Chapter - 5

Summary and conclusion
CHAPTER V
SUMMARY AND CONCLUSION

5.1 SUMMARY

Sericulture has been introduced in Maharashtra as a commercial crop during 1962. Since then the area under mulberry cultivation is increasing day by day, as sericulture is a labor intensive and an agro-based rural cottage industry and it can act as a most prominent role in the rural economy. Sericulture provides an excellent and unique opportunity for socio-economic progress in the content of a developing country like India. Due to urban industrialization with more employment opportunities, the rural poor people have started migrating to urban areas for their livelihood. In order to avoid this trend, emphasis should be laid to develop rural based cottage industry. In this regard, Sericulture should illustrate prime importance by planners, as a means to generate gainful employment opportunities to the unemployed and under utilized rural poor.

Though the main research centers for Sericulture are in traditional silk producing states, Sericulture has received enough attention in non-traditional silk producing state like Maharashtra also. However, in Maharashtra all the research has been concentrated in zoology branch, with respect to rearing of the silkworm.

Mulberry is the sound basis of Sericulture. Mulberry is the only food source of silkworm Bombyx mori L., is of great economic importance to Sericulture industry. The quality and quantity of leaf produced has a direct bearing on cocoon harvest and in turn economy. Hence, the major step in boosting economy is, increased leaf yield coupled with good quality and resistant to diseases or adverse climatic conditions, wide range of adaptability and good response to agronomic inputs.
Mulberry varieties developed and being cultivated presently show high yield potential of leaf yield per hectare under assured moisture condition. Most of the varieties cultivated in India include Mysore local, K2, S54, S36, S34, V1, DD1, S1635, Kajjali, Tr-8, Tr-10 etc. The varieties, which are recommended in Maharashtra, are V1, S36 and S1635, suitable for the local climatic conditions under irrigated condition. However, there is considerable difference in the silk production figures. If goes without saying that the biochemical parameters and protein content playing an important role in the quantity and quality of the silk. Extensive research has been undertaken in these regards in traditional states. However, in Maharashtra the standard figures of these varieties for the biochemical composition and particularly NPK, biomass, moisture content, chlorophyll estimation has not been studied. Since these figures are not available in drought-prone region of Ahmednagar district or in other parts of Maharashtra, such study will help to understand the relation between these parameters and silk quality and quantity in Maharashtra. It would be inadequate to talk of natural causes of environmental conditions and effect of these factors on mulberry. These several factors operate in combination. But if we can co-relate these factors, then selection of genotype in local condition will become easy. Keeping in view all these influences, one ought to think about future of Sericulture and quality of mulberry plant, and ways and means to improvise upon these aspects. In this context, this thesis is the first attempt to study the plant in control conditions, also the effects of physical and chemical mutagen on mulberry for above parameters under this condition.

Despite the efforts made by several breeders to evolve the genotypes of superior varieties, with the expansion of Sericulture and its introduction in varied geographical and agro-climatic regions, yet
there is need for more number of varieties to suit the different region specificity. Since the data indicate quite clearly that the favorable climatic conditions are typified by a greater yielding variety and better quality of silk.

To achieve this object there is necessity to combine available modern tools such as mutation breeding and biotechnology in addition to conventional breeding methods.

While talking about the modern trends in Sericulture research on mutation studies with respect to all the high technology subjects, one should not forget the importance of basic research of such kind. The comparative study will enable us to manage the quality and quantity of silk production, which is based on mulberry genotype. Therefore this is an issue of immediate concern in modern Sericultural practices in Maharashtra. Therefore research models like this projecting comparative study of mulberry species is going to be useful in future to restore the existing germplasm and type specific information. Thus, this is the effort to document the indigenous knowledge of mulberry cultivation which is geographically specific.

In summary the present case study holistically envisages multidisciplinary approaches from morphology, biochemistry, and genetics with specific reference to introduced varieties of mulberry in Maharashtra for unraveling the standard date in our local climatic conditions. It makes a humble effort to provide a perspective to the contemporary studies on mulberry and silk production.

One of the most important practical applications of this research is that, this work may lead to formulate a policy of mulberry cultivation in local climatic conditions of Maharashtra. Thus, the most important applicable legacies that, this research and data sets will be explore the basic necessary qualities of mulberry, which will help to formulate future policy in sericulture in a world of rapidly developing agricultural and sericulture research, to improve silk production and
to uplift economy standard of the poor farmers by providing them best suited varieties of mulberry for rearing the silk worm.

