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Utilization of Magneti Energy for the Qualitative Improvement in the Shell Ratio of the Cocoons Spun by the Mature Larvae of Silkworm, *Bombyx mori* (L) Race: Bivoltine Cross Breed (double hybrid) [(CSR6 x CSR26) x CSR2 x CSR27)]

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ABSTRACT:

The shell ratio gives a satisfactory indication of the amount of raw silk that can be reeled from a given quantity of fresh cocoons under transaction. The calculation of shell ratio assists in estimating the raw silk yield of the cocoon and in deriving an appropriate price for the cocoons. The percentage will change based on the breed of the silkworms, rearing and mounting conditions. Percentage rates are altered based on the age of the cocoons as the pupa loses weight as metamorphosis continues. The fifth instar larvae of bivoltine cross breed (double hybrid) [(CSR6 x CSR26) x CSR2 x CSR27)] of silkworm, *Bombyx mori* (L) were exposed to the magnetic energy of various strengths (1000, 2000, 3000 and 4000 Gauss magnetic field). The magnetization of fifth instar larvae was carried out on the first four days, for half an hour for each day before first feeding. The attempt reveals significant influence of magnetization of *Bombyx mori* (L) larvae on the shell ratio of the cocoons. The shell ratio of the cocoons spun by the fifth instar larvae of untreated control group was 19.427 percent. The provision of 1000 Gauss magnetic energy to the fifth instar larvae on the first four days, for half an hour for each day before first feeding was found the silk cocoons of 20.953 percent. The provision of 2000 Gauss magnetic energy to the fifth instar larvae on the first four days, for half an hour for each day before first feeding was found the silk cocoons of 21.112 percent. The provision of 3000 Gauss magnetic energy to the fifth instar larvae on the first four days, for half an hour for each day before first feeding was found the silk cocoons of 21.204 percent. The provision of 4000 Gauss magnetic energy to the fifth instar larvae on the first four days, for half an hour for each day before first feeding was found the silk cocoons of 22.162 percent. Magnetization may have had influence on the increase in the levels of amino acids followed by accelerated rate of silk synthesis in the fifth instar larvae of silkworm, *Bombyx mori* (L). Magnetic energy should be utilized as efficiently as possible for the qualitative improvement in the shell ratio of the cocoons spun by the mature Larvae of silkworm, *Bombyx mori* (L) Race: Bivoltine Cross Breed (double hybrid) [(CSR6 x CSR26) x CSR2 x CSR27)].

Keywords: Magnetic Energy; Silk cocoons; Cocoon Shell Ratio; Bivoltine Cross Breed; Double Hybrid; [(CSR6 x CSR26) x CSR2 x CSR27)].

INTRODUCTION:

The innovation of India as a developing country is definitely based upon agriculture and agro-based industry. Like agriculture, sericulture plays an important role in the transformation of rural economy as it assures wide scopes in the term of regular employment and provides return round the year. The race Nistari is a resistant variety of multivoltine mulberry silkworm (Bombyx mori), which contributes up to a great extent in the

commercial production of silk. The ultimate aim of sericulture is to enhance the production of quality raw silk as per demand of the market. The potential of sericulture as an important source of income and generating more employment opportunities is definitely based upon the performance of the different stages of life cycle of *Bombyx mori* (L) (Rahmathulla, 2012). India has the unique distinction of being the only country producing all the four-commercial variety of silk namely, mulberry, tasar, eri and muga but Indian sericulture industry depends mainly on multivoltine race. Bombyx mori nistari is a resistant variety of multivoltine mulberry silkworm which contributes up to great extent in the commercial production of cocoon. In order to increase the production of silk, efforts have been made to study the effect of temperature, relative humidity, photoperiod, nutrition efficiency of bivoltine *Bombyx mori* Linn., artificial diet, X-rays etc on the performance of silkworm (Chaugale and More, 1992). The magnetic field influenced the hormone and insulin level in rat and the rate of β galactosidase synthesis in bacteria (Chaugale and More, 1992).

