BREEDING OF A NEW MULTIVOLTINE SILKWORM RACE DAK-205

Mehar Nigar Ashiq*
Muhammad Iqbal Ahmad
and
Raj Muhammad

Abstract

A multivoltine silkworm race, DAK-205, was evolved from a Japanese race AIJ-205 during breeding experiments for development of pure lines. The newly developed line was reared for six generations in succession from April-October in 1987 including the hot months of June, July and August when the room temperature was as high as 30oC and the relative humidity as low as 55%. The line thus evolved can yield several crops of cocoons in a year and is also resistant to silkworm diseases, high temperature and low humidity.

Introduction

Silkworm rearing is carried out by a large number of rural people in Pakistan but only once in a year in spring with bivoltine hybrid varieties. In sericulturally advanced countries of China and India, it is practiced two times for bivoltine and throughout the year (7-8 generations per year) for multivoltine varieties which is the natural silkworm line of tropical regions. This line lays non-diapausing eggs, has shorter life cycle and is resistant to harsh climatic conditions and to various silkworm diseases.

In China, Wang (1979) produced a variety with non-diapausing eggs by using the ancient Chinese technique of treating the eggs with low temperature during incubation for twenty one days in the dark. Sidhu, et al (1968) found that multivoltine mutants and breeds are resistant to harsh climatic conditions and diseases. Lateron Sidhu (1973) also conducted a breeding experiment in India to develop a locally adapted multivoltine breed by using Tazima's procedure. Tazima (1958) breeding procedure consisted developing an improved multivoltine strain by crossing a multivoltine strain with a bivoltine strain followed by selection and inbreeding of the non-diapausing eggs and elimination of diapausing eggs for several generations.

General productivity of cocoon crop in Pakistan is quite low as compared to other silk producing countries in Asia. In order to develope this industry, it is highly important to obtain maximum-yield of cocoon. This would be possible only if the traditional system of single silkworm rearing of bivoltine race is replaced by a multivoltine race in which embryo continues its development by hatching for more than two generations in a year. As no multivoltine strain was available in Pakistan, studies were carried out to isolate a

* The authors are Senior Research Officer, Director Sericulture, Pakistan Forest Institute, Peshawar, and Sericulture Development Officer, N.W.F.P. Sericulture Department, Peshawar

suitable strain capable of rearing for 4-6 generations in succession within a year for increasing cocoon production substantially.

Material And Methods

A new multivoltine silkworm line DAK-205 was bred through inbreeding and selection procedure at Pakistan Forest Institute Silkworm Breeding Laboratory, Peshawar. A Japanese race, AIJ-205, with normal marking and constricted white cocoons was used as breeding material. This race was segregated in the laboratory by inbreeding and selection from an imported Chinese hybrid, Dongfei x Huahe. During an experiment on the purification of various lines in Spring 1986, an interesting and valuable feature was noticed in AIJ-205. This included the hatching of some of the egg batches after ten days of egg laying soon after the completion of the first generation. These eggs did not enter into diapause stage which is a racial character of the univoltine and bivoltine races. Because of inadequate conditions for egg storage, this feature was considered as untimely hatching. Further rearing of the hatched larvae was thus not conducted. However the diapausing eggs were stored at 5oC. In Spring 1987, similar characteristic of hatching of some egg batches in the same race was observed again after completion of the first generation. This feature was not observed in other races, which were preserved under the same environmental conditions.

The newly hatched larvae of the above batches were isolated and bred upto egg-laying stage, thus completing the second generation. Ten days after egg-laying of the second generation, some egg-batches hatched out again which were selected and inbred for third generation. This procedure of egg hatching, selection and inbreeding of the non-diapausing eggs was continued upto six generations in succession till the end of October. The most interesting feature found in the non-diapausing eggs of the line was that each time hatching took place after ten days of egg-laying. During the course of the study, data on various economic characters like the hatchability of eggs, larval duration, survival rate, cocoon and its shell weight and shell percentage were recorded for six generations.

