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Evaluation of Improved Mulberry Genotypes at Jammu in Rainfed Condition

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Abstract

Sericulture is an agro cottage industry wherein poor farmers are involved in producing cocoons through silkworm rearing by feeding mulberry leaves. This provides them additional income by working merely for about 25 days each in spring and autumn.100-200 disease free layings(dfls) , if reared in a crop will lead to production of 50-100 Kg cocoons @ of 50Kg /100 dfls which will fetch an income of 5-10000 in one crop (depending upon the dfls one rears).This requires qualitative , nutritious , palatable mulberry leaves. The local mulberry varieties grown by farmers do not yield leaves of such parameters which may suite to feeding silkworms. Therefore screening of suitable mulberry varieties is an immediate need. Scientists of Central Silk Board have developed hundreds of varieties but one variety performing better at a place may not perform better at other at other place and hence evaluation of such varieties is required at the specific place where it is to be grown.

Screening of mulberry under sub-tropical conditions of Jammu was required to be carried out. The progress made in southern part of India shows that the yield threshold level has been attained by recording 80 MT per hectare per year by growing Vishala in suitable environments as against 10-15 MT /ha /yr. in J&K. The gap in leaf yield needs to be bridged in case sericulture industry is to be made viable.

Germplasm has been simply maintained and no evaluation and characterization has been done so far at this station. Leaf yield , moisture % , moisture retention capacity are prime characters for a variety in rain-fed condition which may be regulated by photosynthesis, transpiration , stomatal conductance and carbon dioxide availability in leaves. Hence varieties need to be screened in mulberry for subsequent field utilization for these characters.

Good mulberry genotypes if screened and recommended for plantation may serve to enrich, environment as well as may be a tool to develop sericulture industry. Hence, eighteen mulberry genotypes were screened at RSRS Miran Sahib farm Jammu. These plantation are rich source of improved mulberry genotype material as germ plasm and may be used to multiply the recommended genotypes for plantation at farmers and farm level and will be of immense use for breeders.

Stomatal conductance, photosynthesis, and transpiration rate were relatively higher under irrigated conditions and lower under rain fed conditions which suggested that sensitive genotype towards rainfed water stress conditions be screened. Identification of

characteristic feature essential for mulberry improvement under rainfed conditions are prime requisites for crop improvement under sub tropical conditions of J&K and to get few varieties giving higher yield in comparison to S-146, the present ruling genotype.

Key words: Sericulture, mulberry, genotypes, photosynthesis, transpiration and screening.

Introduction

India has been doing sericulture for many centuries and the Indian silk has been popular among rulers and the masses. The Indian history and ancient literature for example Ramayan finds a mention about silk. During the pre independence period even the English rulers also promoted the industry. Local mulberry varieties growing scattered in the field at farmers farms form the food plants for silkworms producing silk. Sericulture can play an important role in development of farmers economy through plantation of improved mulberry varieties screened for the region.

The monsoon rains are normal, 80 percent of the total annual rainfall is received between June – September. More than 90 percent of total population directly or indirectly depends upon agriculture and allied activities for livelihood. Sericulture can be a good tool for additional income in short span.

The mulberry wealth is mostly in the form of local variety, scattered around the dwelling units, on bunds of farmers field i.e. along the periphery of agricultural fields. On an average, the beneficiaries have 50 to 100 mulberry trees. Mulberry leaf is harvested once in March-April in sub-tropical areas for rearing purposes and then in September for autumn crop. Thus the plants are disturbed only twice in a year for sericulture purpose making them good plantation for environment as well. [1 & 4] The pruning resorted twice in a year will provide twigs as fuel and the same can be used to prepare baskets and can give an additional revenue. Even leaves harvested can be sold on nominal rates to farmers which will provide revenue to the owners of plantation. Further the fruits of mulberry trees can be exploited to further add to the income by production of Jam and squash and can be source of income for poor farmers.