Per cent shell ratio of *Bombyx mori* (L) was significantly ($P<0.01$) influenced due to variation in the strength of static magnetic field and exposure duration for the treatment of eggs. Maximum shell ratio (14.5%) was recorded in the case of eggs treated in 3000 Gauss magnetic field for 96 hours. Thus, the magnetization of silkworm eggs may open a new field of biotechnology for further investigation to improve certain economic characters in Bombyx mori resulting in the heavy production of cocoon and good quality of silk (Upadyay, *et al.*, 2007).

Santosh Kumar Tripathi (2021) reported increased contents of DNA in the silk gland of larvae and fat body and haemolymph of larvae and pupae with an increase in magnetic exposure of eggs up to 96 hrs and magnetic strength from 1000-3000 Gauss. DNA content was maximum (0.130±0.005 and 0.139±0.002 µ mgG1 haemolymph of larvae and pupae, respectively) for 96 hrs exposed eggs in 3000 Gauss magnetic field. In 4000 Gauss magnetic strength, DNA contents decreased in the tissues of larvae and pupae with an increase in magnetic exposure of eggs up-to 96 hrs. Treatment of *Bombyx mori* eggs in 3000 Gauss magnetic field for 96 hrs exposure was effective to enhanced DNA contents in the tissues (Santosh Kumar Tripathi, 2021).

The fifth instar larvae of multivoltine crossbreed race (PM x CSR2) of silkworm, Bombyx mori (L) were exposed to the magnetic energy of various strengths (1000, 2000, 3000 and 4000 Gauss magnetic field). The magnetization of fifth instar larvae was carried out on the first four days, for half an hour for each day before first feeding. Bioassay of total proteins was carried out on the fifth day of fifth instars. The attempt reveals influence of magnetization of Bombyx mori larvae on the total protein content level in the silk glands, fat bodies and haemolymph. The total protein content was increased with increase in the strength of magnetic field from 1000 to 4000 Gauss magnetic field. The larvae magnetized with 4000 Gauss magnetic field were found with sustained or decreased in total protein contents. Silk gland total proteins were

increased from 5.901 to 17.481 percent. Total proteins of fat bodies were increased from 18 to 46.517 percent. And the total proteins of haemolymph were increased from 16.606 to 33.588 percent. Magnetization may have had influence on the increase in the levels of amino acids followed by accelerated rate of protein synthesis in the fifth instar larvae of silkworm, Bombyx mori (L) (Race: PM x CSR2). Magnetic energy should be utilized as efficiently as possible for the progression of growth of larval instars of silkworm, Bombyx mori (L) (Madhuri Anil Shivpuje, *et al.*, 2016).

Sericulture, or silk farming, is the rearing of silkworms for the production of silk. Although there are several commercial species of silkworms, *Bombyx mori* (L) is the most widely used and intensively studied silkworm. Silk was first produced in China as early as the Neolithic period. Sericulture has become an important cottage industry in countries such as Brazil, China, France, India, Italy, Japan, Korea, and Russia. Today, China and India are the two main producers, with more than 60% of the world's annual production. The sericulture is both an art and science of raising silkworms for commercial silk. Silkworm larvae are fed with mulberry leaves, and, after the fourth moult, climb a twig placed near them and spin their silken cocoons. This process is achieved by the worm through a dense fluid secreted from its structural glands, resulting in the fiber of the cocoon (Vitthalrao Khyade and Jiwan Sarwade, 2013). The silk is a continuous filament comprising fibroin protein, secreted from two salivary glands in the head of each larva, and a gum called sericin, which cements the filaments. The sericin is removed by placing the cocoons in hot water, which frees the silk filaments and readies them for reeling.