There is a wide scope for induction of a particular trait of agronomic importance through mutation breeding over the conventional methods. Several reports are available on induced mutations in mulberry. Many workers have carried out mutagenic work and induced mutation through physical mutagen like gamma irradiation and chemical mutagen like EMS solution in mulberry. Cutting shoot back technique and re-irradiation were also practiced to achieve widest mutation spectra [Hazama 1967, 1968a, 1968b; Hazama et al., 1968; Das 1970; Karagiri 1970, 1973,; Katagiri and Wada 1971; Nakajima 1972; Fujita and Nakajima 1973; Sastry et al., 1983, 1985; Broerties and Van Harten, 1988; Fujita 1974; Fujita and Wada, 1982; Rao J.P. et al., 1984; Jayaramaiah and Munirajappa, 1987; Dandin et al. , 1987, 1989; Ramesh 1997; Reddy 2002; Anilkumar , 2008]. Induction of mutation as a technique in crop improvement occupies a significant place among modern methods of plant breeding. Realizing these aspects in the present investigations, mutations have been induced using EMS and gamma rays in the three mulberry genotypes Vi, S1635 and S36.

5.2 CONCLUSION

The conclusion related to result found in variations in morpho-economic attributes, early growth responses in sprouting, survival per cent, biochemical constituents etc are presented in the following paragraphs.

Generally, in Maharashtra variety Vi is promoted and commonly distributed to the farmers. But it is clear from the study that the mean values of all the characters studied of the S1635 variety are very much similar or better than Vi. The comparative account of Vi and S1635 revealed the fact that sprouting, survival per cent, number of branch,
length, biomass, nitrogen percentage, protein percentage and moisture percentage of both the varieties are compatible.

The comparative account of all the three varieties clearly suggest that $S_{1635}$ is equally compatible or to be precise better than $V_1$ and $S_{36}$. The control figures of $V_1$, $S_{36}$ and $S_{1635}$ are available in CSRTI, Mysore and Germplasm center, Kodti, Tamilnadu. But such comparative study has not been undertaken for these varieties in Maharashtra. Therefore the recommended variety $V_1$ is distributed in Maharashtra. However, the study revealed that $S_{1635}$ is also equally compatible to $V_1$ variety. The study also gives the figures for above criteria which are better than $V_1$, still $S_{1635}$ is not promoted or distributed commonly to farmers. Thus, in nutshell the study suggests that variety $S_{1635}$ should be promoted with $V_1$ in Maharashtra. Since, it shows all the better qualities under the stress of drought-prone area under cultivation in Ahmednagar district and other parts of Maharashtra.

While studying the biochemical analysis it was found that the chemical treatments of EMS could not modify the sprouting phenomenon in mulberry genotypes while sprouting per cent of mulberry genotypes was significantly reduced by the gamma irradiation over control. Gamma rays showed injurious effect to stem cuttings than that of EMS. The chemical mutagenesis by the varying levels of EMS was found non-significant for sprouting of mulberry genotypes. However, numerically it was more in 0.1 and 0.3 per cent EMS treatment [92.37 and 91.01 % resp].

The mean sprouting percentage of $S_{1635}$ (91.48) was better than $V_1$ (86.27) and $S_{36}$ [77.72] (Tab- 4.1, Plate -4, 5, 6, 7, Fig. 4.1& 4.2), while, mean survival percentage of $S_{1635}$ was 55.83% which was more than $V_1$ (19.38 %) and $S_{36}$ [41.48] (Tab -4.2, Plate 8, 9, 10, 11. Fig. 4.3 & 4.4). Survival per cent of mulberry genotypes was higher in chemical mutagenic treatment of EMS.
It was decreased with increased concentration of EMS, while gamma irradiation treatment reduced the survival per cent as compared to EMS. It was observed that increased doses of gamma irradiation drastically reduced the survival per cent. Variety S1635 showed better result for sprouting [97.93 %] at 0.2 and 0.4 per cent of EMS and survival per cent [83.33 %] at 0.2 per cent of EMS as compared to its control. Hence, 0.2 per cent of EMS is better for sprouting and survivability.

The mulberry genotype S1635 was recorded significantly the more length of the branches [103.46 cm] and significantly superior over S36 and V1 [74.94 and 63.57 cm respectively], whereas, V1 and S36 genotypes were statistically on par with each other for length of the branches.

Chemical mutagenic treatment at 0.1, 0.2 and 0.3 per cent were found on par with each other for the length of the branches [116.50, 123.99 and 110.65 cm respectively]. Numerically it was more at 0.2 %.

The chemical mutagenic treatment showed the higher values of length of the branch in variety S1635 at 0.3 % [143.90 cm] followed by 0.2 % [133.12 %]. It was more than its control and other two varieties, while gamma irradiation drastically reduced the length of the branches of mulberry genotypes.

Mean number of branches were more in S1635 at 180 DAP (2.79) than V1 (1.25) and S36 [2.75][Tab - 4.9, Fig. 4.7 & 4.8]. The results indicated that chemical mutagen had less adverse effect on number of branches than the physical mutagen. The chemical mutagen treatment with 0.1 % EMS showed significantly superior over other EMS treatments.