The hilly topography, socio-economic condition of village people , agro-climatic condition of the state and also availability of natural resources like water , forest, climate favour the development of sericulture in J&K state. Sub-tropical and temperate both climate exist.Agriculture is almost rainfed.The climate of the pockets of plains and hills is very congenial particularly for sericulture in spring and autumn. The temperature varies from 40 degree Celsius in plains and 0-25 degree celcius in winters. The state experiences rainfall ranging between 1300-1500 mm. The .major part of which is received between June –September.

Therefore it was felt essential to evaluate established Germplasm of few high yielding genotypes at Jammu.

Materials and Method

The quality and quantity of the silk is directly dependent on the quality of mulberry leaf which influences the healthy growth of silkworm larvae thereby positively affecting the overall cocoon production. Since it is established fact that the quality mulberry foliage plays the most important role for the better crop yield, it becomes absolutely necessary to evaluate mulberry germplasm and improve by

replacing the old and local varieties with new improved ones.

Location of Experiments: The project was taken up at RSRS, Farm Miran Sahib Jammu.

Eighteen improved genotypes were selected for evaluation. The selection of genotypes was based on the trials conducted in other regions and states.

Five year old mulberry plantation of improved genotypes viz: K-2,C4,BR-2,Chinese White,S-1,S-1635,S-146,Tr-10,Sujanpur Local, Chak Majra,V1,AR-10,AR-12,AR-14,BC-259,S-13,S-41, MS-9404 and S-41 were maintained as per recommended package of practices.

Experimental details/Design are as under:

No of genotype: 18 No of plants per Variety: 09

Training: Bush

Replication: Three

Spacing: 3'x3

Design: RBD

The growth observations and photosynthesis , transpiration rate, stomatal conductance and Carbon dioxide data were taken for two seasons. Normal standard recommended package of practices were given regularly.

Growth Parameters

The data on Growth parameters in respect of all varieties was taken on randomly selected 3 plants from each replication were recorded.

Leaf yield: Leaf yield per plant was recorded in Kg by plucking all the leaves through standard plucking method.

Moisture retention (%) after 6 hrs of harvest: The leaves harvested for fresh weight were stored in open at room temperature in the rearing house. Every hour they were turned up down. After 6 hours of harvest, weight of 100 leaves was taken by using electronic top pan balance (Sartorius-MA 40) up to two decimal place in grams. The moisture retention after 6 hours of harvest in % was calculated by the following formula:

$$\text{Moisture Retention (\%)} = \frac{(\text{Wt of leaf after 6 hrs} - \text{Dry wt of leaf})}{\text{Leaf weight after 6 hrs}} \times 100$$

Moisture content in leaves: Moisture content in leaf was calculated by plucking 100 leaves from all replications randomly at 10 am and weighed immediately by using electronic top pan balance (Sartorius-MA 40) up to two decimal place in gram. Thereafter the leaves were dried perfectly at 80^{o}c for 48 hours into hot air oven to determine the total moisture content. Moisture % was calculated by the following formula:

$$\text{Moisture\%} = \frac{(\text{Wt of Fresh leaf} - \text{Wt of dry leaf})}{\text{Wt of fresh leaf}} \times 100$$

Photosynthetic Parameters

Net CO_2 assimilation (P_N) rates of photosynthesis were measured using a LI-6400 XT infrared gas analyzer (Li-Cor, Lincoln, NE, USA) fitted with red-blue LED light source essentially as described by the manufacturer's protocol. Fourth leaf from top that was well exposed to sunlight was used for photosynthetic measurements. Leaf was kept under conditions of ambient CO_2 concentration of 380 µmol mol^{-1} and 1200 µmol m^{-2} s^{-1} light was used for measurements.

Results & Discussion

The data for spring and autumn 2014 (Table 1 & 2) on the major parameters were as under:

Leaf yield(per plant in Kg)

Spring : The leaf was in the range of 1.11 Kg to 0.360 Kg/plant and the top five varieties were S-1635 followed by AR-14,Sujanpur Local,S-146 and S-41.

Autumn: The leaf yield was in the range of 0.912 to 0.320 Kg/plant and the top five varieties were S-1 followed by MS-9404,BC-259,S-41 and C-4

Moisture (%)

Spring: The leaf moisture % was in the range of 79.93 to 60.00 and the top five varieties were Chinese White followed by AR-12,S-13,SC-4 and MS-9404.