This is known as the degumming process. The immersion in hot water also kills the silkworm pupae. Single filaments are combined to form thread, which is drawn under tension through several guides and wound onto reels. The threads may be plied to form yarn. After drying, the raw silk is packed according to quality. In order to increase in the production of quality raw silk, efforts have been made to investigate the effect of temperature (Verma and Atwal, 1968), relative humidity (Upadhyay and Mishra, 2002), photoperiod (Jolly, *et al.*, 1971), X-rays (Kanarev and Cham, 1985) on the silk producing potential of B. mori. The effect of magnetism on biological system has been the subject of worldwide interest. Magnetic field influences morphological, physiological and biochemical characteristic of biological system (Patnev and Mankova, 1986). Magnetic field affects larval behaviours of silkworm (Chaugale, 1993), hormonal level (Udinsteve and Moraz, 1982) and acid phosphatase activities (Conely, *et al.*, 1966) in mouse and germination of seed (Pittman, 1965). Its positive effects include cell viability (Ferment, 1994), nerve regeneration (Byers, 1998) and bone healing in guinea pig Darendetiler, *et al.*, 1997). Magnetization of eggs influences incubation period (Tripathi and Upadhyay, 2005), silk producing potential (Tripathi and Upadhyay, 2006) and amino acids content in the larvae of B. mori (Tripathi, *et al.*, 2012).

There are no reports on utilization of magnetic energy for the improvement in the performance of larval instars of Bivoltine Cross Breed

[(CSR6 x CSR26) x CSR2 x CSR27)] of silkworm, *Bombyx mori* (L) for economic traits. Therefore, the present attempt has been planned.

MATERIAL AND METHODS:

Bivoltine Cross Breed (double hybrid) [(CSR6 x CSR26) x CSR2 x CSR27)] race silkworm, of *Bombyx mori* (L) was utilized for study. The silkworm, *Bombyx mori* (L) completes its life cycle through the stages like egg stage, larval instars, pupa within cocoon and adult moth. The eggs of bivoltine cross breed (double hybrid) race have 9- 12 days duration. The larval duration for bivoltine cross breed (double hybrid) race is little bit longer as compared to the larvae of multivoltine race. The larval stage is most active period in the life cycle of silkworm, especially with reference to voracious feeding. During feeding the larva accumulates the nutrients required for its physiological and developmental activates. The larval stage of silkworm is tetra, moulter and therefore having five larval instars. At the maturation, fifth instar larvae spin the cocoon, in which it moults and resumes the successive stage, the pupa. The pupal stage lasts for 10-12 days in bivoltine cross breed (double hybrid) race. As the pupa is within the silken cocoon, it appears to be quiescent. Within the cocoon the pupa transforms itself into adult. The adult moth of bivoltine cross breed (double hybrid) race emerges from the cocoon and lives for about 6-10 days.

The present attempt was carried out at the Sericulture Unit, Malegaon Sheti Farm, Agricultural Development Trust Baramati, Shardanagar, (Malegaon Khurd) Post Box No - 35, Baramati, Pune 413 115, Maharashtra, India for three years: 2019; 2020 and 2021 (three cycles per year).

The seed cocoons (Pupa enclosed in silken case) of Bivoltine Cross Breed (double hybrid) [(CSR6 x CSR26) x CSR2 x CSR27)] race silkworm, of *Bombyx mori* (L) were obtained from silkworm grainage Gadhinglaj, Directorate of sericulture, Maharashtra State, India and were maintained in plywood trays (23×20×5 cm) under the ideal rearing conditions (Krishnaswami, *et al.*, 1973) in silkworm laboratory, Sericulture Unit, Malegaon Sheti Farm, Agricultural Development Trust Baramati, Shardanagar, (Malegaon Khurd) Post Box No - 35, Baramati, Pune 413 115, Maharashtra, India. The temperature and relative humidity were maintained 26±1EC and 75±5% till the emergence of moths from seed cocoons.

