

**EFFECT OF ORGANIC FERTILIZERS ON GROWTH OF  
MULBERRY (*Morus alba*) AND ECONOMIC TRAITS  
OF SILKWORM (*Bombyx mori* L.)**

BY  
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T 5537



**DISSERTATION**

*Submitted to the  
Marathwada Agricultural University  
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**DEPARTMENT OF AGRICULTURAL ENTOMOLOGY  
MARATHWADA AGRICULTURAL UNIVERSITY,  
PARBHANI 431 402 (M.S.), INDIA.**

**2008**

## **CANDIDATE'S DECLARATION**

*I hereby declare that the dissertation  
or part thereof has not been  
previously submitted by  
me for a degree of  
any University.*

Place : PARBHANI  
Date : 04 / 06 / 2008

  
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## **CERTIFICATE-I**

This is to certify that the dissertation entitled "**EFFECT OF ORGANIC FERTILIZERS ON GROWTH OF MULBERRY (*Morus alba*) AND ECONOMIC TRAITS OF SILKWORM (*Bombyx mori* L.)**" submitted by Shri **YANGAR TANAJI DNYANABA** to the Marathwada Agricultural University, Parbhani in partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE (Agriculture)** in the subject of **AGRICULTURAL ENTOMOLOGY** is record of original and bonafide research work carried out by him under my guidance and supervision. It is of sufficiently high standard to warrant its presentation for the award of the said degree.

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Date : 04/06/2008



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Research Guide

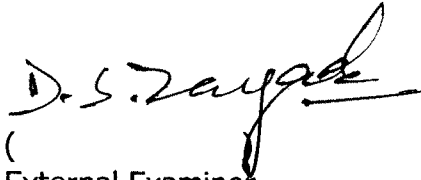
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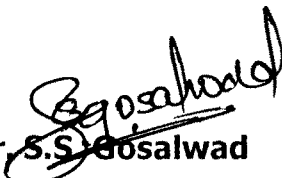
## CERTIFICATE-II

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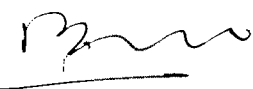
  
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## ABBREVIATIONS

@	=	at the rate of
a.i.	=	active ingredient
<i>et al.</i>	=	and other
etc.	=	etceteras
EC	=	Emulsifiable concentration
SC	=	Suspension concentration
WP	=	Wettable powder
Fig.	=	Figure
g	=	gram (s)
ha	=	hectare
kg	=	kilogram (s)
q	=	quintal
L	=	litre(s)
ml	=	millilitre(s)
%	=	per cent
viz.,	=	videlicet (namely)
N	=	North
/	=	per
>	=	greater than
Ltd.	=	Limited
SE	=	Standard error
SL	=	Soluble liquid
CD	=	Critical difference
pp	=	pages
i.e.	=	that is
lit	=	liter(s)
mg	=	milligram(s)
t	=	tone(s)



*Introduction*

## Chapter-1

### INTRODUCTION

Sericulture is an agro-based industry ideally suited to the economy of India. It is an employment generating industry giving gainful employment to rural masses. India has unique distinction in the world where all the four known commercial silkworms namely mulberry silkworm (*Bombyx mori* L.), tropical and temperate tasar silkworm (*Antherapea mylitta* D.), eri silkworm (*Samia Cynthia ricini* Boisduval) and muga silkworm (*Antheraea assamensis* Westwood) are reared.

The main silk producing 29 countries in the world situated in silk belt between 29° and 42° latitude North. Total silk production in the world was 125605 metric tones during 2004. India ranks second next to china. In India, Karnataka, Jammu and Kashmir, Andhra Pradesh, Tamil Nadu and West Bengal are the five traditional states practicing sericulture. It is also spreading in 22 non-traditional states including Maharashtra. Total area under mulberry plantation in Maharashtra State is 2647 hectares during 2006-07, with silk production of 80 metric tones which has generated employment upto 60 thousand people in the State. A separate Directorate of Sericulture at Nagpur has now been established in September 1997 to boost sericulture in Maharashtra.

It has been proved that mulberry siikworm rearing is feasible and economically viable in Marathwada region due to availability of irrigation water in the command area of Jayakwadi. Sidheshwar, Yeldari and Manjara projects and it has further bright prospects of Sericulture in Marathwada. Area under mulberry cultivation in Marathwada is 3265 acres

and 2306 farmers are practicing sericulture and earning gainful employment. Cocoon production mainly depends upon mulberry garden management, which is a vital part of successful silkworm rearing.

The various factors responsible for successful cocoon harvest are mulberry leaf (38.2 %), climate (37 %), rearing technique (9.3 %) and other factors (6.6 %) (Miyashila, 1986). Mulberry leaf quality plays a predominant role in healthy growth of silkworm. Nutrition of silk worm is of primary importance in cocoon production which directly influenced the nutritive status of mulberry leaves. The cost of leaf production accounts for nearly 60 per cent of total cost of cocoon production.

Among the factors known to contribute yield of crops, supply of optimum quantities of essential nutrients to the plants is the most important. The quality of mulberry was influenced by nutrients supplied, agronomic practices like spacing variety, type of pruning etc. (Yokoyama, 1962).

Recently introduced mulberry varieties gave good response to fertilizer application. Moreover, application of fertilizer plays an important role in quality leaf production which directly affect silkworm growth and quality cocoon produced.

Organic manures are bulky in nature and contain all the essential nutrients that are required for plant growth and development. Therefore, fertilizer management plays an important role in improving the yield and quality of mulberry.

Thus a investigation entitled “Effect of organic manures on economic traits of mulberry silkworm” was undertaken at the Sericulture

Research Unit, Marathwada Agricultural University, Parbhani with following objectives.

1. To study the effect of organic manures on mulberry leaf yield.
2. To study effect of biofertilizers and chemical fertilizers for mulberry leaf production
3. To study the effect of organic fertilizers on growth of mulberry and economic traits of silkworm
4. To study the physiological parameters of mulberry.



*Review of  
Literature*



## **Chapter-2**

### **REVIEW OF LITERATURE**

Literature pertaining to the effect of organic manures for mulberry and ultimately on silkworm cocoon production and silk quality are presented in this chapter under following heads.

1. Effect of organic manures on mulberry leaf yield.
2. Effect of biofertilizers and chemical fertilizers for mulberry leaf production
3. Effect of organic fertilizers on growth of mulberry and economic traits of silkworm
4. Physiological parameters of mulberry

#### **2.1 Effect of organic fertilizers on the mulberry leaf yield**

Sen (1949) reported that 80 per cent requirement of the crop could be provided in the form of organic manure of which 47 per cent through composition.

Lipke and Frankel (1956) and Dadd (1963) stressed the importance of soil fertility and nutrition of host plant in governing the nutrition of insects. Organic manuring played a dominant role in the production of mulberry.

Pain (1961) observed that application of FYM compost @ 30 t/ha increased the foliage yield by 75 per cent with effect on crude protein,

crude fat, sugar, starch, pH and K, besides, increased silk content and cocoon filament length.

Purohit *et al.* (1990) suggested that leguminous green manure crops, observed better than non-leguminous ones because of the N fixating ability in leguminous crops. In mulberry, green manuring with Dhencha alone increased the leaf yield by 18.7 per cent and that with sunhemp 8.7 per cent. Further, they reported that repeated applications of green manure improved the fertility of soil and brought about sustained increase in leaf production.

Singh (1998) reported that the application of green manuring, dry weed and in addition black polythene mulching had resulted in to an increased leaf yield and quality of leaf in mulberry. It has been observed that green manuring crops like horse gram (*Dolichus biflorus*), cow pea (*Vigna sinensis*) and mouth bean (*Phaseolus acontiflouius*) in rainfed mulberry has significantly increased leaf yield per hectare by 2036, 1857 and 1777 kg respectively, over control which yielded 1621 kg leaf per hectare.

Reddy *et al.* (1995) observed in a field trial conducted by CSR&TI, Mysore the influence of *Azotobacter* on several non-leguminous crops and experienced 5-15 per cent increase in yield and a nitrogen content in the soil of about 25 kg/ha. Apart from nitrogen fixing ability, the micro-organism produced growth promoting substances which favoured better

growth of plants. Performance of biofertilizers was highly unpredictable and the yield increase ranged from 10 to 65 per cent.

Anilkumar and John (2000) recorded in an experiment conducted at College of Horticulture, Vellanikkara for two years with five treatments viz., *Azospirillum*, VAM, PSB, combined application of *Azospirillum*, VAM and PSB and no biofertilizer to find out an ideal microbial inoculant for boosting the productivity of mulberry. The results indicated that combined application of *Azospirillum*, VAM and PSB had significant effect on total leaf production, total leaf dry matter production, total stem dry matter production and total root dry matter production.

Murarkar *et al.* (1998) studied when an experiment was conducted on mulberry crop (*Morus* sp.) to investigate the effect of vermicompost in comparison with farm yard manure and fertilizers on the mulberry leaf yield during October 1993 and February 1994 at Akola, India. The treatment with full dose NPK fertilizers (300:120:120 kg, NPK/ha) plus vermicompost of 6000 kg/ha and half dose of farm yard manure of 10 cart loads/ha was significantly better than untreated control for increasing the number of branches, height of the plant, number of laves per plant and leaf yield per plant.

Reddy *et al.* (2003) evaluated in their study at Anantpur, Ar.dhra Pradesh, India the effectiveness of farm yard manure (FYM) and vermicompost for different quantitative and qualitative characters in mulberry. Three species of earthworms (*Udrilus eugeniae*, *Eisenia fetida*

and *Perionyx excavatus*) were released into the pits and 5 mulberry varieties (V1, V13, S 30, S 36 and K2) were tested. The treatments used in the study were (T<sub>1</sub>) FYM (applied in two split doses) at 20 MT/ha per year + chemical fertilizer (300:120:120, NPK in split doses) and T<sub>2</sub> vermicompost (applied in two splits doses) at 10 MT/ha per year + chemical fertilizer (300:120:120, NPK in 5 split doses). The percentage improvement in leaf yield, plant height and leaf area were considerably high when compared to qualitative characters. Leaf yield improvement was found to be maximum in V1 (15.73) and minimum in K2 (10.90). Significant improvement in the leaf yield in all varieties was observed in vermicompost plots over the FYM plots. V1 and V13 showed high response to FYM and Vermicompost which clearly indicated the varietal efficiency to organic manures. A slight increase in quantitative characters of mulberry was observed in vermicompost treated plots.

Bose *et al.* (1992) studied the effect of soil amendments on chemical properties of an alkali soil and on mulberry leaf yield in a mulberry farm in Mysore, India. Farm yard manure (FYM) pressmud, both at 20 and 40 t/ha, gypsum at 4 and 8 t/ha and sulphur at 2 and 4 t/ha were compared over 2 years period. The red loamy soil had surface pH 8.8, EC 0.161 dS/m and ESP 19.8. Amendments reduced soil pH and ESP considerably in all treatments whereas EC increased. The pH was lowered by 0.5-2.7 units and ESP by 2.78-9.3 at the surface, while EC increased by 0.2-0.74 dS/m. The effects of the amendments were most prominent in

surface soils and decreased with depth and were most effective in the following order: sulphur > gypsum > pressmud > FYM. Mulberry leaf yield also increased in all these treatments by 59, 42, 38 and 32 per cent with sulphur (4 t/ha), gypsum (8 t/ha), sulphur (2 t/ha) and gypsum (4 t/ha), respectively. The reasons for improved yield and soil properties were considered.

Rajanna *et al.* (2000) studied in a field experiment at Bangalore, Karnataka, India, the influence of sericulture bi-products and other organic manures like pupal powder, silkworm excreta, sheep manure (SM), swine waste, pongamia cake and farm yard manure (FYM) on leaf yield and elemental composition of mulberry (*Morus alba*) (M5 variety) under rainfed conditions during 1997-98. Results clearly indicated that application of FYM + NPK (4508 kg/ha/crop) recorded significantly higher leaf yield, N, P, K, Ca, Mg and S followed by SM + R.NPK (4485 kg/ha/crop). There was no significant difference in the quantity of chemical components of the leaves raised completely either on sericulture by products or other organic manures. The results were also discussed in relation to the suitability of sericulture byproducts in improving the mulberry leaf quality.

## **2.2 Effect of biofertilizers and chemical fertilizers for mulberry leaf production**

Sinha *et al.* (2000) studied at beneficiaries level, the effect of *Azotobacter* on mulberry under rainfed conditions and reported that in the

biofertilizer (*Azotobacter*) treated plots, mulberry leaf yield was found to be at par with the control plots where full dose of nitrogenous fertilizer was applied. Thus, 50% reduction in nitrogenous fertilizer in the treated plots did not affect the productivity of mulberry leaves, rather use of biofertilizer reduced the cost of nitrogenous fertilizer.

*Azotobacter* biofertilizer @ 20 kg/ha in 5 equal splits doses (4 kg/crop mixed with 200 kg of powdered FYM) has been found to curtail 50% of the chemical nitrogen input without any adverse effect on leaf yield and quality (Anonymous, 2001).

Besides, the laboratory studies showed that leaf yield (46.9 MT leaf/ha/year) was on par with that of control (46.8 MT/ha/year) even after 50% reduction in the application of nitrogen but supplemented by biofertilizer. One year field trial with 6 farmers also revealed similar results leading to 50% saving in nitrogenous fertilizer without any reduction in leaf yield and quality. Adoption of the technology ensured saving of 333 kg urea or 750 kg of ammonium sulphate/ha/year (Anon., 2001).