Results And Discussion

Observations on the economic characters of cocoons for six generations are given in Table 1 below:

Table 1. Economic Characters of the multivoltine line DAK-2-5 from April 1987 to April 1988

Regarding seasons	Larval Characters			Cocoon Character		
	Hatchability, (%)	Larval duration Days-hours	Survival rate (%) (gms)	Single Cocoon weight (gms)	Single cocoon shell weight	Cocoon shell ratio (%)
April 1987	92.1	25-4	99.0	1.309	0.299	22.8
June 1987	88.9	24-4	100.0	1.252	0.271	21.6
July 1987	88.9	24-5	99.0	0.951	0.186	19.6
August 1987	90.3	24-8	99.6	0.974	0.181	18.6
September 1987	90.8	24-0	100.0	0.856	0.155	18.1
October 1987	82.6	25-3	97.9	0.976	0.176	18.0

The above late indicate the hatchability of eggs as 90.3 90.8% and 92.1% in the months of August, September and April respectively which is in accordance with the internationally accepted standard for multivoltine races. However it was 88.9%, 87.8% and 82.6% during the months of June, July and October which, through slightly lower than that of the later generations, but is still a positive indication of a multivoltine line. The larval duration varied from 24 and 25 days for different generations, which is also the standard character of multivoltine line. Survival rate was studied at spinning stage. The highest value of 100% was found in the months of June and September while the lowest value of 97.9% was observed in October which again conforms to the standard value for multivoltine line.

Observations on various cocoon characters showed a wide range of variability in the form of gradual decrease in the weight of single cocoon and its shell and shell ratio from spring to early fall. Between the months of April and September, single cocoon weight reduced from 1.309 grams to 0.856 gram, cocoon shell weight from 0.299 grams down to 0.155 grams while cocoon shell ratio ranged from as high as 22.8% to as low as 18.1%. But upon the approach of the proper autumn rearing season there is a sudden slight rise in all these characters as weight of single cocoon rose from 0.856 grams to 0.976 grams and its shell weight from 0.155 grams to 0.176 grams in October. However there is also slight decrease in the shell ratio in this period which is 18.0% as compared to 18.1% in September. However, all the these characters are close to standard values.

The above results were obtained under the temperature ranging between 24.6oC to 26.1oC and relative humidity between 55% and 70.1% from April, 1987 to October, 1987. The multivoltine race is generally raised at 28oC temperature and 70% relative humidity. The data of temperature and relative humidity during the study period are given in Table 2.

Table 2. Monthly temperature and humidity data from April to October, 1987

Rearing seasons	Temperature (Co)	Relative humidity(%)
April 1987	26.1	65.33
June 1987	30.0	55.00
July 1987	30.0	55.00
August 1987	30.0	65.00
September 1987	-	-
October 1987	24.6	70.1

It maybe seen from the above data that exact requirement of temperature and relative humidity of multivoltine race were not met in the present study, still all the characters of the multivoltine race as discussed above are either identical or close to the standard requirement. Over and above this, the hatching of the larvae in this line after ten days of each egg-laying under identical conditions as for other races and without any treatment for breaking the diapause of eggs is another important character which confirms that the line is multivoltine.

The experimental multivoltine line showed the following racial characters:

1. Egg Colour : Purplish brown with white shell.
2. Full grown larvae : Small, strong, pinkish with grey and black specks. Markings are normal.
3. Mature larva : Pink, transparent, with intersegmental septa deep pink.
4. Cocoon : White, peanut shape, less flossy, less wrinkled, a bit soft and small in size.

As far as general characters of the line are concerned, it is easy in rearing. It with stands as high temperature as 30oC and as low relative humidity as 55%. It is resistant to nuclear polyhedrosis, an acute viral disease of silkworm which prevails in almost all silkworm rearing areas of the country. Although the weight of single cocoon and its shell as well as cocoon shell ratio was reduced in each successive generation and this also resulted in low cocoon production in them as compared to a bivoltine race, still, several generations of this line could easily be reared between the months of March and October, thereby, producing large greater quantity of cocoons over the whole season.

Conclusion

Although DAK-205 is pure line, yet it consists of only one parent. Another multivoltine parent is needed for producing F1 seed for commercial production. Since methodology is now known, several such lines could possibly be developed in similar fashion in future. Meanwhile it is possible to utilize this newly evolved multivoltine line in producing seed for commercial purposes
through crossing it as a resistant line with the available bivoltine races. The cross is expected to produce some multivoltine egg layings, besides bivoltine and mixed seed which can be improved and developed subsequently into multivoltine line. The newly evolved line DAK-205 is pure and multivoltine. It can be reared easily for at least 2-6 generations in a year and cocoon production be increased several times the present quantity which will lead to the development of sericulture as well as to increase income of rural people.

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