A. INCUBATION: The DFLs (eggs) were incubated at temperature of 25c. Relative humidity of 80-85% was maintained. At the end of incubation period a blue spot was developed on each and every fertilized egg. The eggs at this stage were kept in dark box for uniform hatching of all the eggs at a time at a next day. In the dark condition, the early maturing embryos of silkworm are prevented from maturing and hence, hatching. The DFLs were kept in dark box for 24 hours.

B. BRUSHING: Brushing refers to separation of the rearing bed. On the next day after keeping in dark the DFLs were suddenly exposed to diffused light (they hatch uniformly in response to the stimulus). The newly hatched larvae were separated from the eggshell by brushing. The egg cards along with newly hatched larvae (ant stage were

transferred to the rearing tray. Which was already disinfected and lined, by paraffin paper.0.5 cm2 with the help of chopping board and knife. The pieces of mulberry leaves were spread on the surface of egg card along with newly hatched larvae, the ants. With the help of bird feather, newly hatched larvae, the ants were separated from eggshell.

FEEDING THE LARVAL INSTARS Feeding must satisfy the appetite and nutritional requirements of the larvae. The appetite deals with amount and frequency of feeding for each larval instar. Nutritional requirements deal with the quality of mulberry leaves. The required quality and quantity of mulberry leaves were harvested for each larval instars of silkworm, *Bombyx mori* (L). Tender and succulent leaves were chopped and provided to newly hatched larvae, the ants. Soft and mature leaves were chopped and provided to the young age silkworm. (I, II and III instar larvae). The late age silkworms (IV and V instar larvae) were supplied with mature leaves. For early instars the size of the chopped leaves was increased along with increase in the age, Late instars were fed with entire leaves. The feeding frequency Daily four feedings were given at 6 a.m., 11 p.m. An additional fifth feed was given for the V instar, especially during the dry season. The mulberry leaves supplied to the silkworm larvae were on weight basis. The quantity of mulberry leaves used of rearing 400 larvae at different instars is given in table no. 3. A large quantum of feed was usually provided during night to compensate the major gap in the night feeding early in the morning. Maintenance of freshness and succulence of available mulberry leaves is the key point to be considered by any sericulturist for the purpose to utilize available system as efficiently as possible and to improve (or at least to maintaen) the quality of cocoon crop. To avoid wastage of leaves and to full-fill the appetite of larvae, different quantities of feed were used within the same instar by taking into consideration the following stages of each instar. 1) First feeding stage. 2) Sparce feeding stage, 3) Moderate feeding stage 4) Active feeding stage 5) Premoulting stage 6) Moulting stage The mulberry leaves were harvested in morning and evening.They were stored in leaf chamber.

C. BED CLEANING Sizeable quantity of unconsumed leaves in a state of unfit for feeding remain in the rearing bed after each feeding. Faecal pellets of larvae and exuvaeof themoulted larvae also appear in the rearing bed. Such position create the unhygienic condition in the rearing bed, which affect the qualitative and quantitative cocoon crop. Therefore, it is necessary to clean the rearing bed frequently. As per the schedule prescribed in the standard methods of silkworm rearing Krishnasawmi (1978), the silkworm rearing bed cleaning was followed. The bed was cleaned once at premoulting stage/at the middle of the first instar. In second instar, the bed was cleaned twice, firstly just after the first moult and secondly before the larvae prepared themselves for next moult. The third instar bed cleaning was done immediately after second moult, at the middle stage and before the larvae prepared for the third moult. Daily bed cleaning was done for fourth and fifth instar larval stage, early in the morning, before first feeding. For the purpose to clean the rearing bed, the well-known net cleaning method was followed. Were transferred to the

fresh rearing tray, disinfected and lined by paraffin paper. The mesh size for the first, second, third, fourth and fifth was 2 mm2 , 4mm2 , 10mm2 , 20 mm2 , and 20 mm 2 , respectively.