Dandin *et al.* (2006) suggested composting and vermicomposting to enrich the soil and also to reduce the use of chemicals.

Tomy Philip (2000) at Central Sricultural Research and Training Institute (CSRTI), Mysore has recommended the application of bacterial biofertilizer (*Azotobacter*) as an alternate source of nitrogen. Its application in the soil along with spraying of triacontanol, a plant growth

promoter on the foliage, observed to increase the leaf yield substantially, besides saving 50 per cent of cost on urea.

Masilamani *et al.* (2007) revealed in on farm trial at RSPS during 2003-04 with Dhaincha (*Sesbania aculata*) as an intercrop with mulberry and reported that green manuring namely increased mulberry leaf yield (cost: benefit ratio to 1:5) and amending the alkaline soils could further enhance the cost: benefit ratio to 1:8.

Das *et al.* (1993) conducted on 6 farmers field at Mysore and Chamarajanagar under irrigated conditions and the treatment combination of *Azotobacter* biofertilizer application with 150 kg N/ha/year was tried against the recommended practice (300 kg N/ha/year). Application of 20 MT FYM, 120 kg P<sub>2</sub>O<sub>5</sub> and 120 kg K<sub>2</sub>O/ha/year was common for both the treatments. Observations were recorded on leaf nitrogen (crude protein) content. Pooled data of one year revealed that the average leaf yield obtained from six farmers in the treated plots was 39743 kg/ha/year and it was on par with that of control receiving full dose of nitrogen with leaf yield 40019 kg leaf/ha/year. Similarly, leaf nitrogen and crude protein values did not vary with the application of *Azotobacter* biofertilizer and reduced 50 per cent of the input supply of chemical nitrogenous fertilizers.

### **2.3 Effect of organic fertilizers on growth of mulberry and economic traits of silkworm**

Ito and Nimura (1966) observed better growth of mulberry in plots treated with localized placement of farm yard manures on sandy soil. Application of compost increased the larval survival, cocoon quality and silk yield.

Sengupta *et al.* (1972) revealed that mulberry leaves enriched with glucose and molasses had significant beneficial effect on growth and cocoon production.

The main factors contributing for successful harvest of cocoon crops identified as mulberry leaf (38.2 per cent), climate (37 per cent), rearing techniques (9.3 per cent), silkworm race (4.2 per cent), silkworm egg (3.1 per cent) and others (6.6 per cent) (Miyashila, 1986). Thus the physical and chemical properties of leaves had significant impact on the nutritive value of silkworm.

Matsumura (1954) reported that fifth instar larvae demanded less water in leaves than younger ones, owing to sufficiently grown silk glands which secreted silk substances for spinning cocoons. They needed to take leaves containing protein to a large extent.

Jadhav *et al.* (2000) studied the effect of organic manures, vermicompost (VC), farm yard manure (FYM), inorganic fertilizers and their combinations on mulberry cv. M 5, silkworm growth and cocoon yield, in Karnataka, India during 1993-94. Treatments comprised :

recommended dose of FYM (RD FYM; 20 t/ha) + D NPK fertilizer, T<sub>1</sub> : RD FYM + 75% RD NPK + 25% VC; T<sub>2</sub>; RD FYM + 50% RD NPK + 50% VC, T<sub>3</sub>; RD FYM + 25% RD NPK + 75% VC, T<sub>4</sub>; D FYM + 100% VC, T<sub>5</sub>; only VC, T<sub>6</sub>; and control, T<sub>7</sub>. Among the four silkworm crops studied, the matured larval weight and silk gland weight was maximum in T<sub>1</sub>, which was significantly superior over all treatments except T<sub>2</sub> and T<sub>3</sub>. Cocoon weight significantly high in T<sub>1</sub> compared to all treatments except T<sub>2</sub> and T<sub>3</sub> in all crops. Significantly higher silk ratios were observed upon treatment with T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>. The low shell ratio obtained from the treatments with VC suggested that less crude protein content in leaves resulted in decreased cocoon and shell weights. The recommended dose of fertilizer and its combination with VC was significantly superior to all the treatments in all crops. It is concluded that the treatment T<sub>3</sub>, saved fertilizer and it was most suitable for obtaining quality leaves and high cocoon yield.

#### **2.4 The physiological parameters of mulberry**

In Japan, favourable and healthy growth of silkworms were attained by feeding leaves which did not contain much water and nitrogenous matter, but was rich in carbohydrates. Further, it was reported that nitrogen application for mulberry plantation meant for young worms (Chawki) should be more from organic manures such as compost, farm yard manures than from chemical fertilizers. The phosphorus and potassium application were needed to get mulberry leaves rich in carbohydrates. Whereas for late age silkworms, plantation were to be

supplied with to produce large quantity of leaves rich in protein content (Anonymous, 1980).

The chemical composition of mulberry leaf depends on mulberry variety and environmental conditions viz., growing season, temperature, length of sunshine hours, nature and type of soil profile, type of fertilizers applied, water table and method of leaf harvesting, etc. Generally mulberry leaves produced with only chemical fertilizers are not of good quality. The effect of fertilizer depend very largely on the amount of nutrients supplied (Shyamala, 1953 and Ushioda, 1954). Good responses to the applied nutrients have been reported by Pain (1965) and Kasivishwanathan and Sitarama Iyengar (1965).

Yokoyama (1962) reported that higher dose of nitrogenous fertilizer was effective in increasing the foliage yield but from the point of silkworm rearing, leaves obtained with higher nitrogen were inferior in quality chawki worms. On the contrary, Krishnaswami *et al.* (1971) reported that the leaves obtained from the nitrogenous fertilizer treated plot resulted in better cocoon characters. Application of nitrogen increased crude protein content of leaves from 16.6 to 21.5 per cent and factors like moisture, starch, crude fiber and mineral content in leaf remained unaffected by nitrogen level (Pain, 1965).

Jolly (1986) revealed that under irrigated condition application of 20 tonnes of FYM per ha per year was better for harvesting good quality leaves required for chawki worms.

Kherdekar (1996) observed that the treatment with vermicompost recorded significantly more leaf area (150.25 cm<sup>2</sup>), followed by the treatment with MAUs organic booster (147.00 cm<sup>2</sup>) and cowdung urine slurry treatment (144.00 cm<sup>2</sup>) to mulberry.

Patil *et al.* (2002) observed the effect of integrated nutrient management on the growth and yield of mulberry (Cv. V 1) under rainfed condition in Dharwad region, Karnataka, India, during 2000-01. The growth and yield parameters were recorded and leaf yield per hectare per year was calculated. The application of 300;150:200 kg NPK/ha per year recorded significantly higher plant height (181.41 cm), maximum number of laves per plant, higher leaf yield (14.38 t/ha) and maximum leaf moisture content compared to application of 150:75:100 kg NPK/ha per year than control. The application of compost at 5 t/ha recorded significantly higher plant height (181.23 cm) and maximum leaf yield (14.84 t/ha) when compared to control and application of 2 t/ha vermicompost. The maximum leaf yield was recorded with the application of vermicompost at 5 t/ha + 200;100:150 kg NPK/ha followed by the application of same quantity of vermicompost with 300:150:200 kg NPK/ha per year.

Kherdekar *et al.* (2000) applied eight fertilizer treatments including different combinations of chemical and organic amendments. They recorded that foliage yield ranged from 15.09 t/ha in control to 22.39 t with 5 t vermicompost + 80:60:60 kg NPK/ha. Chemical fertilizers alone (300:120:120 kg NPK/ha) gave a foliage yield of 19.63 t. Vermicompost +

NPK enhanced silkworm larval weight by 15.23 %, single cocoon and shell weight by 22.64 and 21.78 %, respectively, cocoon yield by 28.79 % and filament length by 32.06 %, and reduced mortality by 14.10 %. Silkworm and foliage characteristics were also high with one litre organic booster per plant plus basal NPK or one litre cattle urine slurry/plant plus basal NPK. Farm yard manure and wheat straw were generally the least effective fertilizers.



*Material and  
Methods*



## **Chapter-3**

### **MATERIAL AND METHODS**

The present investigation was undertaken to study the effect of different organic manures on yield and quality of mulberry leaf, disease incidence and economic traits of MYs x CSR<sub>2</sub> a promising silkworm hybrid.

The experiment was conducted at Sericulture Research Unit, Marathwada Agricultural University, Parbhani during 2007-08. The material used and the methods followed in present investigation were given in this chapter.

#### **3.1 Location**

The experiment was superimposed in mulberry garden of Sericulture Research Unit, Marathwada Agricultural University, Parbhani, on existing paired row mulberry plantation at (5 + 3 x 2 ft) spacing.

The Parbhani is situated on 19<sup>o</sup> 16' North latitude and 76<sup>o</sup> 47' East longitude with an altitude of 408.5 m.

#### **3.2 Cropping history**

The mulberry plantation at experimental site was done one year before in paired row system. This mulberry garden was cultivated and managed with recommended fertilizer package. Fertilizer applied has considerable effect on mulberry leaf yield. In the present study different treatments of fertilizer application were employed to record the growth of

silkworm and economic characters than the normal application of chemical fertilizer application.

### **3.3 Climatic conditions**

Mean rainfall of Parbhani district was 800 to 900 mm. Mean daily maximum temperature varied from 29°C in December to 45°C in May. The minimum temperature varied from 11.32°C in winter and 25.77°C in summer. Mean relative humidity ranged from 30 to 90 %. The climate was subtropical hot and dry type. It has been presented in Appendix-I.

### **3.4 Land preparation**

The land selected was vertisol type as per classification by Malewar (1976). This land was rich in iron, lime and magnesium (Gajabe *et al.*, 1976).

### **3.5 Soil testing**

Sample were taken by using an auger for a plough depth at several spots and then composited. The soils from four spots of each treatment were collected. It was mixed thoroughly spread on a clean sheet of paper and divided into four equal. Two opposited quarters were rejected and samples from remaining two quarters were mixed. The procedure was repeated till ½ kg of the sample was left and then it was collected in a plastic bag. The soil samples were analysed for available N, P, K content by using analytical method. Soil testing was done in the Department of Agricultural Chemistry, MAU, Parbhani.

Before the organic fertilizer applied into soil the chemical composition of experimental soil was determined and presented in Table 1.

**Table 1. Chemical composition of the soil from experimental plot before application of organic fertilizers and at harvest of mulberry**

Parameters	Before application of organic fertilizer	At harvest of mulberry
pH	7.60	7.18
EC	0.78 dSm <sup>-1</sup>	0.70 dSm <sup>-1</sup>
Organic carbon	0.53%	0.68 %
CaCO <sub>3</sub>	3 %	4.4 %
Available nitrogen	170.88 kg/ha	194.43 kg/ha
Available phosphorus	13.26 kg/ha	13.93 kg/ha
Available potassium	385.28 kg/ha	384.16 kg/ha

After harvesting the mulberry shoots the soil samples were collected and analysed in the Department of Soil Science and Agricultural Chemistry, MAU, Parbhani. Chemical composition of soil after application of treatments is presented in Table 1.

### **3.6 Material**

The disease free eggs of promising silkworm (MYs x CSR<sub>2</sub>) hybrid were supplied by the Department of Sericulture, Government of Maharashtra, Parbhani. The larvae hatched from dfls were used for taking observations.

Following equipments were used for rearing the silkworm.

1. Rearing tray (3x2x ¼ ft)
2. Rearing stand

1. **Rearing tray (3x2x ¼ ft)**
  2. **Rearing stand**
  3. **Chopping board**
  4. **Chopping knife**
  5. **Bamboo sticks**
  6. **Bird Feathers / Painting brush**
  7. **Cleaning nets**
  8. **Mountages (Netrica)**
  9. **Paraffin paper**
  10. **Hygrometer**
  11. **Thermometer**
  12. **Bed disinfectant (Vijetha)**
  13. **Muslin cloth**
- 3.7 **Crop variety**

The mulberry variety VI which was erect and fast growing with large, unlobed dark green leaves was used for experimentation.

### 3.8 **Experimental method**

The experiment consisted of soil application of different sources of organic manures viz., vermicompost (VC), farm yard manure (FYM), green manure (Dhencha), PSB, *Azotobacter*, glyricidia and foliar spray of different sources of organic manures viz., vermiwash, cattle urine, sea weed, phosphorus solubilizing bacterial culture (PSB) and humic acid) at 15 days interval.

The Nitrogen, phosphorus and potassium contents of all 5 organic manures selected are presented in Table 3.

To study the effect of different sources of organic manures on leaf, yield and quality of leaf, disease per cent and economic traits of silkworm (*Bombyx mori*). Experiment was laid out in randomized block design (RBD) with four replication. For organic manure treatments quantity of organic manure was calculated and applied.

**Table 2. N, P, K content of different sources of organic manure used in the experiment**

Fertilizer	N (%)	P (%)	K (%)
FYM	0.5	0.2	0.5
Vermicompost	3	1	1.5
Dhaincha	3.5	0.60	1.20
Glyricidia	2.76	0.28	4.60
Cattle urine	1	--	1.35

### 3.8.1 Experimental design

The experiment was laid out in Randomized Block Design (RBD) with four replications and six treatments. The plan of layout of treatments are given in Fig. 1.

#### Treatments

- T<sub>1</sub> Vermicompost @ 10 t/ha + vermiwash spray at 15 days interval
- T<sub>2</sub> FYM @ 25 t/ha + cattle urine (1:10) spray at 15 days interval
- T<sub>3</sub> Green manuring of Dhiancha + sea weed spray at 15 days interval.