Autumn: The leaf moisture % was in the range of 71.16-67.20 and the top five varieties were S-13 followed by AR-12,BC-259,S-1 and MS9404

MRC

Spring: The leaf moisture retention capacity was in the range of 85.12-69.19 and the top five varieties werel Sujanpur Local followed by BR-2 , Chak Majra ,C-4 and S-146

Autumn: The leaf moisture retention capacity was in the range of 91.92 to 79.69 and the top five varieties were S-1635 followed by TR-10,Sujanpur Local,BR-2 and BC-259.

Photosynthesis:

Spring : The photosynthesis was in the range of 22.48-12.47 and the top five varieties were Sujanpur Local followed by Chinese White ,C-4,MS-9404 and BR-2.

Autumn: The photosynthesis was in the range 17.55 to 12.11 and the top five varieties were Chinese white followed by K-2,BR-2,Chak Majra and S-146.

Transpiration Rate:

Spring: The transpiration rate was in the range of 1.63-5.56 and the top five varieties in ascending order were S-13 followed by S-1 K-2, S-1635 and Tr-10.

Autumn: The transpiration rate was in the range of 3.51-7.27 and the top five varieties ascending order were S-1 followed by V-1 K-2, BC-259 and Chinese White.

Carbon Di-oxide availability:

Spring: The **Carbon Di-oxide availability** was in the range of 284.33-760.75 and the top five varieties were S-146 followed by Sujanpur Local TR-10,C-4and K-2.

Autumn: The **Carbon Di-oxide availability** was in the range of 273.1-268.84 and the top five varieties were S-41 followed by BC-259,C-4,S-146, and TR-10.

Stomatal Conductance:

Spring: The **Stomatal Conductance** was in the range of 0.452-0.341 and the top five varieties were Sujanpur Local followed by C-4, Chinese white,TR-10,and BR-2.

Autumn: The **Stomatal Conductance** was in the range of 0.348-0.315 and the top five varieties were S-146 followed by AR-14,BC-259,Chak Majra and S-41.

Based on above data, S-1635 is recommended for plantation in Jammu region. This will provide stability to sericulture Industry in the state. After about five years of plantation 6-10 tonnes/hectare leaves can be harvested based on the location, soil and climatic conditions. The plantation should be preferably kept under irrigated conditions up to three years and afterwards they can be maintained under rainfed conditions. This will provide better survival and growth. Recommended pruning and package of practices should be

followed for expression of full potential of the genotypes.

Besides, S-1635 and S-146 the other genotypes viz TR-10, S-13 and S-1 form a gene pool are also recommended as high yielding improved mulberry genotype. The Local varieties MS-9404 and Sujanpur local will be an asset for breeders. The gene pool raised will serve as germplasm for further studies and the germ plasm needs to be maintained. S-13 and can be grown in water stress conditions.S-1 and TR-10 are very good for late age rearings. Even K-2 genotype which showed lower yield is useful variety and is in demand for chawkie rearing by expert sericulturists.K-2 can be grown in chawkie gardens for departmental use during chawkie rearing. The other varieties falling under rmedium and lower group form a very suitable gene-pool for breeders to develop further region season specific varieties.

It is recommended that the suitable recommended genotypes be multiplied and saplings may be supplied to farmers and state Govt sericulture department to grow them as trees at the spacing of 8-10 feet distance depending on space. The trees can also be grown on bunds and periphery of farmers field who have land holdings less than an acre. The trees after full growth will provide 20-30 kgs of leaves per tree/year in two harvests and a unit of 100 trees will yield 2500-3000 Kgs of leaves which are sufficient to rear 200 dfls of chawkie reared worms and will lead to production of 100-150 kgs of cocoons worth Rs 10000-15000 @ 50 Kgs of cocoons /100 dfls in two crops. Each crop will take only 20 days and the related works can be done by ladies and children in their leisure time.100 trees can be planted by poor farmers on the bunds/peripheri of their farms and also in the vicinity of their houses without involving their main land holdings.The rearing involves nominal expenditure.