D. CARE DURING MOULTING: The silkworms (Race: PM x NB4D2) exhibit four moults. The moulting period starts feeding. Prior to moulting, the leaves of smaller size were provided, when larvae stopped feeding, lime powder was sprinkled on the bed. It helped in preventing the start of feeding activity by the larvae, which had come out of moult early. Lime powder keeps the bed dry, further it helped in achieving uniformity in larval growth. The criteria which were used to identify the larvae approaching moulting, under moult and out of moult. i) Larvae approaching moulting: - Have attained their maximum growth for a particular instar become stout and shiny - Have stopped feeding. - Have become dull in appearance and wandered about in search of resting place. ii) Larvae under the moult- Have small head with somewhat dark colour. The head was held up. - Have loosed and wrinkled skin. iii) Larvae out of moult- After moulting the new instar larvae emerge out casting their old skin, these larvae have a rusty colour and head appeared bigger.

E. MAINTENANCE OF HUMIDITY AND TEMPERATURE: The productivity and profitability of sericulture depend s upon healthy and hygienic rearing. For healthy rearing in addition to giving quality leaves. Optimum environmental conditions must be maintained within the rearing room, During the rearing attention was paid to maintain the optimum environmental conditions constant in the rearing house. Humidity and temperature affect both the growth of larvae and quality of cocoons produced. Humidity has influence over the physiological activates of silkworm, Bombyx mori (L). Constant humidity was maintained as per the requirements of the instar as indicated. Paraffin paper and wet foam rubber stripes were used to maintain humidity during rearing of young age larva l instar (I, II and III). During summer when humidity was low and temperature was high, Khus curtains were used. Smple water was sprinkled on them from time to time. To reduce humidity, especially during moulting, more spacing was provided. Lime powder was sprinkled on the bed of paraffin papers and wet foam rubber stripes were taken out of tray.

F. MAGNETIC ENERGY TREATMENT: Soon after the fourth moult, the fifth instar larvae were grouped into one control group and four experimental groups (1000, 2000, 3000 and 4000 Gauss magnetic field), each with hundred individuals. The fifth instar larvae were magnetized in bulk, by keeping them in plastic container (perforated) and suspending in between two pole of an axial electromagnet. The desired field strength was developed by adjustment of electric power supply, which is regulated by electric power regulator. Magnetic field strength was measured by a digital gausso-meter. The magnetic exposure was carried for the first four days of fifth instar larvae, daily before the first feeding. The larvae of first (I) experimental group were magnetized in 1000 Gauss magnetic field for half an hour. The larvae of second (II) experimental group were magnetized in 2000 Gauss magnetic field for half an hour. The larvae of third (III) experimental group were magnetized in 3000

Gauss magnetic field for half an hour. And the larvae of fourth (V) experimental group were magnetized in 4000 Gauss magnetic field for half an hour. After magnetization, the larvae were reared in BOD incubator maintain at optimum rearing conditions as control group study.

G. PROVISION OF MOUNTAGE (SERINET) FOR MATURE LARVAE TO SPIN THE COCOON: The larvae after attaining full growth, search suitable support for spinning the cocoon around itself and transforms into pupa inside it. This larva is called mature larva. Distinguishing features of it are as below1- Loss of appetite. 2- Having translucent yellowish colour. 3- Raise its heads. 4- Move periphery of the rearing bed. 5- Shows reduction in their length. The tray of mature larvae was provided with mountage, the plastic Serinet. Spacing among the spinning among the spinning larvae influence the quality of cocoon crop. The larvae were moderately spaced (40-50 larvae per square feet) Krishnaswami *et al* (1978). The mountages were placed slightly inclined to prevent spotting of the cocoons due to semisolid excretory material of the larvae. Ant-wells were used to prevent the attack of ants on the spinning larvae and the cocoons. 240 c temperature and 60-70% relative humidity, adequate ventilation was also provided for spinning worms.