- T<sub>4</sub> PSB 25 kg /ha in two equal split doses + *Azotobacter* @ 20 kg/ha at 15 days interval
- T<sub>5</sub> Glyricidia @ 5 t/ha within 15 days of pruning of mulberry + humix (humic acid) at 15 days interval
- T<sub>6</sub> Control with 50% RDF

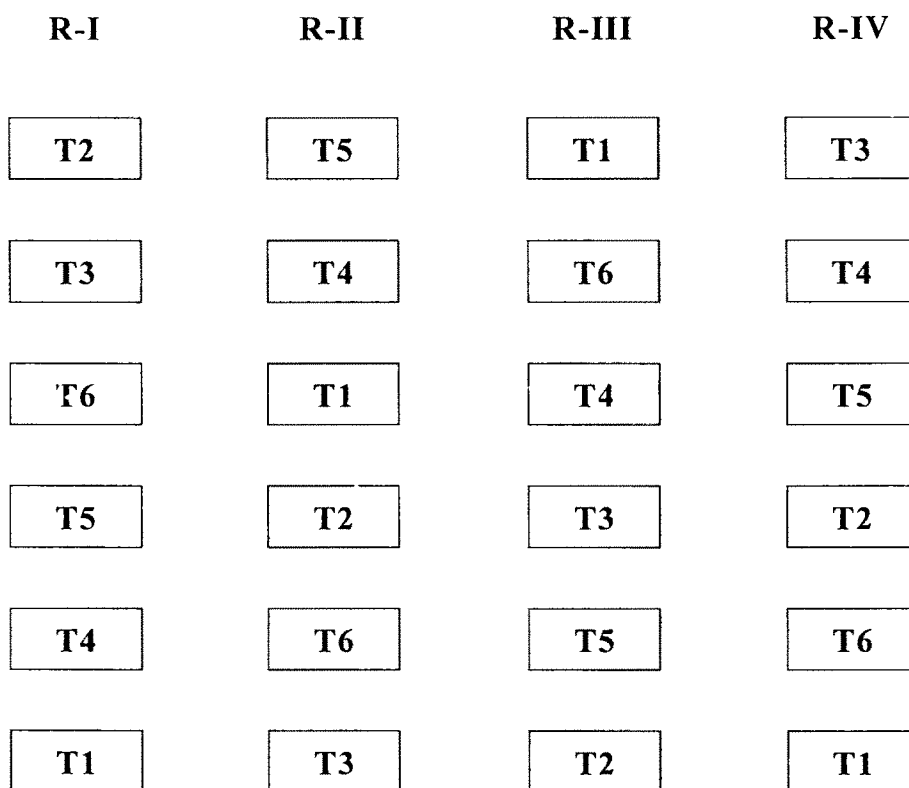
The experimental mulberry garden was planted in 2006 and pruned in June 2007. The organic manures as per treatments were applied to each plot in the first week of August. Quantity of organic manures computed were applied by burying into the soil. Dhencha was sown and buried in the soil. Glyricidia was buried in the soil, 15 days before pruning. The experimental view is shown in Plate 1.

### **3.9 Observations**

The following growth and yield parameters of were recorded at 60 days interval in all the treatments during the course of investigation.

#### **3.9.1 Leaf yield per hectare(kg)**

Four plants were labeled separately for rearing silkworm and for recording the leaf yield. Leaves were harvested at sixty days interval and weighed which is later converted into leaf yield (kg/ha).



Design	:	RBD
Replications	:	Four
Treatments	:	Six
Variety of mulberry	:	V-1
Date of planting	:	28.7.2006
Date of pruning	:	21.6.2007
Spacing	:	5 + 3 x 2 ft
Distance between two replications	:	6 ft
Distance between two treatments	:	6 ft
Per plot size	:	Gross : 392 sq.ft. Net : 308 sq.ft.
Silkworm race	:	MYs X CSR <sub>2</sub>

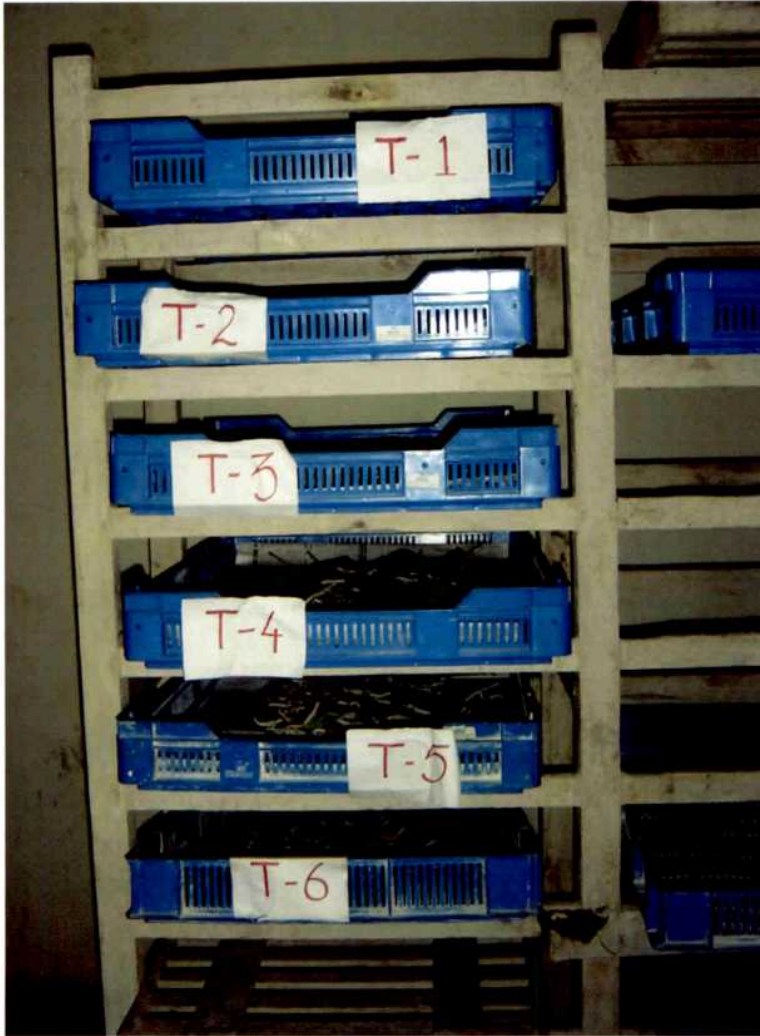
**Fig. 1. Plan of layout**



**Plate 1. Experimental plot of mulberry plantation**



**Plate 2. Larval growth due to vermicompost application to mulberry**



**Plate 3. Silkworm rearing by using mulberry leaf grown from different organic manures**

### **3.9.2 Shoot height (cm)**

The shoot height was measured from the base of plant to the top petiol from fully opened leaves of all the shoots of four randomly selected plants. Mean shoot height was calculated from the total height of all the shoots observed

### **3.9.3 Leaf yield per plant (g)**

Four labeled plants exclusively maintained for estimation of yield were harvested and leaves weight was recorded. The mean yield per plant was worked out.

### **3.9.4 Leaf area**

The observations were recorded by measuring length and width of leaf. The leaf area was computed by using the following formula.

The data thus collected were statistically analysed.

### **3.10 Silkworm rearing**

Disease free laying of silkworm. hybrid was procured from the State Department of Sericulture and were reared as suggested by Krishnaswami (1971).

Hundred worms were selected per tray from treatment and reared in separate trays. Then they were fed with leaves from the respective treatment plots. During rearing care was taken to follow the recommended practice.

### **3.10.1 Larval weight (g)**

Weight of 10 randomly selected larvae in 5<sup>th</sup> stage on 5<sup>th</sup> day before spinning was recorded from respective replications treatments and separately.

### **3.10.2 Disease occurrence during rearing (%)**

During the larval duration i.e. from the day of brushing (the hatched worms) to the day of spinning of cocoons (the ripening stage), the occurrence of disease was recorded and expressed in percentage.

## **3.11 Cocoon characteristics**

### **3.11.1 Mean single cocoon weight (g)**

After complete spinning and allowing 5 days interval, 10 cocoons were randomly selected from each plot, replication wise and mean cocoon weight recorded.

### **3.11.2 Single shell weight (g)**

After removing pupae and exuviae (last larval skin), the remaining shell was weighted and mean shell weight was recorded.

### **3.11.3 Shell percentage**

It was worked out using following formula.

$$\text{Shell percentage} = \frac{\text{Mean shell weight (g)}}{\text{Mean cocoon weight (g)}} \times 100$$

#### 3.11.4 Filament length

Ten cocoons were randomly selected in each treatment replication wise to measure, the filament length. The randomly selected cocoons were boiled in water. Each cocoon was reeled and the length of filament was measured out with the help of epprouvate. Filament length was determined by using the formula.

$$L = R \times 1.125$$

Where,

L = Total filament length (M)

R = No. of revolution recorded

1.125 = Circumference

Other observations recorded were disease percentage, cocoon yield per 10000 larvae brushed in kg, effective rate of rearing (by number), filament weight and Denier.

The Denier was computed by using the following formula. This term is used to denote the thickness of the silk filament and expressed in terms of ratio of weight of filament to filament length multiplied by 9000.

The data thus collected were statistically analyzed.



# *Results*



## Chapter-4

### RESULTS

The results obtained on physiological parameters such as shoot length, leaf area, leaf yield of mulberry variety influenced by organic manuring and cocoon production are illustrated hereunder different heads.

#### 4.1 Physiological parameters of mulberry

The data on physiological parameters of mulberry like shoot length, leaf area, leaf yield per plant and leaf yield per hectare are presented in Table 3.

##### 4.1.1 Shoot length

The data presented in Table 3 and Fig. \_\_\_ revealed that the shoot length of mulberry varied in the range from 204.00 to 255.75 cm. All the treatments were significantly superior over control. The treatment with vermicompost + vermiwash (255.75 cm) was significantly superior over the other treatments. The treatments, FYM + cattle urine (249.00 cm), PSB + *Azotobacter* (246.00) and Glyricidia + humic (244.00 cm) were on par with each other. Lowest shoot length of mulberry was recorded in control (204.00 cm).

##### 4.1.2 Leaf area

The data presented in Table 3, revealed that the mean leaf area of mulberry varied from 176.50 to 259.50 cm<sup>2</sup>. All the treatments were significantly superior over control. Maximum leaf area (259.5cm<sup>2</sup>) was recorded with vermicompost + vermiwash treatment and it was however significantly superior over PSB + *Azotobacter* (246.75 cm<sup>2</sup>),

**Table 3. Shoot length (cm), leaf area (cm<sup>2</sup>), leaf yield per plant (g) and leaf yield per ha (kg) of mulberry**

Tr. No.	Treatment	Shoot length (cm)	Leaf area (cm <sup>2</sup> )	Leaf yield per plant (g)	Leaf yield per ha (kg)
T <sub>1</sub>	Vermicompost + vermiwash	255.75	259.50	653.75	54476
T <sub>2</sub>	FYM + cattle urine	249.50	220.75	631.25	52601
T <sub>3</sub>	Dhaincha + seaweed	224.25	195.50	577.50	48122
T <sub>4</sub>	PSB + <i>Azotobacter</i>	246.00	246.75	616.25	51351
T <sub>5</sub>	Glyricidia + humic acid	244.00	241.00	610.00	50830
T <sub>6</sub>	Control with 50% RDF	204.00	176.50	410.0	33956
	SE ±	1.6948	3.414	2.4260	187.29
	CD at 5%	5.0995	10.274	7.2997	563.56