The mutagenic treatment of EMS was found non significant whereas gamma irradiation were found significant for internodal distance of mulberry.
The mean biomass production of S1635 was 596 g, which was higher than V1 (501.40g) and S36 (348.40g). (Tab 4.11, Plate-15). It was found that lower doses of EMS [0.1 and 0.2 %] and lower doses of gamma irradiation [3 kR] showed higher biomass than the higher doses.

The mean moisture percentage of S1635 was 64.45 %, 62.42 % and 60.30 % which was more than V1 48.97%, 47.42% and 45.82 % and S36 was 56.85%, 55.05%, 53.35 % (Tab - 4.14, 4.15, 4.16). At 0.1 % S36 variety showed more moisture per cent than its control.

The mean crude protein percentage of Siess in tender, medium and coarse leaves were [20.49, 14.77, 10.29%, respectively] which was more than V1 [14.28, 10.34, 7.54%] and S36 was [18.01, 13.51, 9.81%] (Tab - 4.17, 4.18, 4.19). The variety S1635 showed better protein content at 0.1 per cent [23.13] than its control.

The mean nitrogen percentage of S1635 in tender, medium and coarse leaves was [3.28, 2.30, 1.65% resp] which was more than V1 [2.28, 1.72, 1.21%] and S36 that was [2.88, 2.17, 1.57 % resp]. (Tab - 4.29, 4.30, and 4.31].At the concentration of 0.1 per cent EMS the variety S1635 showed better nitrogen content in tender leaves[3.70%] , medium [3.25 %] and coarse [2.38 %] as compared with conventional control variety.

The mulberry genotype S1635 showed increase in phosphorus content in tender leaves [0.60%], medium [0.41%], and coarse leaves [0.36%] which were higher than V1 and S36. The genotype S36 at 0.4 % showed significant increase in concentration of phosphorus in tender leaves [0.81%], medium [0.61%], coarse leaves [0.56%] than control, which was also more than S1635 and V1. However S1635 and V1 variety of mulberry was found to be on par with each other for their phosphorus concentration.
Variety V₁ showed the highest concentration of Cu content in tender leaves [5.55] while medium [5.85] and coarse [6.35] which was more as compared with the other two varieties also. For all the three varieties for all doses the Cu content had been significantly increased than their respective control.

The mulberry genotype S₁₆₃₅ was recorded significantly higher Fe as compare to V₁ and S₃₆. Variety V₁ showed the highest value at 0.2 % which was more as compared with the other two varieties also. For all the three varieties for all doses the Fe content had been significantly increased than its control.

The mulberry genotype S₁₆₃₅ was recorded significantly higher Mn as compare to V₁ and S₃₆. In var. V₁ @ 0.2 per cent EMS, Mn was more than control and other two varieties.

The mulberry genotype S₁₆₃₅ was recorded significantly higher Zn as compared to V₁ and S₃₆. However S₁₆₃₅ and S₃₆ variety of mulberry was found to be on par with each other for their Zn content.

Leaf quality is influenced by a number of factors such as variety, cultivation practices, incidence of pests and diseases, method of harvesting and preservation of leaves [Krishnaswami et al., 1970; Koul et al., 1980 and Sastry et al., 1988]. Several scientists have reported different quality traits such as leaf moisture content, protein content, carbohydrate content, nitrogen content, amino acid content and chlorophyll content are responsible for leaf quality [Bongale et al., 1991; Chaluvachari and Bongale, 1995] while Sujathamma and Dandin, [2000] and Bose and Bindro, [2001] reported that no single variety consists of all the nutrients at the highest level. All the quality traits or nutrients may not be available at the highest level in a genotype as there are several factors, such as nutrients uptake, absorption of water, nitrogen utilization efficiency etc., which are involved and differ from genotype to genotype. Therefore, it is most essential to identify a genotype possessing some of the important quality traits together, which may help to improve the growth and
cocoon characters of silkworm.

In view of these facts an attempt was made to analyze some of the important biochemical traits in these three varieties by using mutation breeding.

Thus, the present investigation clearly indicated the morphological characters such as sprouting per cent, survival per cent, length of branches, number of branches and green leaf weight, moisture per cent, biochemical constituents like nitrogen, protein Cu and Fe showed better induced qualities in S\textsubscript{1635} via 0.1 to 0.3 per cent EMS. Thus, variety S\textsubscript{1635} can be induced better qualities by lower doses of EMS. This mutant genotype of S\textsubscript{1635} can be introduced as a new mulberry variety in future for Maharashtra.

5.3 FUTURE STRATEGIES OF WORK

It is very necessary to study the next consecutive generations to confirm the improved characteristics under consideration in this thesis.

It is very important to study the bioassay of the variety and its confirmation by testing the cocoon and silk characters.