H. HARVESTING THE COCOONS FROM TRAY WITH SERINET MOUNTAGE: Harvestation of cocoons was carried. The cocoons were deflossed for assessment. The analysis of cocoon was done for the following characters - Weight cocoon - Weight of shell - Shell ratio % - Silk Fiber length - Silk fiber weight - Denier Cocoons were preserved under the ideal conditions. Krishnaswami et al (1978) and green cocoons on fifth day ware used for studying above mentioned characters.

I. ANALYSIS OF SILK COCOONS FOR SHELL RATIO: The twenty cocoons from each group were selected randomly. Weight of individual cocoon (entire) was recorded through the use of electronic balance. With the help of fine blade, each cocoon was processed for transverse cut for the purpose to separate the silk shell from the pupa. Weight of individual pupa and silk shell was recorded through the use of electronic balance. The weight of individual cocoon (entire) and the weight of individual silk shell were accounted for the calculation of shell ratio.

$$\frac{\text{Weight of the cocoon shell}}{\text{Weight of the whole cocoon}} \times 100$$

J. STATISTICAL ANALYSIS: For the purpose to get consistency in the result, the whole attempt was repeated for three times in each year. The data on weight of individual cocoon (entire); individual pupa and weight of individual silk shell were subjected for statistical analysis. The statistical methods were employed to calculate the mean, standard deviation, percent variation and student "t" - test (Norman and Bailey, 1955).

RESULTS AND DISCUSSION:

The results on the utilization of magnetic energy for the qualitative improvement in the shell ratio of the cocoons spun by the mature larvae of silkworm, *Bombyx mori* (L) Race: Bivoltine Cross Breed (double hybrid) [(CSR6 x CSR26) x CSR2 x CSR27)] are presented table-

1. The weight (gm) individual cocoon (entire) belong to the untreated control group was 2.692 (±0.128). The weight (gm) individual cocoon (entire) spun by the fifth instar larvae treated with magnetic energy of 1000 Guass was 2.854 (±0.417) with 06.389 percent improvement in comparison with untreated control group. The weight (gm) individual cocoon (entire) spun by the fifth instar larvae treated with magnetic energy of 2000 Guass was 3.723 (±0.639) with 38.298 percent improvement in comparison with untreated control group. The weight (gm) individual cocoon (entire) spun by the fifth instar larvae treated with magnetic energy of 3000 Guass was 3.886 (±0.786) with 44.353 percent improvement in comparison with untreated control group. The weight (gm) individual cocoon (entire) spun by the fifth instar larvae treated with magnetic energy of 4000 Guass was 3.894 (±0.961) 44.650 with 44.65 percent improvement in comparison with untreated control group.

The silk shell weight (gm) of individual cocoon belong to the untreated control group was 0.523 (±0.016). The weight (gm) individual cocoon (entire) spun by the fifth instar larvae treated with magnetic energy of 1000 Guass was 0.598 (±0.074) with 14.340 percent improvement in comparison with untreated control group. The weight (gm) individual cocoon (entire) spun by the fifth instar larvae treated with magnetic energy of 2000 Guass was 0.786 (±0.108) with 43.212 percent improvement in comparison with untreated control group. The weight (gm) individual cocoon (entire) spun by the fifth instar larvae treated with magnetic energy of 3000 Guass was 0.824 (±0.119) with 57.552 percent improvement in comparison with untreated control group. The weight (gm) individual cocoon (entire) spun by the fifth instar larvae treated with magnetic energy of 4000 Guass was 0.863 (±0.016) with 65.009 percent improvement in comparison with untreated control group.