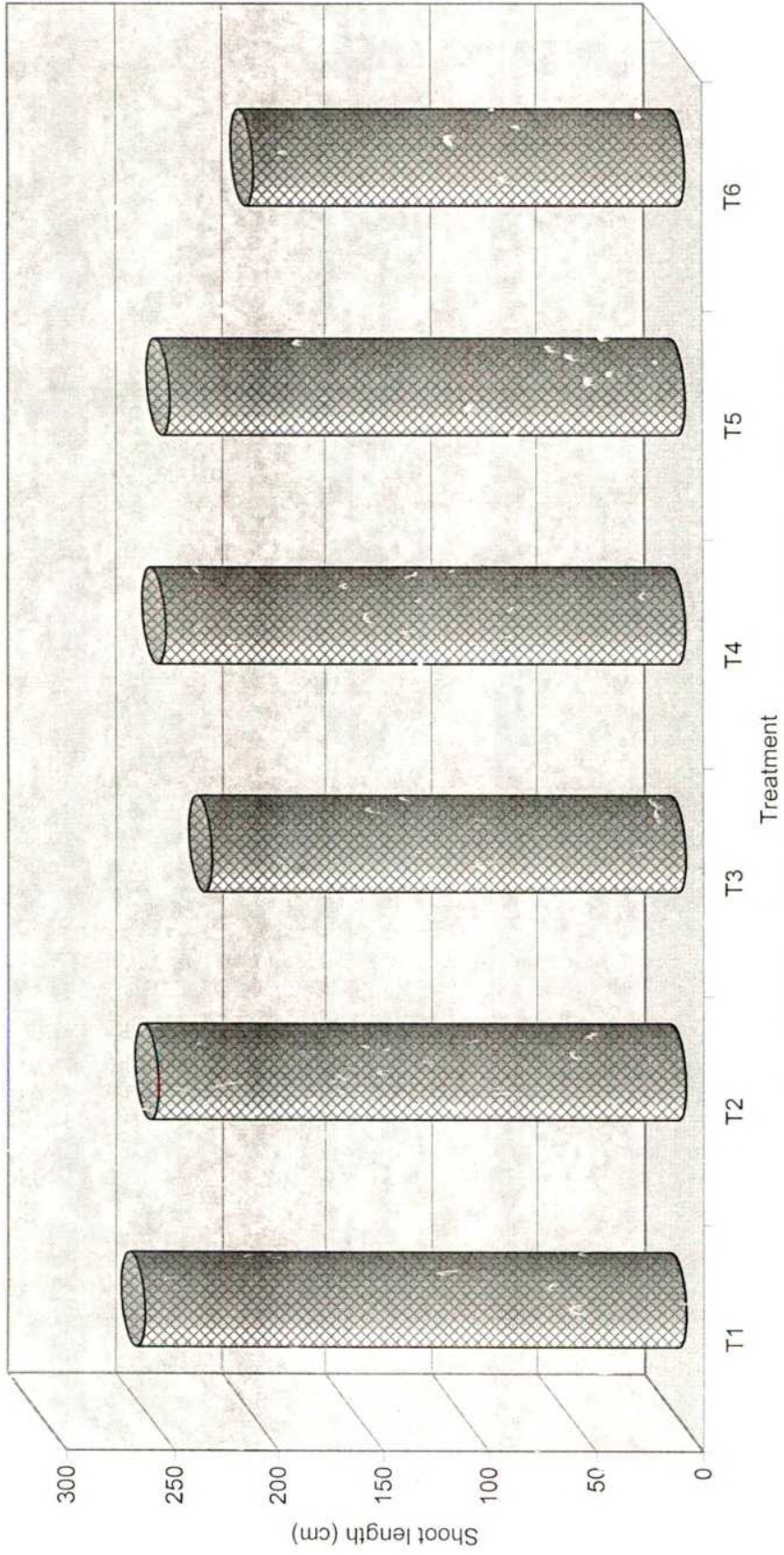


Fig. 2 Effect of organic fertilizers on shoot length (cm) of mulberry

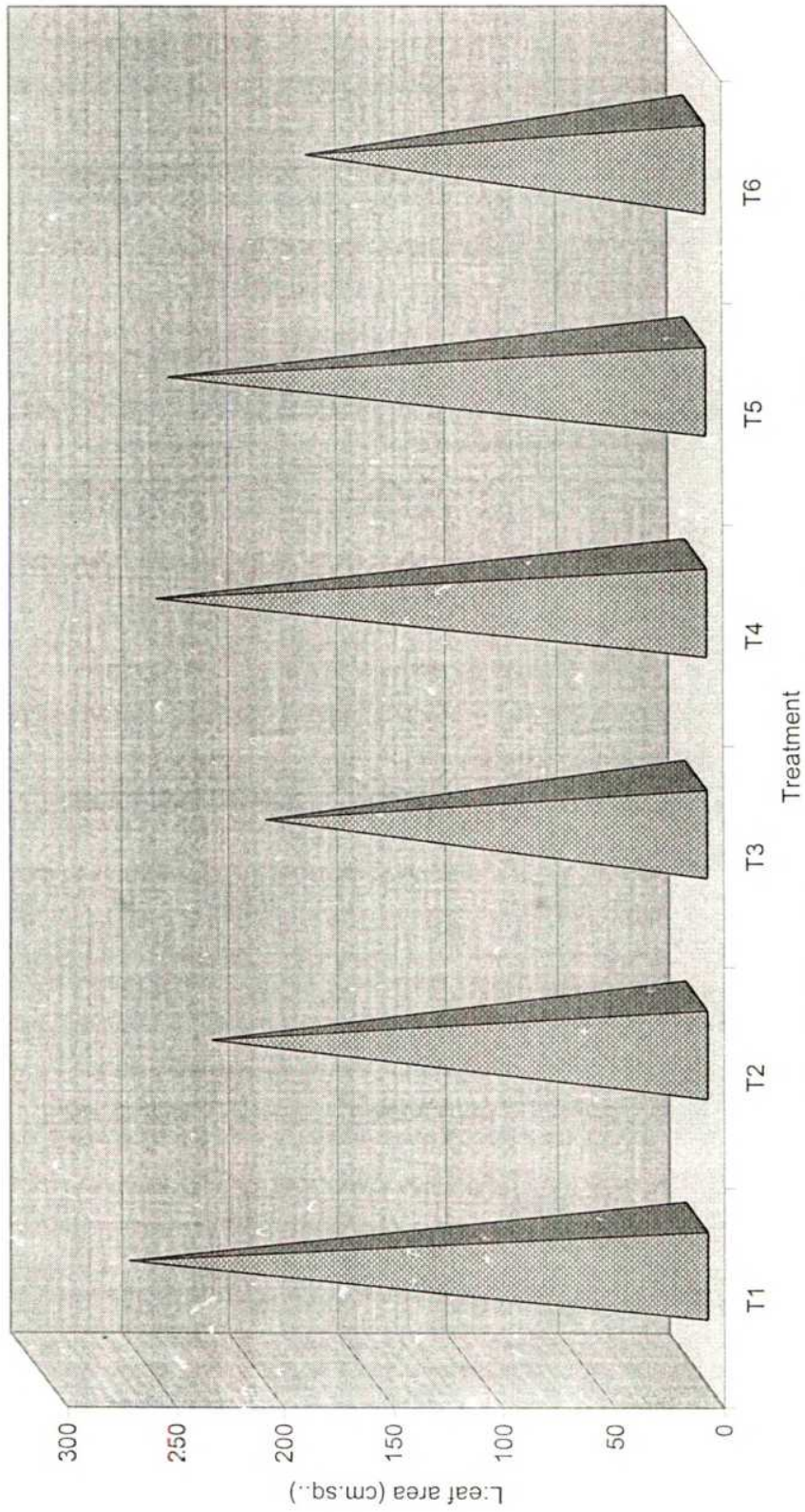


Fig. 3 Effect of organic fertilizers on leaf area (sq.cm.) of mulberry

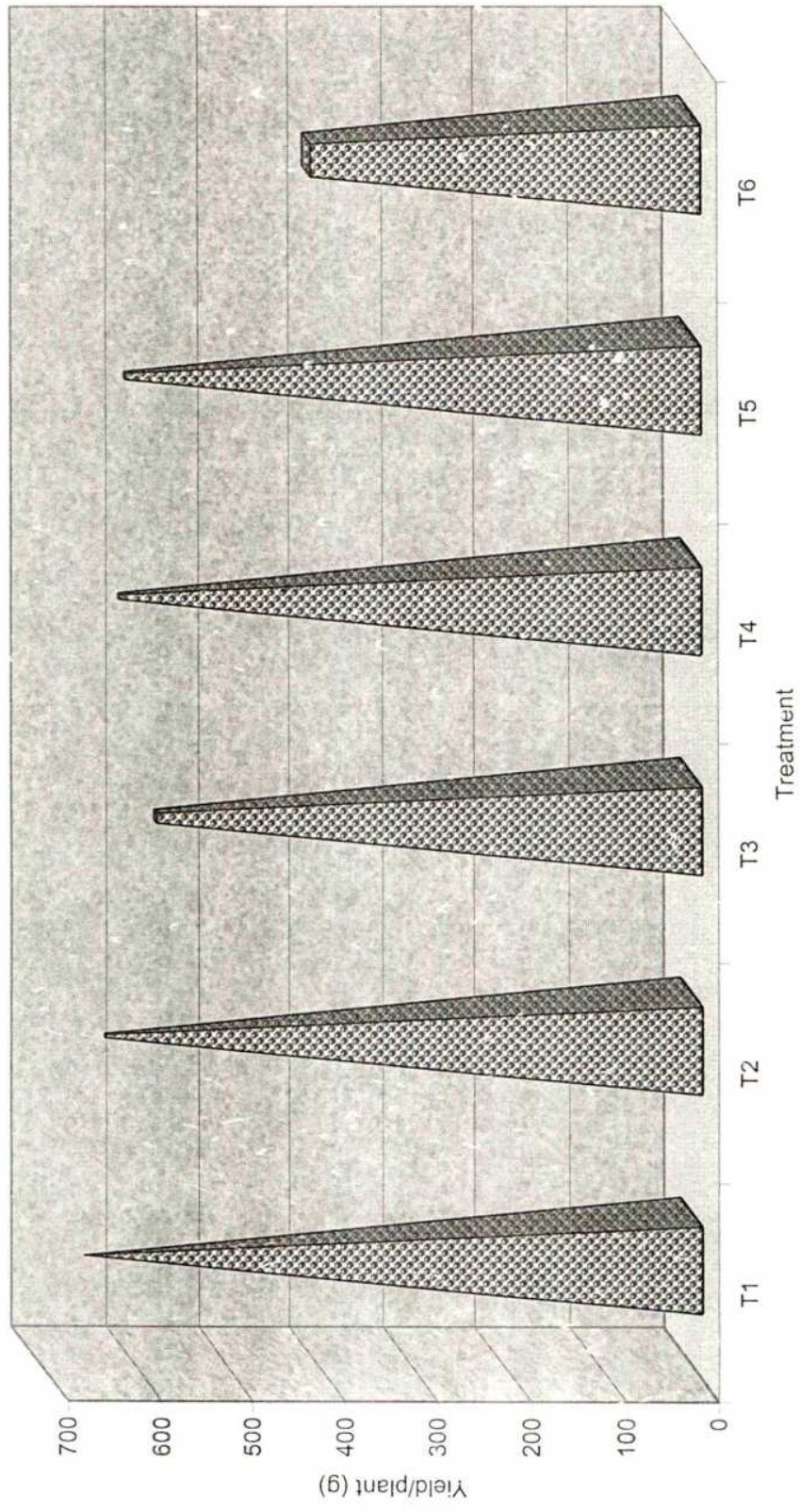


Fig. 4. Effect of organic fertilizers on leaf yield per plant (g) of mulberry

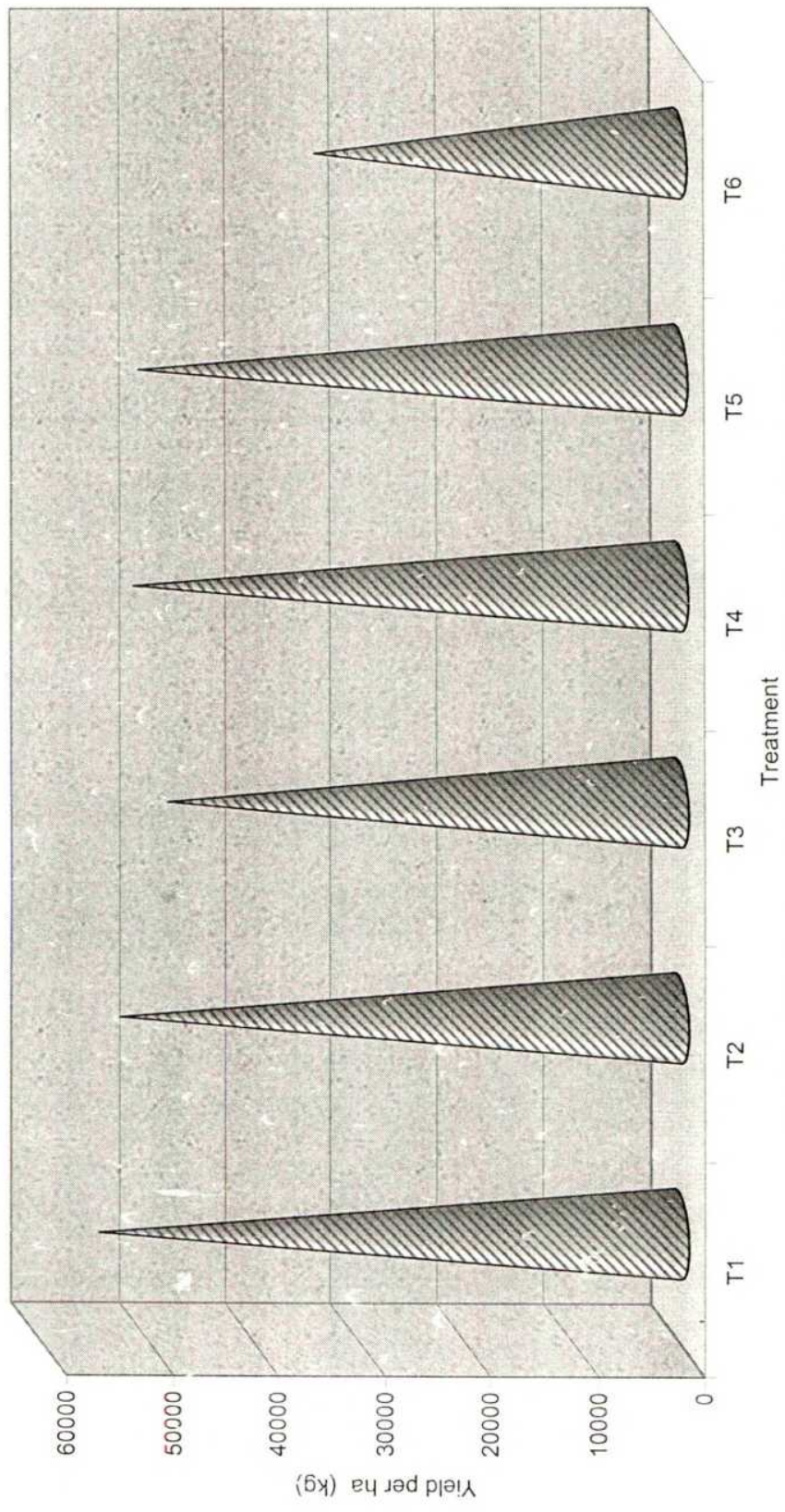


Fig. 5 Effect of organic fertilizers on leaf yield per hectare (kg) of mulberry

glyricidia + humic acid (241.00 cm<sup>2</sup>) and FYM + cattle urine (220.75 cm<sup>2</sup>) and in Dhaincha + seaweed treatment (195.5 cm<sup>2</sup>) Lowest leaf area of mulberry was recorded in control 176.50 cm<sup>2</sup>.

