttings prepared from basal portion of shoots shoots of mulberry genotypes against cutting rot disease

Genotype	Disease Incidence (%)	Disease Reaction
Ichinose	51.50	Moderately susceptible
Goshoerami	51.25	Moderately susceptible
KNG	41.80	Moderately resistant
Kokuso-21	5.50	Resistant
Kanva-2	8.15	Resistant
Ensatakusuke	28.00	Moderately resistant
Botatul	31.50	Moderately Resistant
Rokokayaso	18.50	Resistant
Chinese White	26.65	Moderately Resistant
Brentul	35.67	Moderately resistant

Discussion

The study indicated varied response of mulberry genotypes towards cutting rot disease. The results revealed that genotypes Kanva 2, Kokuso 21 and Rokokayaso were resistant against cutting rot disease. Similar results have been reported by Belaghihalli *et al.,* (2022) [4] where in Kanva-2 belonging to Morus *indica* possessed resistance against Black Root Rot caused by *Lasiodiplodia theobromae*. Hongthongdaeng (1987) [3] reported that genotypes- Kokuso 21 and Rokokayoso from *Morus multicaulis* exhibited resistance towards root rot disease. The study conducted by Chandrashekar *et al.,* (2001) [6] reported that, mulberry genotype Kanva 2 was best in survivability rate compared to other genotypes studied. The present study is also in conformity with Maji *et al.,* (2006) [17] who have found Kanva2 resistant against powdery mildew disease. According to

Cuttings made from different portions of the shoot showed varied response towards cutting rot disease. Cuttings made from the apical portion of mulberry shoots showed more disease incidence as compared to thgose prepared from middle and basal portion. Apical cuttings of Kanva 2, Rokokayoso and Kokuso 21 depicted moderate resistance towards cutting rot whereas, the middle and basal portion of shoot of these genotypes exhibited resistance towards cutting rot. The apical portion of shoot of cuttings is more prone to desiccation and have a smaller amount of nutrientsand thus fail and subsequently rot. The apical portion of shoots are more tender, succulent and are more prone to fungal attack as reported by Agrios (2005) [1]. Further the apical portion of shoot has high metabolic activity, leading to increased nutrient availability and respiration. This creates a favorable environment for fungal growth, which thrives on readily available nutrients and sugars. Unlike older tissues which have well developed bark or other protective layers, the apical portion of shoot lacks such defence, leaving it more vulnerable to fungal attack. Simelar findings have also been reported by Schumann, & Stuntz (2002) [22]. The present findings are also in agreement with the findings of Hartman and Kester (1975) [11], who noted that although the apical portion of cuttings in some species may root quickly, they lack sufficient food reserves and are unable to meet the demands of growing plants. The cuttings prepared from the middle and basal portion of shoot have thicker bark which acts as a physical barrier making it difficult for fungal spores to penetrate and reach inner tissues of cuttings. The lignin content is more in hardwood cuttings which helps strengthen cell wall and is less easily degraded by fungi. This increased lignin content makes it harder for fungi to breakdown and colonize tissues. It is also reported that some hardwood cuttings produce anti fungal compounds within their tissues inhibiting the growth and development of fungi. The middle and basal portion of shoots have slower metabolic rates. This slower metabolism can lead to lower water content and reduced release of nutrients and sugars making these cuttings less attractive to pathogenic attacks (Brown, & Ogle, 1997 and Jones, 2007) [5, 15]. The findings of the present study are also in close conformity with the work done by Honda (1972) [12], Jolly and Dandin (1986) [14], Mala *et al.,* (1992) [18], Vijayan *et al.,* (1998) [26], de Vries, (2003) [8], Banerjee *et al.,* 2009 [3], Chattopadhyay *et al.,* 2010 [7], Marian Pinto *et al.,* 2018 [19] and Aruna kumar *et al.,* 2021 [2]. The results further are supported by the work conducted by Hae and Funnah (2011) [10], who investigated the propagation of Kei apples (*Dovyalis caffra*) and found that cuttings prepared from middle and basal portions of shoot root better probably because those prepared from apical shoots succumb to attack by pathogens.

Conclusion

This study highlights the variable susceptibility of mulberry genotypes to cutting rot disease, emphasizing the importance of cutting source selection for disease management. Genotypes Kanva 2, Kokuso 21, and Rokokayaso showed notable resistance, particularly in cuttings from middle and basal portions, due to their thicker bark and higher lignin content which deter fungal invasion. Apical cuttings were more vulnerable, likely due to their tender nature and higher nutritional content, making them attractive to pathogens. These findings align with prior research on mulberry disease resistance and underscore the critical role of both genotype selection and strategic cutting practices in enhancing disease resistance, thereby providing valuable insights for improving mulberry cultivation and propagation methods.

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