The shell ratio value gives a satisfactory indication of the amount of raw silk that can be reeled from a given quantity of fresh cocoons under transaction. The calculation assists in estimating the raw silk yield of the cocoon and in deriving an appropriate price for the cocoons. The percentage will change based on the breed of the silkworms, rearing and mounting conditions. Percentage rates are altered based on the age of the cocoons as the pupa loses weight as metamorphosis continues. In newly evolved hybrids, recorded percentages are 16 to 19 percent, where male cocoons are higher than female cocoons. The silk shell ratio (silk shell percentage in entire cocoon) of individual cocoon belong to the untreated control group was 19.427. The shell ratio (silk shell percentage in entire cocoon) belongs to the group of fifth instar larvae treated with magnetic energy of 1000 Guass was 20.953. It was found significant ($P < 0.05$) over the control. The shell ratio (silk shell percentage in entire cocoon) belongs to the group of the fifth instar larvae treated with magnetic energy of 2000 Guass was 21.112, which was also significant ($P < 0.005$) over the control group. Provision of magnetic energy of strength 3000 Guass to the fifth instar larvae was found reflected into the cocoons of 21.204 shell ratio with significant ($P < 0.01$) increase over the control group. Provision of magnetic energy of strength 4000 Guass to the fifth

instar larvae was found reflected into the cocoons of 21.162 shell ratio with significant ($P < 0.01$) increase over the control group.

The present attempt reports 1.526 – 2.735 units of improvement in the shell ratio of the silk cocoon through the provision of magnetic energy (1000 – 4000 Guass) to the fifth instar larvae of silkworm, *Bombyx mori* (L) Race: Bivoltine Cross Breed (double hybrid) [(CSR6 x CSR26) x CSR2 x CSR27)].

Magnetic energy exert influence on significant increase in the rate of synthesis of DNA in the cells of silk glands (Tripathi Santosh Kumar, *et al.*, 2005 and Santosh Kumar Tripathi, 2021). Increase in amount of DNA in silk gland cell get reflected into the increase in quantity of protein (both, total and soluble) (Madhuri Shivpuje, *et al.*, 2016). Magnetization may have had influence on the increase in the levels of amino acids followed by accelerated rate of silk synthesis in the fifth instar larvae of silkworm, *Bombyx mori* (L). Magnetic energy should be utilized as efficiently as possible for the qualitative improvement in the shell ratio of the cocoons spun by the mature Larvae of silkworm, *Bombyx mori* (L) Race: Bivoltine Cross Breed (double hybrid) [(CSR6 x CSR26) x CSR2 x CSR27)].

CONCLUSION:

It can be concluded that four days magnetization of the fifth instar larvae in 1000-4000 Gauss magnetic fields for half an hour before the first feeding is the most suitable for the significant improvement in the quality of silk cocoons. The magnetic energy is going to increase the amount of silk deposition in the cocoon, possibly through the increase in DNA contents in the silk gland tissues which may be helpful for the greater synthesis of silk protein. The magnetization of the fifth instar larvae should be in bulk, by keeping them in plastic container (perforated) and suspending in between two poles of an axial electromagnet. The desired field strength should be developed by adjustment of electric power supply, regulated by electric power regulator.

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Table-1: Influence of magnetic energy on shell ration of cocoons in silkworm, *Bombyx mori* (L) of Bivoltine Cross Breed (double hybrid) [(CSR6 x CSR26) x CSR2 x CSR27)] race.

Group Parameter	UTC (Untreated Control)	I (1000 Guass)	II (2000 Guass)	III (3000 Guass)	IV (4000 Guass)
Cocoon Weight (gm)	2.692 (±0.128) 00.000	2.854 (±0.417) 06.389	3.723 (±0.639) 38.298	3.886 (±0.786) 44.353	3.894 (±0.961) 44.650
Shell Weight (gm)	0.523 (±0.016) 00.000	0.598 (±0.074) 14.340	0.786 (±0.108) 43.212	0.824 (±0.119) 57.552	0.863 (±0.016) 65.009
Pupal Weight (gm)	2.169 0.000	2.256 04.011	2.974 50.286	3.128 44.213	3.108 43.291
Shell Ratio (Percentage)	19.427	20.953*	21.112**	21.204***	22.162***

-Each figure is the mean of the three replications. -Figure with ± sign in the bracket is standard deviation. -Figure below the standard deviation is the increase for calculated parameter and percent increase for the others over the control. *: P < 0.05; **: P < 0.005; ***: P < 0.01