#### **4.1.3 Leaf yield per plant (g)**

The data presented in Table 3, revealed that the leaf yield per plant of mulberry variety was in the range of 410.00 to 653.75 g. All the treatments were significantly superior over control. Vermicompost + vermiwash (653.75 g) treatment was observed significantly superior to rest of the treatments and it was followed by FYM + cattle urine (631.25 g). The treatments PSB + *Azotobacter* (616.25 g) and glyricidia + humic acid (610.00 g) were on par with each other. Lowest leaf yield per plant of mulberry was observed control (410.00 g).

#### **4.1.4 Leaf yield per hectare (kg)**

The data presented in Table 3 revealed that the leaf yield per hectare of mulberry varied from 33956 to 54476 kg. All the treatments were significantly superior over control. The treatments, vermicompost + vermiwash (54476 kg) was observed significantly superior over other treatments, and it was followed by FYM + cattle urine (52601 kg). The treatments, PSB + *Azotobacter* (51351 kg) and glyricidia + humic acid (50830 kg) were on par with each other for leaf yield per hectare. Lowest leaf yield per hectare of mulberry observed in control (33956 kg).

#### **4.2 Silkworm**

The data on larval duration, ten mature larval weight and disease percentage as influenced by feeding of mulberry leaves obtained through application of organic manures are presented in Table and depicted graphically in figure.

**Table 4. Larval duration in days, Ten mature larval weight (g), Disease percentage of silkworm**

Tr. No.	Treatments	Larval duration in days	Ten mature larval weight (g)	Disease percentage
T <sub>1</sub>	Vermicompost + vermiwash	22.40	38.800	2.0 (7.99)
T <sub>2</sub>	FYM + cattle urine	22.80	38.300	2.5 (8.84)
T <sub>3</sub>	Dhaincha + seaweed	23.07	36.850	4.0 (11.49)
T <sub>4</sub>	PSB + <i>Azotobacter</i>	22.63	37.975	2.5 (8.38)
T <sub>5</sub>	Glyricidia + humic acid	22.85	37.325	2.75 (9.44)
T <sub>6</sub>	Control with 50% RDF	23.82	34.625	9.25(17.64)
	SE $\pm$	0.19	0.2857	0.9376
	CD at 5%	0.57	0.5897	2.8212

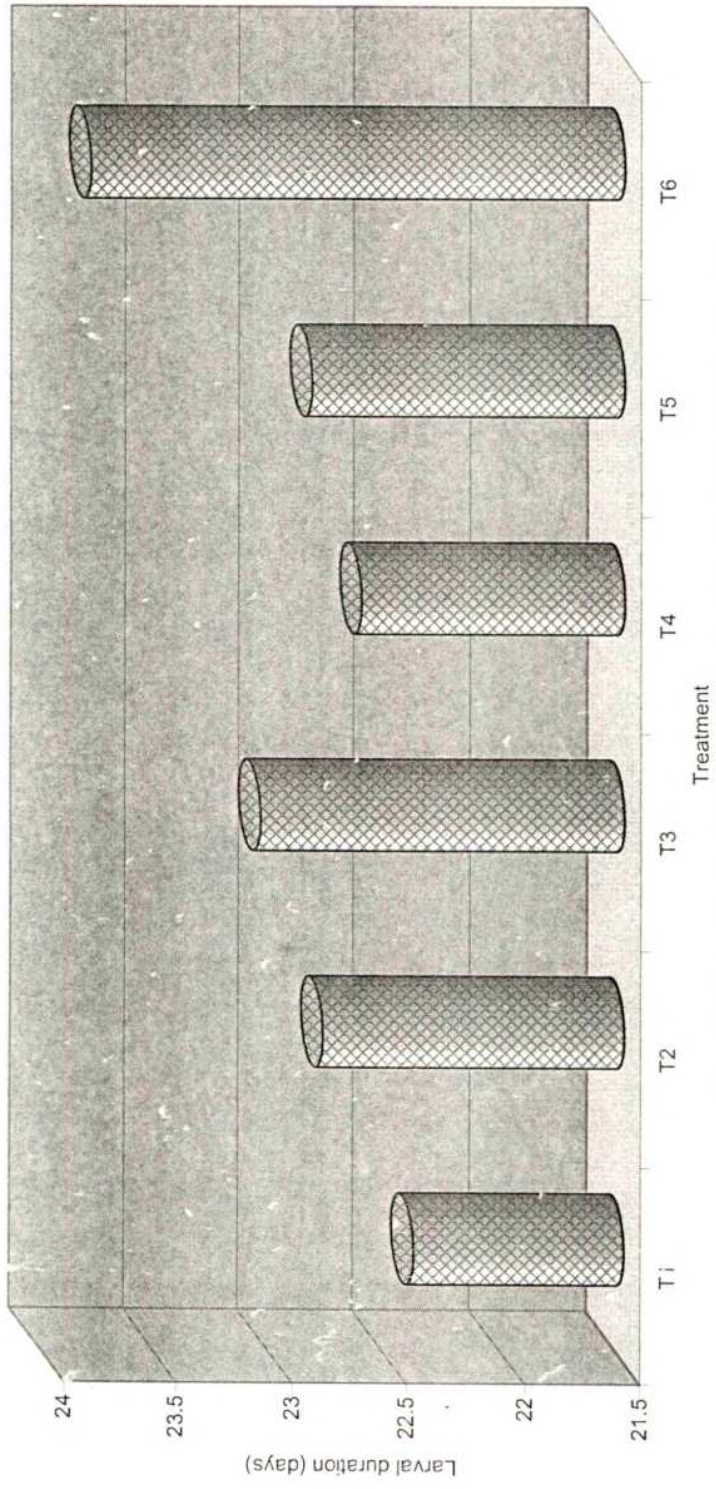


Fig. 6 Effect of organic fertilizers on larval duration (days) of mulberry silkworm

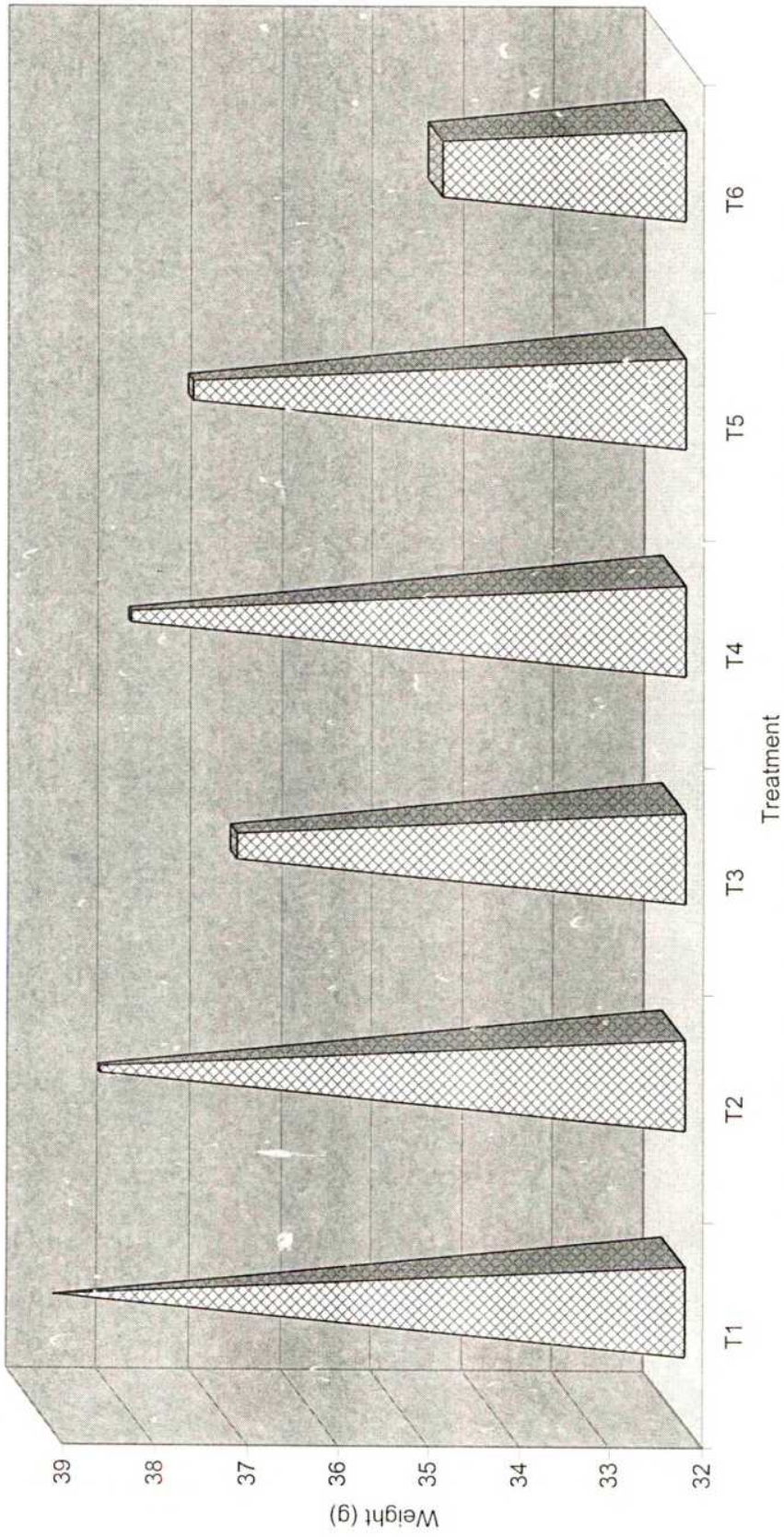


Fig. 7 Effect of organic fertilizers on 10 mature larval weight (g) of mulberry silkworm

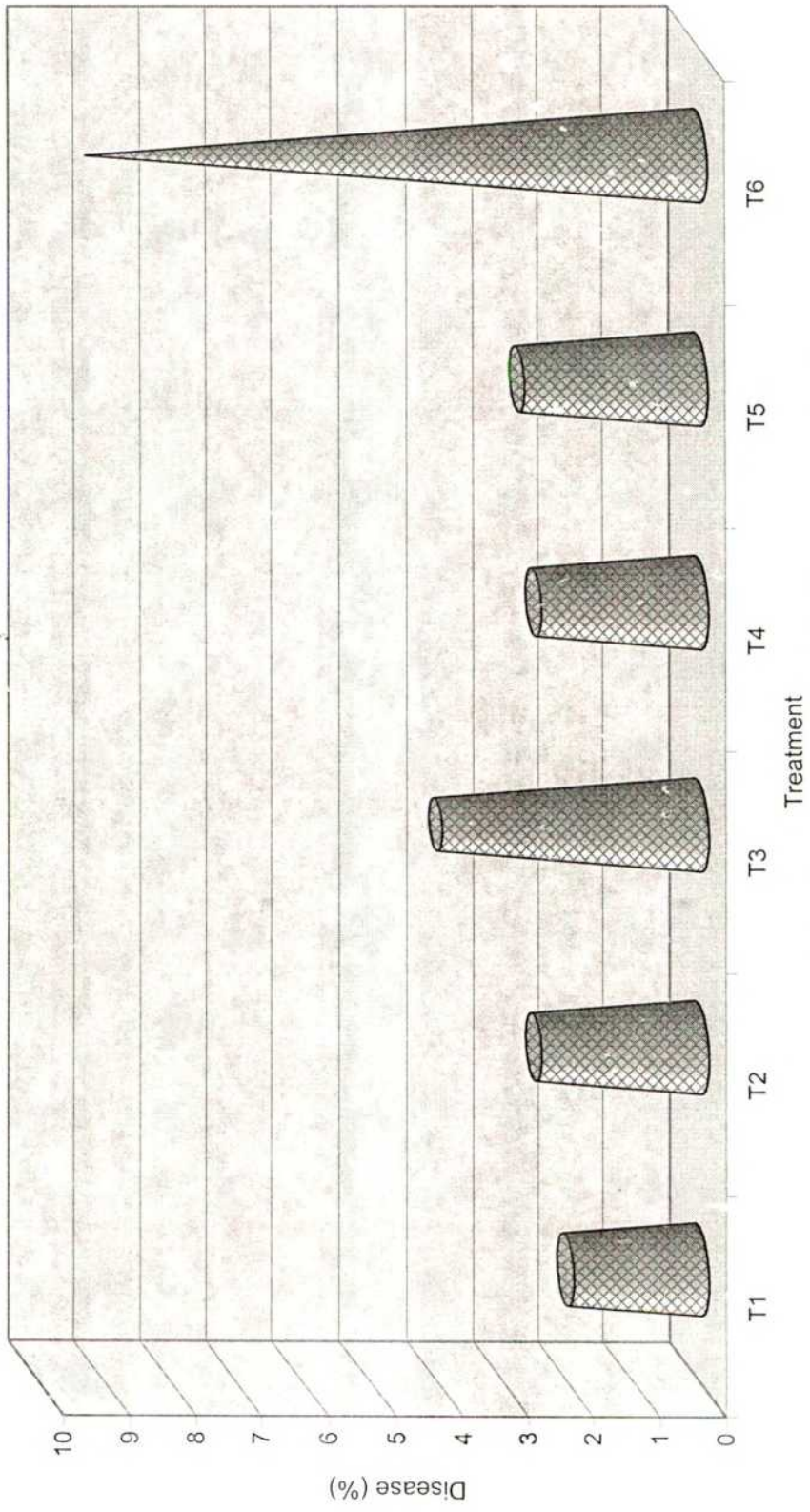


Fig. 8 Effect of organic fertilizers on disease percentage

#### **4.2.1 Larval duration (days)**

The result revealed that the larval duration of mulberry silkworm was varied in the range of 22.40 to 23.82 days. All the treatments were significantly superior over control. Vermicompost + vermiwash (22.40 days) treatment was observed superior treatment, which was followed by FYM + cattle urine (22.80 days), PSB + *Azotobacter* (22.63) and Glyricidia + humic acid (22.85) being on par with it. The highest larval duration was recorded in control (23.82 days).

