Review Article

EARLY SPROUTING MULBERRY GENOTYPE - A BOON FOR SPRING SEASON SILKWORM REARING IN NORTH WEST INDIA

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ABSTRACT
The early sprouting mulberry genotype is an advantage for on time spring crop rearing in the states of NW India because any delay in bivoltine rearing in spring season adversely affects cocoon production. The mulberry varieties which sprout early during the onset of spring season with long photoperiodic conditions are recognized as early sprouting genotype. Early sprouters are preferred for feeding silkworms in the spring season, because they give sufficient quantity of leaves on time in March. With rise in temperature in April, the season becomes unfavorable for silkworm rearing. The sprouting duration of various mulberry varieties in NW India ranges from 33-52 days after winter pruning whereas it takes 11-15 days after monsoon pruning. Normally mulberry varieties take more time for sprouting after winter pruning due to winter dormancy and photoperiodic conditions. Soil moisture plays an important role in leaf bud break after winter dormancy. It needs both increasing temperature and tissue wetting for bud break and shoot emergence to occur with onset of spring season. The mulberry varieties differ in their requirement of moisture and temperature for leaf sprouting and growth. Photoperiod also exerts a considerable influence in the leaf bud break of mulberry. An optimum period of 11 hours illumination is desirable. Increase in the day length use to be observed from February, which coincides with leaf bud break in early sprouting genotypes of mulberry. Photoperiod requirement of different varieties may differ as a result, the early sprouting genotype requires less duration of light to sprout in comparison with other genotypes. The early sprouting mulberry genotypes are useful for feeding chawki silkworms at Chawki Rearing Centres to synchronize adult age rearing with leaf maturity in the field on already existing mulberry trees, which usually sprout late. By on time distribution of chawki silkworms, the cocoon yield in the field improves considerably.

INTRODUCTION

Mulberry (*Morus* spp.) being the only food plant for the silkworm, *Bombyx mori* L., the breeder concentrates on all the possible growth parameters associated with its leaf yield while evaluating a mulberry variety. Thus, the most important traits of improved mulberry varieties are the quantity and quality of the foliage and related plant growth parameters. Availability of mulberry leaf is the key factor that decides the success and sustainability of sericulture. Selection of superior mulberry varieties should be based on leaf yield, annual growth of stem, number of branches and length of internodes. Thus, plant growth and yield were considered the basis for mulberry improvement. Certain parameters should be evaluated at nursery stage while others should be studied in the second or third year of plantation.

In recent years maximum attention has been given for the improvement of mulberry both in terms of quality and quantity. The major objective of mulberry crop improvement is to evolve new elite mulberry varieties for high leaf yield, resistance to pests, drought and their adaptability to different agro-climatic conditions. The genus *Morus* L. is highly heterozygous with lot of variations in the off springs. Propagation of mulberry is done through vegetative means such as planting of cuttings or by grafting so as to preserve the phenotypical characters (Murthy *et al*., 2012).

Sprouting is the inherent capacity of the strains to unfold the buds and produce new flush of shoots. Capacity and quickness of sprouting determine the subsequent growth and yield in mulberry. In addition, sprouting ability determines the success of establishment of new garden. Though sprouting is a genetic feature of a genotype, soil moisture and temperature contributes equally for the cause (Jolly and Dandin, 1986). With the onset of spring season with long photoperiodic conditions, the mulberry, which sprouts first of all, is called early sprouting variety. Such early sprouter is identified as early sprouting genotype. Early sprouters are preferred for feeding silkworms in the spring season, because they give sufficient quantity of leaves on time in March. With rise in temperature in April, the season becomes unfavorable for silkworm rearing (Pandey, 2013).

In case of irrigated mulberry garden where shoot harvest system is followed, the number and quickness of bud sprouting determines the number of primary and secondary branches and in turn the leaf yield. Whereas in rainfed garden, the individual leaf plucking is practiced and here total number of sprouted buds on each branch after leaf harvest determines the lead yield of subsequent crops. Though sprouting is a genetic feature of the strain, soil moisture and temperature have a profound influence. Maximum sprouting can be experienced in summer with optimum moisture in the soil. In winter, the breaking of buds is slow due to low temperature, hence the yield of the subsequent crop is less (Jolly and Dandin, 1986).

So far, only the *Morus alba* genotype, S146 and S1635 are available for the North Western sub Himalayan, which sprout first of all in January itself as a result, there is great demand of these by the farmers of the region, because other genotypes sprout in the first week of March. The sprouting duration of various mulberry varieties in NW India ranges from 33-52 days after winter pruning whereas it takes 11-15 days after monsoon pruning. Koul (2006) examined twenty varieties of mulberry in Jammu and demarcated two groups. One, early sprouting tropical varieties, Chak Majra, Tr-10, Sujanpur and C763. The second group includes late sprouting temperate varieties, Ichinose, Rokokayoso, Enshutaka and Goshoerami. While tropical varieties sprouted in 3rd week of January in Jammu region, the temperate varieties sprouted in the first week of April under the sub-tropical environment of Jammu.