Thus the germplasm of the eighteen improved mulberry genotypes are a rich source of genepool for further multiplication and plantation at farmers level. [6, 7, 9 & 11]

Discussion

High leaf yield recorded in S-1635 variety in the present study is corroborated with the work of (Dwivedi *et al* (2&3), 1888,1989) who reported that the leaves of the variety were thick , coarse , dark green in colour and larger in size and also recorded highest leaf moisture retention capacity [9 & 10] reported that the variety showed faster growth rate associated with higher values of leaf yield per unit area. Accordingly in the present study S- S-1635 variety is recommended for plantation at farmers leave. Based on the data on photosynthesis and transpiration rate S-13 and S-1 are recommended for rain-fed water stress condition.

Among the various factors for mulberry breeding, selection of promising genotypes with desirable economic traits is very important. For selection of promising genotypes, efforts should be given on the desirable physiological attributes and quality characters of the genotypes. Photosynthesis and its related transpiration rate, stomatal conductance and availability of carbon dioxide are to be considered for determining the leaf yield of a crop [5 & 8].

Conclusion

Therefore, from t he above study it could be inferred that the genotypes (S-1635, S-1 ,S-13, S-146,S-41, AR-12, Chinese white and Sujanpur Local) showing top position in different characters may be utilized for future breeding programme and hence the

study on photosynthesis and its related gas exchange parameters, leaf water status and quality parameters of leaf may be given more emphasis for screening and developing a superior genotype.(Table 1 & 2).Besides the best data , the genotypes falling under medium and lower categories are extremely valuable for breeders. The local varieties Sujanpur Local and MS-9404 have come up as asset for breeders as per this study.

Package of Practices for These Genotypes When Grown As Tree

These genotypes can be grown on a wide range of soil ranging from pH 6.5-7.5. High . These genotypes can be easily multiplied in nursery by cutting with 3-4 active buds obtained from at least 6 months old branches. These genotypes have more than 90% survival through plantation of one year old saplings. Nursery can be raised in December/January & in July/August. Nursery in Dec/Jan is subject to availability of assured irrigation.

Planting season: In the rain fed area the June/July is the best planting season for raising plantation. The December/January can also be a good season provided assured irrigation is available. However, backup saplings of same age should be maintained in nursery for gap fillings of mortality, if any. In case of tree plantation the saplings should be of one year. Six-month-old saplings are used for plantation as bush.

Spacing: Tree type : 8x8 feet (can vary as per land availability i.e. between 8 to 10 feet for tree type plantation and 3'x3' for bush type plantation.).

Nutrient management:

FYM :Under rainfed conditions FYM /compost should be given @ 10 MT/ha/year and @ 20 MT/ha year in irrigated conditions

Chemical Fertilizers :

First Year : N :P :K Kg/ha/year @ 50 :25 :25 in rainfed and irrigated both the conditions

Second year onwards : N :P :K Kg/ha/year @ 100 :50 :50 in rainfed conditions and in irrigated conditions it should be 150 :75 :75 Kg/ha year and in both the cases these may be applied in two split doses.

Pruning : Twice in a year : Bottom pruning in June/July 6-12'' from crown and middle pruning in December/January : 2-3' from crown

Plant protection : Due to adoption of the practice of two seasonal pruning the chance of attack of disease and pests are very less.Some sporadic incidence may occur which do not cause economic damage.The pests are not found at threshold level.However, the fungal diseases can be controlled by 0.2% Bavistin with 15 days safe period.The pests may be checked by DDVP 0.2% solution with 15 days safe period.