#### **4.2.2 Ten mature larval weight (g)**

The result revealed that 10 mature larval weight varied in the range of 34.625 to 38.800 g. All treatments were significantly superior over control. The treatment, vermicompost + vermiwash (38.800 g) was observed significantly superior over the others, except FYM + cattle urine (38.300 g). The treatments, PSB + *Azotobacter* (37.975) and glyricidia + humic acid (37.325) were on par with each other. The PSB + *Azotobacter* and Glyricidia + seaweed were on par with each other. The lowest ten mature larval weight was observed in control (34.625 g.)

#### **4.2.3 Disease percentage**

The data on disease percentage on mulberry silkworm as influenced by feeding of mulberry leaves obtained from the application of organic manures are presented in Table 4.

The significant highest (9.25%) disease percentage in mulberry silk worm was observed in control. The treatments, vermicompost + vermiwash (2%), FYM + Cattle urine (2.5%), PSB + *Azotobacter* (2.5%)

and Glyricidia + humic acid (2.75%) were on par in respect of disease percentage.

#### **4.3 Cocoon character**

##### **4.3.1 Single cocoon weight (g)**

The data presented in the Table 5, revealed that the single cocoon weight varied in the range of 1.1725 to 1.3525 g. All treatments were significantly superior over control. Vermicompost + vermiwash (1.3525 g) treatment was recorded significantly superior over Dhaincha + seaweed (1.2425) and PSB + *Azotobacter* (1.2825). Treatments, FYM + cattle urine (1.3100 g) and glyricidia + humic acid (1.3050 g) were on par with each other. Lowest single cocoon weight was recorded in control (1.1725 g).

##### **4.3.2 Cocoon yield per 10000 larvae brushed (kg)**

The data presented in the Table 5, indicated that the cocoon yield per 10000 larvae brushed varied in range of 11.725 to 13.525 kg. All the treatments were significantly superior over control. The treatment vermicompost + vermiwash (13.525 kg) was recorded significantly highest cocoon yield, followed by treatments with FYM + cattle urine (13.10 kg) and glyricidia + humic acid (13.050 kg). The treatments Dhaincha + seaweed (12.425) and PSB + *Azotobacter* (12.825) were on par with each other. The lowest cocoon yield per 10000 larvae brushed was recorded in control (11.725 kg).

##### **4.3.3 Single shell weight (g)**

The data represented in the Table 5 revealed that the single shell weight of silkworm varied in the range of 0.1900 to 0.2525 g. All the treatments were significantly superior over the control. The

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**Table 5. Single cocoon weight (g), Cocoon yield per 10000 larvae brushed (kg), Single shell weight, Shell percentage**

Tr. No.	Treatments	Single cocoon weight (g)	Cocoon yield per 10000 larvae brushed (kg)	Single shell weight	Shell percentage
T <sub>1</sub>	Vermicompost + vermiwash	1.3525	13.525	0.2525	18.635 (25.57)
T <sub>2</sub>	FYM + cattle urine	1.3100	13.100	0.2350	17.69 (24.86)
T <sub>3</sub>	Dhaincha + seaweed	1.2425	12.425	0.2100	16.45 (23.94)
T <sub>4</sub>	PSB + <i>Azotobacter</i>	1.2825	12.825	0.2350	17.76 (24.915)
T <sub>5</sub>	Glyricidia + humic acid	1.3050	13.050	0.2325	17.65 (24.83)
T <sub>6</sub>	Control with 50% RDF	1.1725	11.725	0.1900	16.03 (28.58)
	SE ±	0.016081	0.16081	0.005916	0.2811
	CD at 5%	0.04838	0.48388	0.01780	0.8459

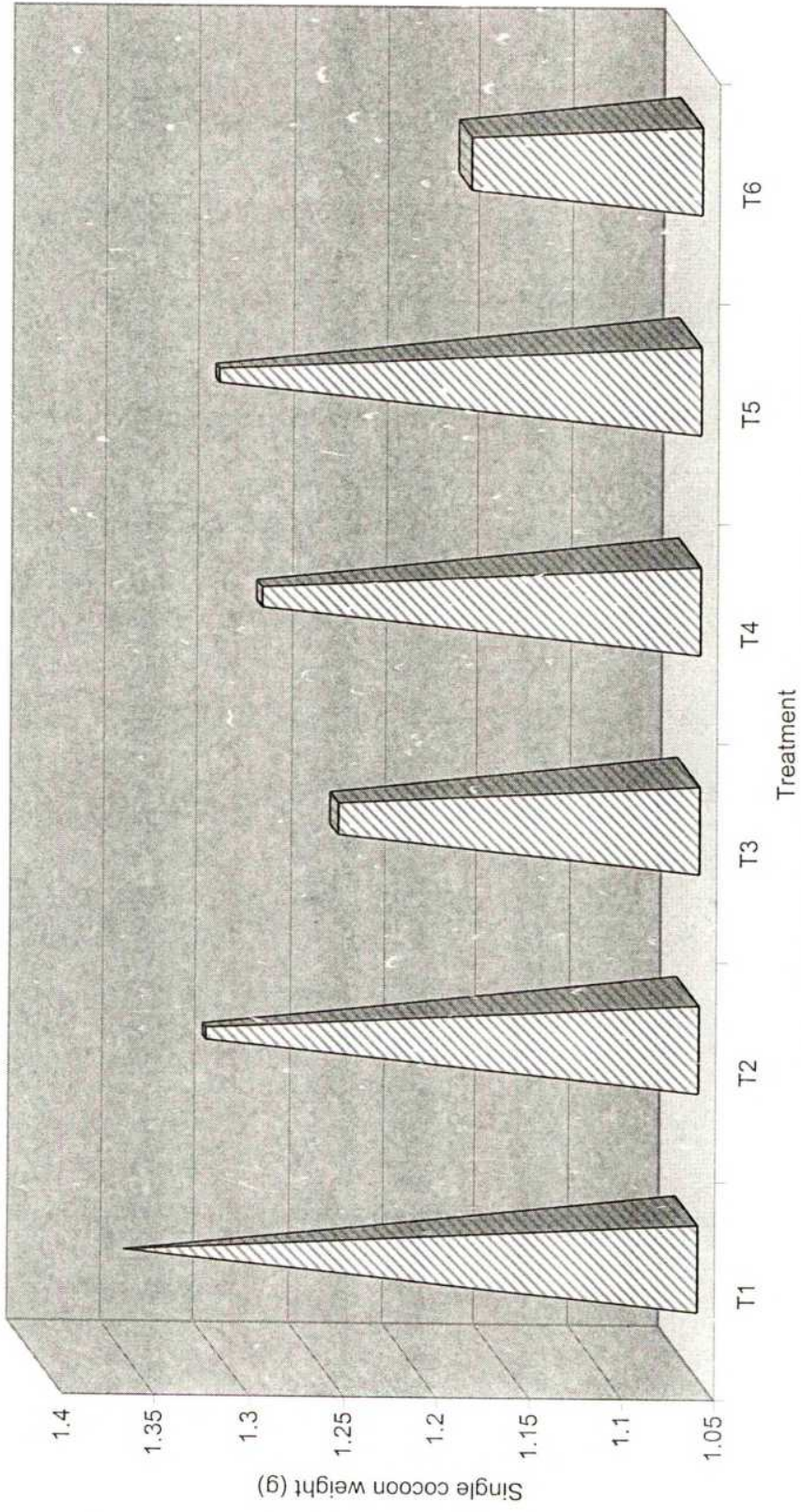


Fig. 9 Effect of organic fertilizers on single cocoon weight (g)

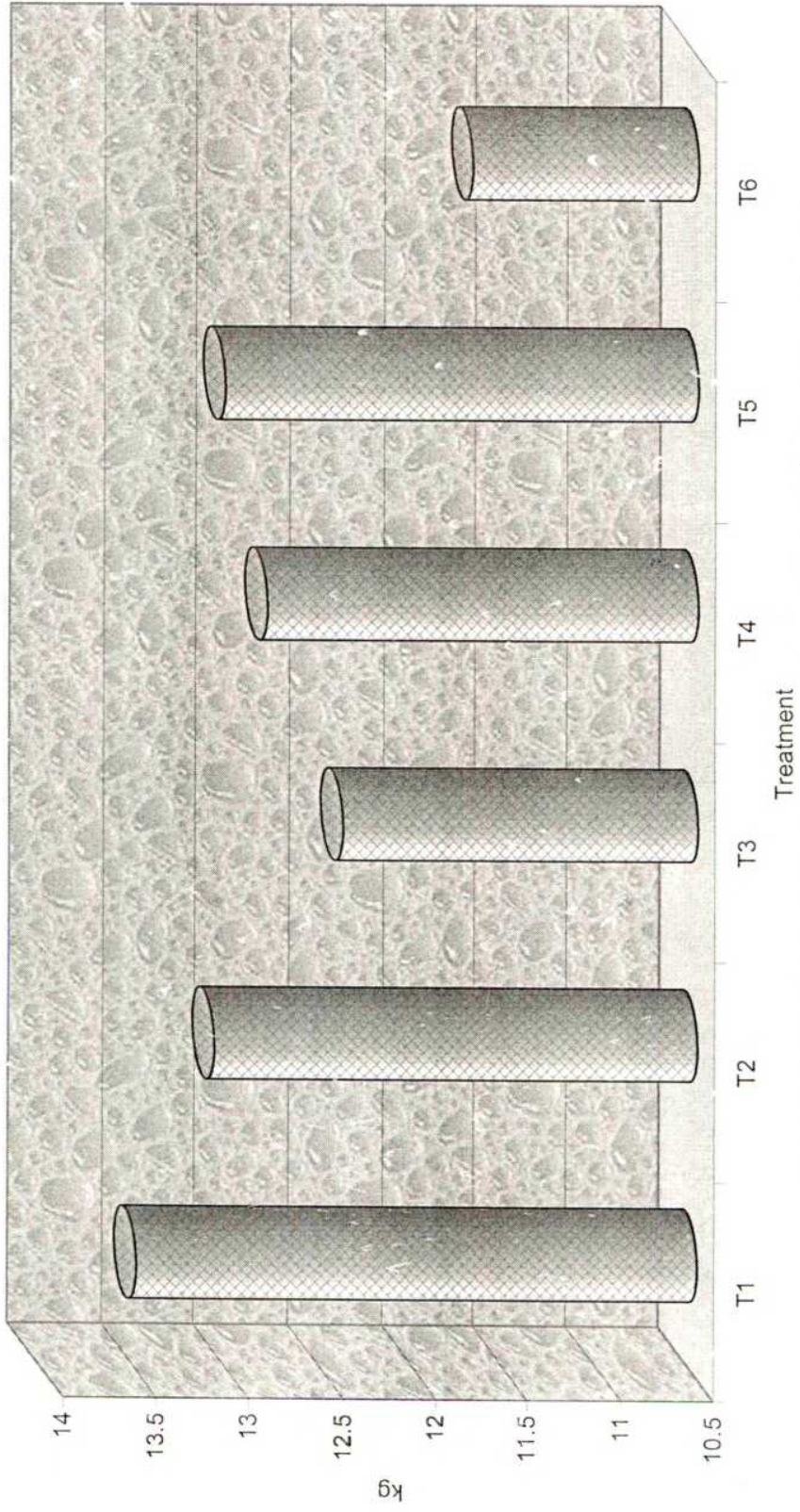


Fig. 10 Effect of organic fertilizers on cocoon yield per 10000 larvae brushed (kg)