Susheelamma *et al*. (1990) studied sprouting and rooting percentage in 92 germplasm accessions and reported 34 accessions as low, 24 as medium and 34 as high sprouters/rooters respectively. Sujathamma and Dandin (1998) evaluated rooting and sprouting ability of 23 elite mulberry genotypes along with two popular cultivars K2 and Mysore local under Rayalaseema region of Andhra Pradesh during rainy, winter and summer seasons and reported some triploid varieties along with Sujanpur-5 to be suitable for the Rayalaseema region of Andhra Pradesh. Eswar Rao *et al*. (2000) concluded that highest sprouting percentage of mulberry cuttings was recorded in diploid varieties (93.33%) followed by triploids (91.35%) and tetraploids (80.98%).

Chandrashekar *et al*. (2001) observed good sprouting in V1, M5, DD and S30 mulberry varieties. Patil (2002) reported that, mulberry variety S1635 cultivated under 60cm x 60cm recorded 98% of sprouting. Murthy *et al*. (2012) evaluated 9 mulberry varieties along with one check variety for sprouting behavior and reported that sprouting percentage was above 95% in TR8, TR12 and S1708 mulberry varieties. Pandey (2013) studied 5 newly developed mulberry varieties for sprouting behavior after winter and summer pruning and reported that FYT-99/G4, S1635, and S146 were the early sprouters and will be helpful in spring silkworm rearing.

Role of soil moisture and temperature

Sprouting rate depends more on the soil moisture, which is uniform under irrigated conditions, only the genotypic variation seems to play a major role. However it is found that sprouting is good in summer than in the rainy season. Maximum sprouting can be experienced in summer with optimum moisture in the soil (Jolly and Dandin, 1986). Since the temperature variations are minimum and the required minimum temperature for good sprouting (>20°C) is prevalent in semiarid tropics, it could be an advantage to get mulberry leaf throughout the year if availability of soil moisture is assured.

Soil moisture plays an important role in leaf bud break after winter dormancy. During the winter pruning in December a moderate rainfall may occur and in the subsequent months the rainfall will gradually reduce. To survive the coldest part of the winter, mulberry buds are isolated from the mulberry's vascular system (water-conducting xylem and nutrient-conducting phloem) and start losing moisture from autumn season with decline in ambient relative humidity. It needs both increasing temperature and tissue wetting for bud break and shoot emergence to occur with onset of spring season. The mulberry varieties differ in their requirement of moisture and temperature for leaf sprouting and growth (Pandey, 2013).

Role of photoperiod

Photoperiod exerts a considerable influence in the leaf bud break of mulberry. An optimum period of 11 hours illumination is desirable. The increase in the day length use to be observed from February, which coincides with leaf bud break in early sprouting genotypes of mulberry. The important role of short photoperiods in the autumn as the dormancy-inducing signal has been amply demonstrated and documented in a wide range of woody plants (Kramer, 1936; Downs and Borthwick, 1956). Photoperiod requirement of different varieties may differ as a result, the early sprouting genotype require less duration of light to sprout in comparison with other genotypes (Pandey, 2013).

Role of carbohydrate

The mulberry plant has a great capacity to sprout and grow new shoots from stems or stumps. When sprouting from a hardwood stem, carbohydrates stored in organs such as the stem are used as an energy and carbon source. Although seasonal changes in stem carbohydrates are well defined in many deciduous trees (Kramer and Kozlowski, 1979), little information has been obtained about the biochemical events involved in their regulation.

Total carbohydrate content of stems and branches of deciduous trees increases to a maximum in autumn, tends to decrease in later winter, and then decreases rapidly in early spring (Kramer and Kozlowski, 1979). The increase in concentration of soluble sugars during the time when plants are subjected to low temperature enhances the ability of plants to tolerate freezing (Sakai and Larcher, 1987). However, the mechanism promoting the hydrolysis of starch to sugar remains unknown. While the mulberry stem supplies carbon and energy for growing buds, it simultaneously strengthens the demand for current photosynthate for newly developing leaves.

Role of proline

The role of proline as a storage and transport compound of nitrogen has been recognized (Miflin and Lea, 1977). In mulberry trees, the presence of proline has been noted in stems of trees in midwinter, in stem cuttings in early spring and in saplings harvested in early spring. Furthermore, after planting of cuttings or saplings, the content of proline decreased in a similar manner to that observed during sprouting. Proline, which progressively accumulated from early December, may play a role not only in nitrogen storage but also in the development of frost hardiness (Sakai and Larcher, 1987).

CONCLUSION

Early sprouters are preferred for feeding silkworms in the spring season, because they give sufficient quantity of leaves on time in March. With rise in temperature in April, the season becomes unfavorable for silkworm rearing. Normally mulberry varieties take more time for sprouting after winter pruning due to winter dormancy and photoperiodic conditions. Soil moisture plays an important role and photoperiod also exerts a considerable influence in leaf bud break after winter dormancy in mulberry. Total carbohydrate content of stems and branches of mulberry trees has a great influence in sprouting. The early sprouting mulberry genotypes are useful for feeding chawki silkworms at Chawki Rearing Centres to synchronize adult age rearing with leaf maturity in the field on already existing mulberry trees, which usually sprout late. By on time distribution of chawki silkworms, the cocoon yield in the field improves considerably.

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