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Table 1-: Leaf yield and leaf moisture data of Spring and Autumn 2014

Varieties	*Leaf Yield /Plant (Kg)*		*Moisture % in leaves*		*MRC (%) After Six hours*	
	Spring	*Autumn*	*Spring*	*Autumn*	*Spring*	*Autumn*
V-1	0.40	0.546	78.65	67.74	69.37	80.48
K-2	(IV)0.53	0.481	60.00	68.59	69.19	86.94
SUJANPUR	(III)0.56	0.371	78.63	68.40	(I)85.12	(III)90.77
TR-10	0.51	0.482	78.99	68.25	76.77	(II)91.19
CHAK MAJRA	(Iv)0.53	0.519	78.55	69.11	(III)80.81	84.35
CH.WHITE	0.35	0.321	(I)79.93	68.743	73.27	79.69
S-146	(III)0.56	0.374	78.69	69.43	(V)78.77	86.35
C-4	(II)0.75	0.780	(IV)79.067	68.16	(IV)79.85	85.34
BR-2	0.50	0.419	78.08	69.74	(II)85.09	(IV)88.96
AR-10	0.36	0.523	76.30	69.34	70.36	83.35
S-41	(III)0.56	0.789	77.74	69.12	76.31	88.5
AR-12	(IV)0.53	0.586	(II)79.69	(II)71.16	71.41	85.90
AR-14	(II)0.67	0.557	79.13	68.1	72.74	84.99
S-13	0.44	0.516	(III)79.09	(I)72.24	73.91	80.10
BC-259	(V)0.524	0.862	78.68	(III)70.48	69.26	(V)88.50
S-1	0.44	0.912	77.99	(IV)70.40	74.19	82.36
MS-9404	0.49	0.888	(V)78.93	(V)70.34	70.00	86.62
S-1635	(I)1.11	0.542	76.78	67.20	70.10	(I)91.92
CD at 5% level	0.24	0.33	5.07	2.57	8.49	4.74

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Table 2:Photosynthesis, transpiration rate , Carbon di oxide concentration(Ci) and Stomatal conductance of eighteen mulberry varieties during spring and Autumn 2014

Variety	*Photosynthesis* (µmol $m^{-2}s^{-1}$)		*Ci* (ppm)		*Stomatal conductance* ((µmol $m^{-2}s^{-1}$)		*Transpiration Rate* (µmol $m^{-2}s^{-1}$)	
	Spring	*Autumn*	*Spring*	*Autumn*	*Spring*	*Autumn*	*Spring*	*Autumn*
V-1	18.14	13.048	253.91	261.04	0.285	0.229	3.55	(II)4.43
K-2	17.74	(II)17.36	260.75 (V)	253.66	0.319	0.305	(III)2.28	(III)5.23
Sujanpur Local	(I)22.48	14.43	280.62 (II)	261.25	0.452 (I)	0.266	6.35	5.78
TR-10	17.73	14.94	263.23 (IV)	(V)268.84	0.344 (IV)	0.296	(V)2.74	5.43
Ch.Majra	17.41	(IV)16.63	249.71	261.99	0.299	(IV)0.316	2.85	5.47
Ch.White	(II)21.54	(I)17.55	262.09	251.84	0.356(III)	0.302	5.53	(V)5.33
S-146	17.05	(V)16.52	284.33(I)	(IV)268.87	0.410	(I)0.348	3.16	6.34
C-4	(III)19.21	14.55	276.93 (III)	(III)269.83	0.364 (II)	0.305	5.563	6.68
B-R2	(V)18.29	(III)17.14	259.37	246.92	0.341 (V)	0.279	3.57	5.56
AR-14	16.95	16.37	222.71	263.22	0.197	(II)0.324	3.82	6.72
AR-12	21.2	13.4	203.65	268.83	0.214	0.270	4.57	5.77
AR-10	13.53	13.33	244.78	251.261	0.213	0.229	2.91	5.35
S-41	18.18	12.11	231.73	(I)285.75	0.235	(V)0.315	4.85	7.27
S-13	12.47	14.18	199.95	259.96	0.123	0.255	(I)1.63	5.84
BC-259	17.69	15.08	213.64	(II)273.1	0.190	(III)0.318	4.19	(IV)5.29
S-1	18.14	10.67	231.26	237.05	0.177	0.144	(II) 2.2	(I)3.51
MS-9404	(IV)18.98	15.32	248.31	268.6	0.282	0.313	5.3	5.59
S-1635	15.55	14.06	202.04	265.14	0.246	0.278	(IV)2.68	5.5
CD at 5 % level	2.75	1.05	18.57	8.49	0.71	0.02	0.6	1.97