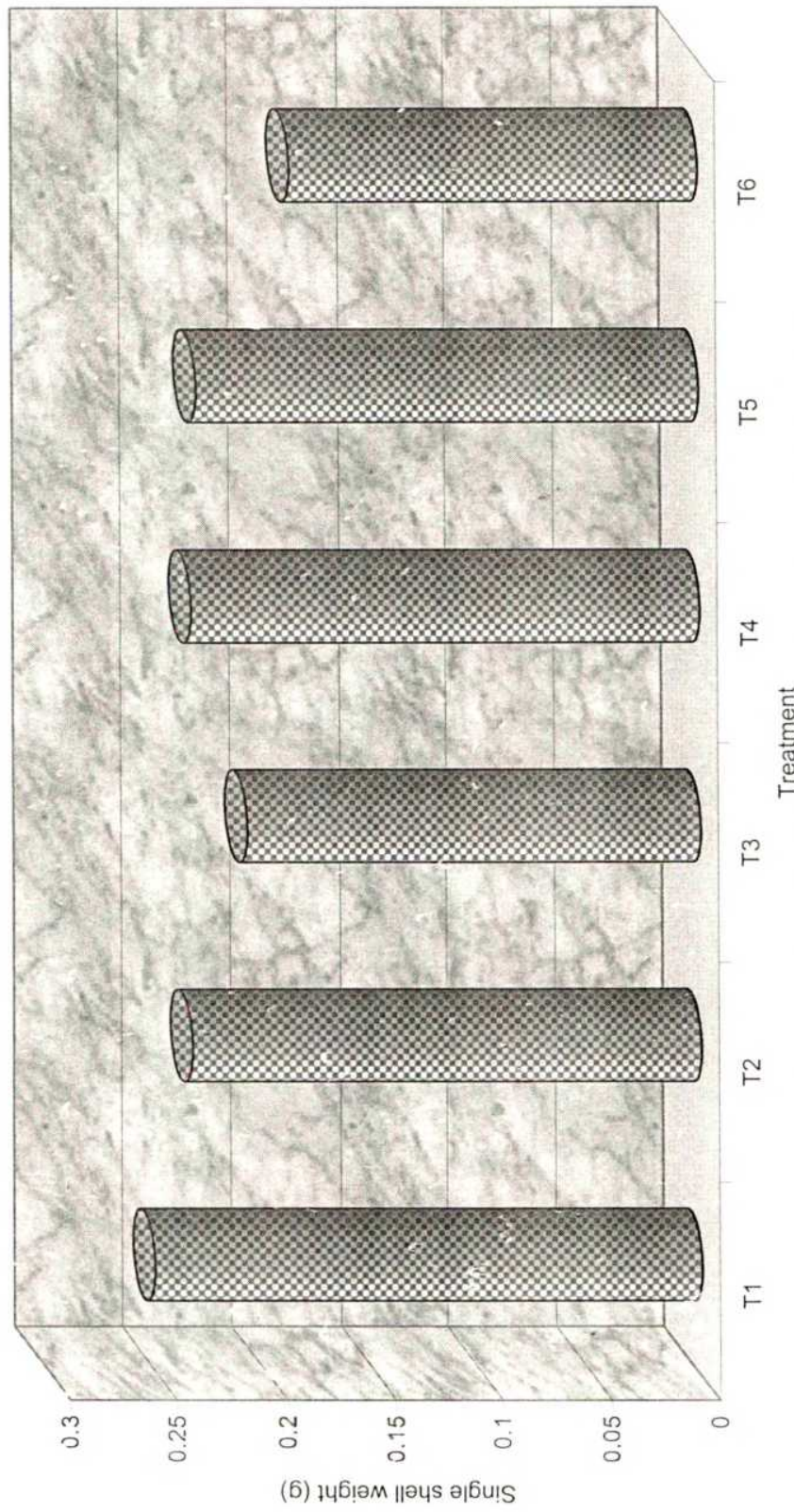


Fig. 11 Effect of organic fertilizers on single shell weight of cocoon

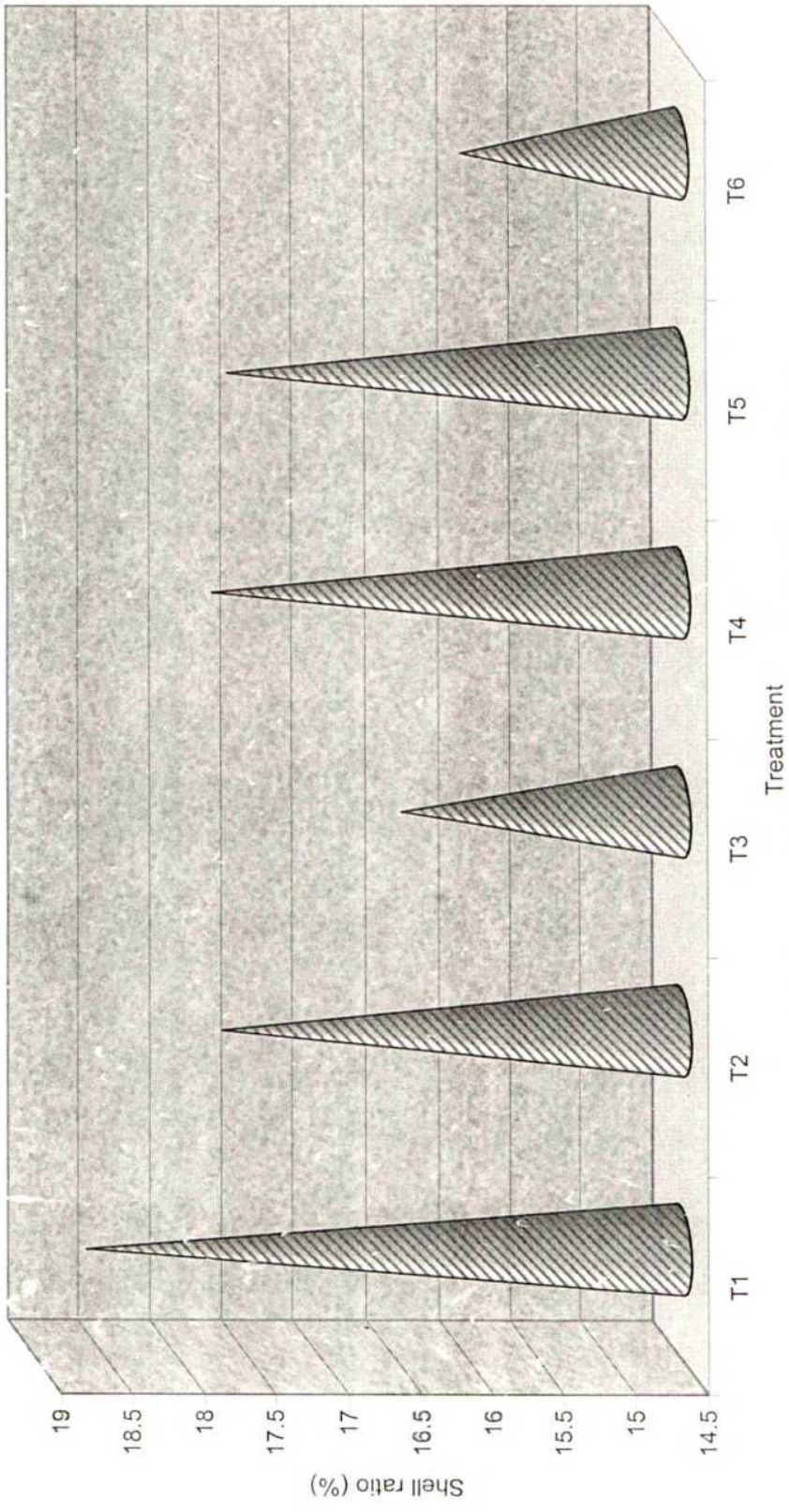


Fig. 12 Effect of organic fertilizers on shell percentage

treatment, vermicompost + vermiwash (0.2525 g) was recorded significantly highest single shell weight over other treatments except FYM + cattle urine and PSB an *Azotivacter*. The treatments FYM + cattle urine (0.2350 g), PSB + *Azotobacter* (0.2350 g), and glyricidia + humic acid (0.2325 g) were on par with each other. The lowest single shell weight was observed in control (0.1900 g).

#### **4.3.4 Shell percentage**

The data on shell percentage given in Table 5. revealed that, the shell percentage of silkworm varied in the range of 16.03 to 18.635 per cent. All the treatments were significantly superior over control, the treatment vermicompost + vermiwash (18.635 %) was observed significantly superior over other treatments and followed by the treatment PSB + *Azotobacter* (17.76 %). The treatments, FYM + cattle urine (17.69 %) and glyricidia + humic acid (17.65 %) were on par with each other for shell percentage. The lowest shell percentage of silkworm was observed in control (16.00%).

#### **4.3.5 Effective rate of rearing (ERR) (by number)**

The data in Table 6. indicated that the effective rate of rearing (ERR) by number of mulberry silkworm varied in the range of 9150 to 9800. All the treatments were significantly superior over control. The treatment vermicompost + vermiwash was observed superior to the other treatments followed by PSB + *Azotobacter* (9775), FYM + cattle urine (9750) and Glyricidia + humic acid (9725). The lowest ERR by number was observed in control (9150).

**Table 6. Effective rate of rearing (ERR) per 10000 larvae (by number)**

Tr.No.	Treatments	R-I	R-II	R-III	R-IV	Total	Mean
T <sub>1</sub>	Vermicompost + vermiwash	9800	9700	9900	9800	39200	9800
T <sub>2</sub>	FYM + cattle urine	9700	9800	9600	9900	39000	9750
T <sub>3</sub>	Dhaincha + seaweed	9700	9600	9500	9600	38400	9600
T <sub>4</sub>	PSB + <i>Azotobacter</i>	9800	9600	9800	9900	39100	9775
T <sub>5</sub>	Glyricidia + humic acid	9700	9800	9600	9800	38900	9725
T <sub>6</sub>	Control with 50% RDF	9600	9100	8900	9000	36600	9150
	SE $\pm$						77.280
	CD at 5%						232.53

#### **4.5.1 Filament length (m)**

The data on filament length is presented in Table 7. The results revealed that filament length of cocoon varied in the range 655.50 to 813.25 (m). All the treatments were significantly superior over the control. The treatment vermicompost + vermiwash (813.25 m) recorded significantly more filament length, than the other treatments. The treatments, PSB + *Azotobacter* (765.50 m) and FYM + cattle urine (758.75 m) were on par with each other. The lowest filament length of cocoon was observed in control (655.50 m).

#### **4.5.2 Filament weight (g)**

The data on filament weight given Table 7 indicated that, the filament weight of cocoon varied in range of 0.1400 to 0.2025 g. All the treatments were non significant over control except vemricompost + vermiwash The treatment vermicompost + vermiwash (0.2025 g) was observed significantly superior over all other treatments. The treatments, PSB + *Azotobacter* (0.1625 g), FYM + cattle urine (0.16090 g) and glyricidia + humic acid (0.1600 g) were on par with each other. The lowest filament weight of cocoon was observed in control (0.1400 g).

#### **4.4 Denier**

The data of Denier of cocoon as influenced by feeding of mulberry leaves obtained through application of different organic manures are presented in Table 8.

The result revealed that Denier of cocoon varied in the range of 1.5685 to 2.2300. The treatment, vermicompost + vermiwash (2.2300) was observed significantly superior over all other treatments. The treatments.

**Table 7. Filament length (m)**

Tr. No.	Treatments	Filament length (m)	Filament weight (g)
T <sub>1</sub>	Vermicompost + vermiwash	813.25	0.2025
T <sub>2</sub>	FYM + cattle urine	758.75	0.1600
T <sub>3</sub>	Dhaincha + seaweed	732.25	0.1500
T <sub>4</sub>	PSB + <i>Azotobacter</i>	765.50	0.1625
T <sub>5</sub>	Glyricidia + humic acid	734.00	0.1600
T <sub>6</sub>	Control with 50% RDF	655.50	0.1400
	SE $\pm$	8.5275	0.01064
	CD at 5%	25.659	0.032033

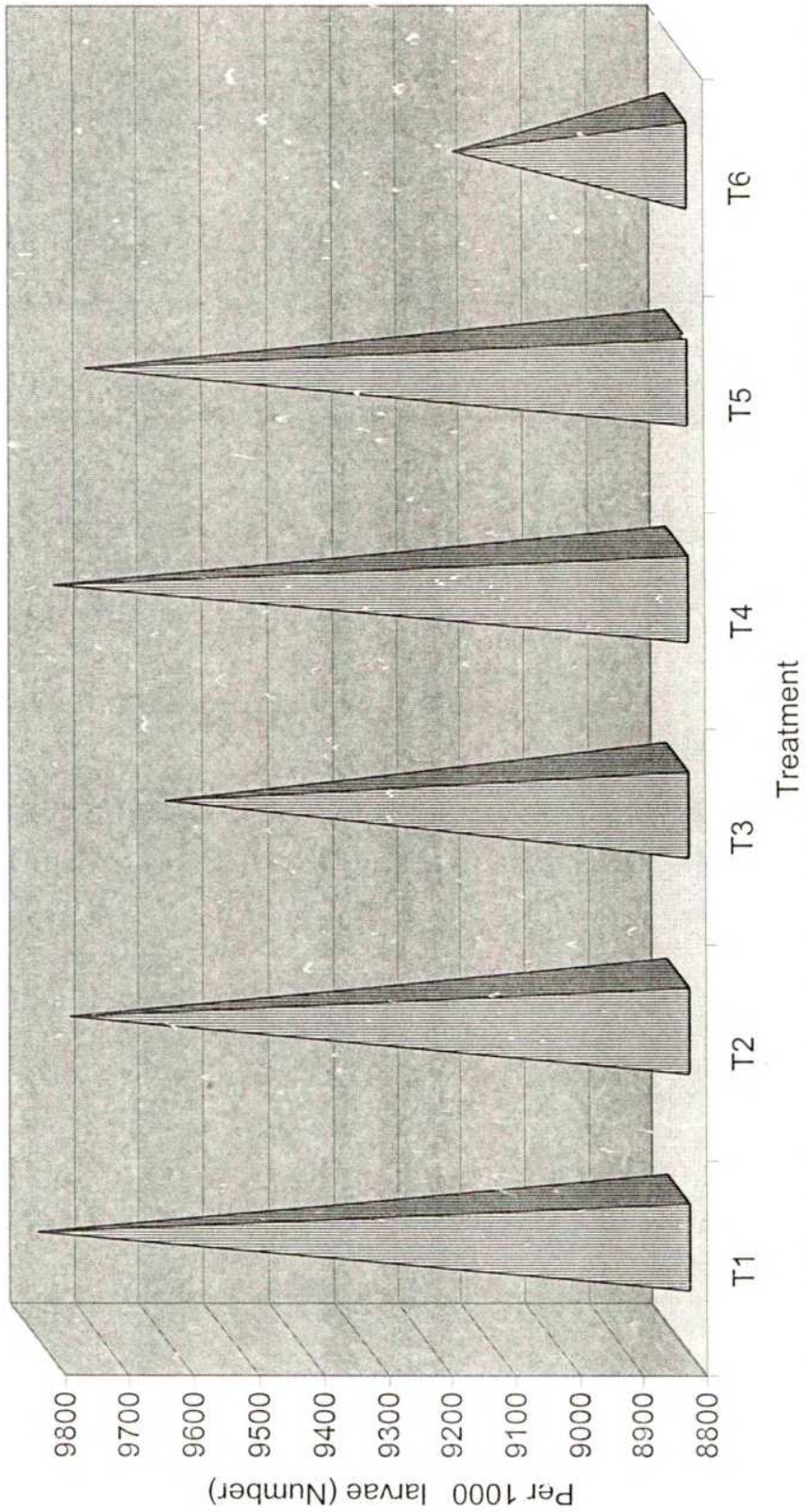


Fig. 13 Effect of organic fertilizers on effective rate of rearing (ERR) per 10000 larvae (by number) of mulberry silkworm

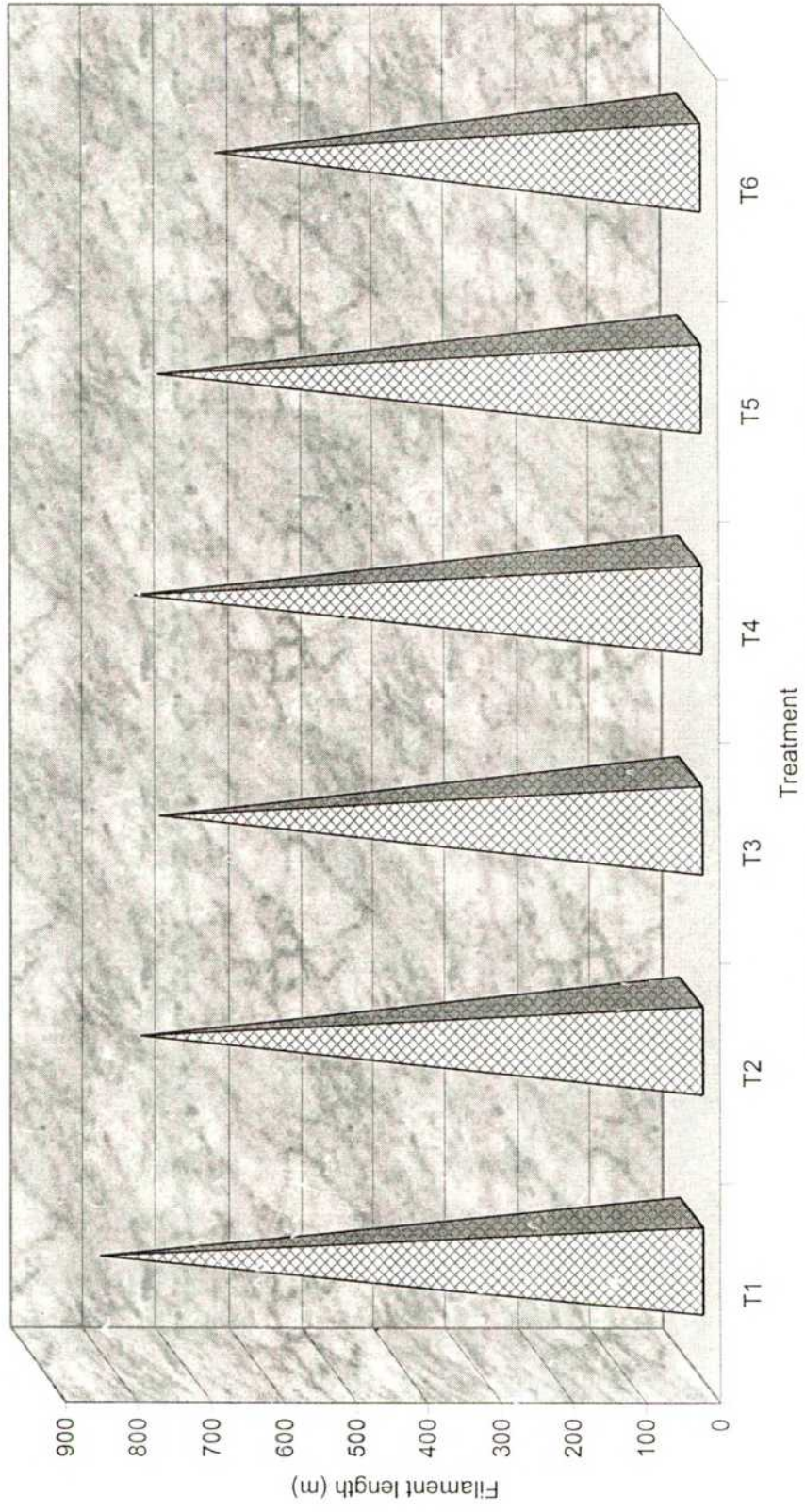


Fig. 14 Effect of organic fertilizers on filament length of cocoon

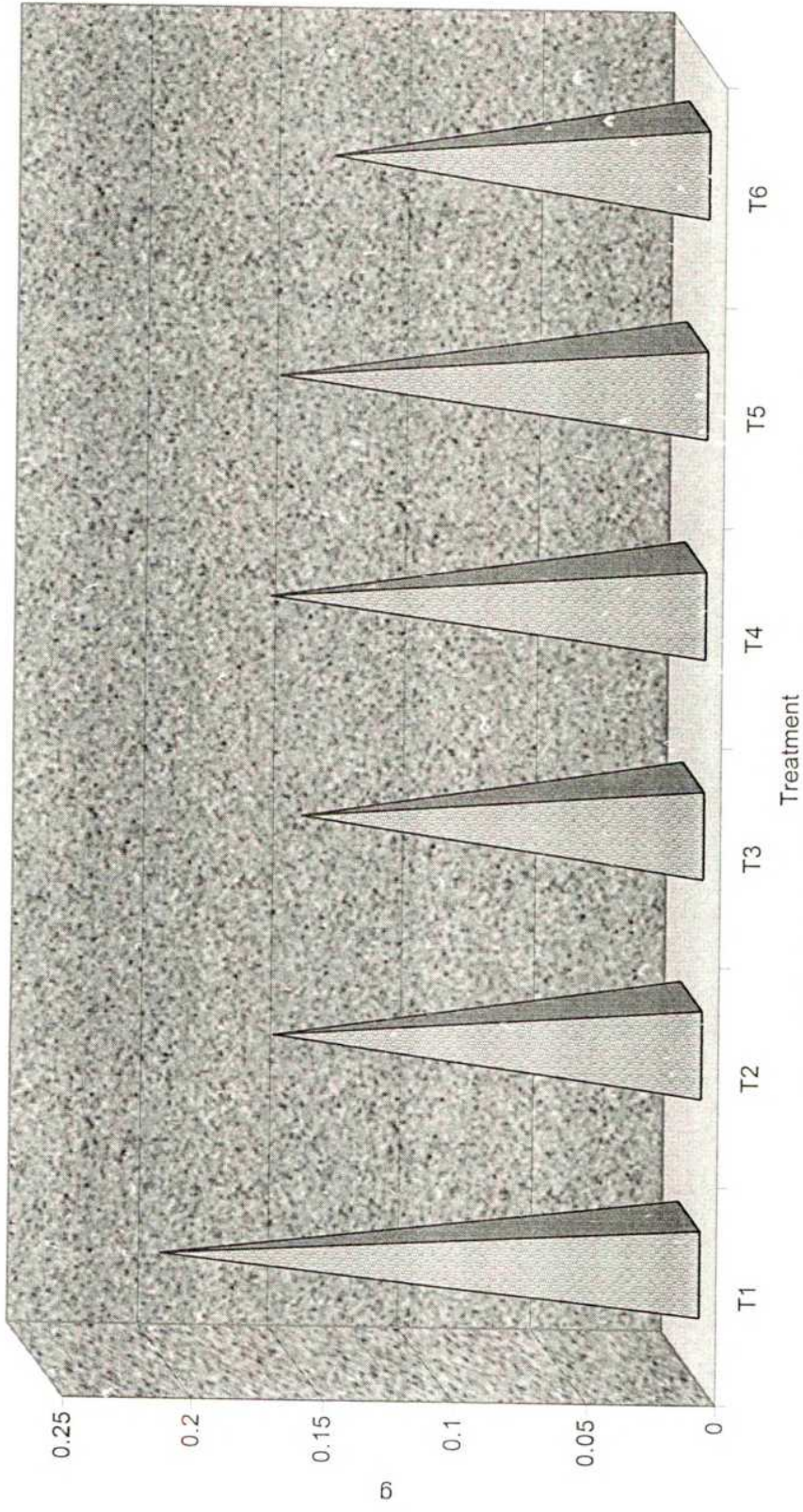


Fig. 15 Effect of organic fertilizers on filament weight (g) of cocoon

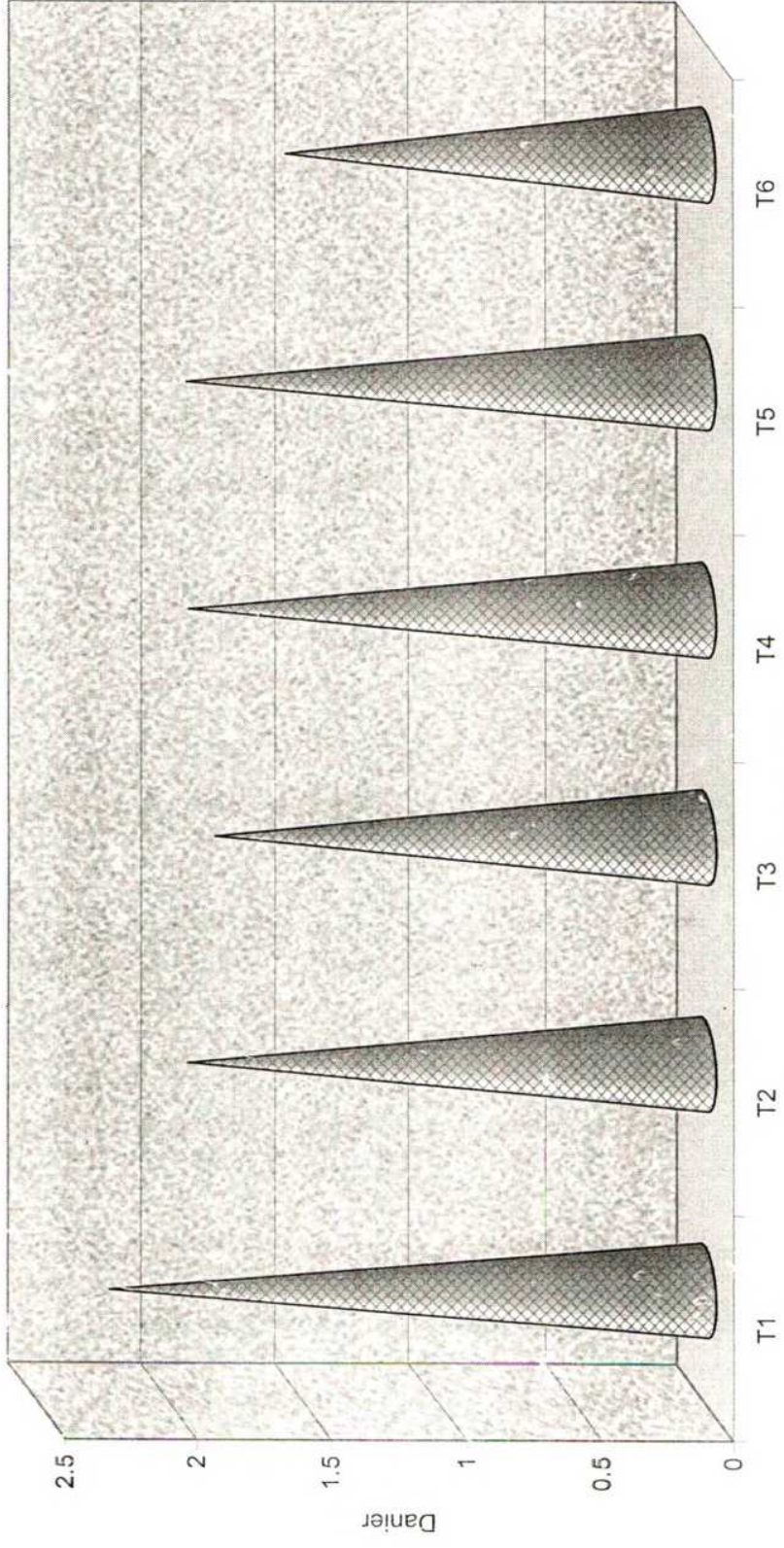


Fig. 16 Effect of organic fertilizers on Danier of cocoon

**Table 8. Danier**

Tr. No.	Treatments	R-I	R-II	R-III	R-IV	Total	Mean
T <sub>1</sub>	Vermicompost + vermiwash	2.40	2.18	2.12	2.22	8.92	2.2300
T <sub>2</sub>	FYM + cattle urine	1.91	2.00	1.84	1.92	7.72	1.9300
T <sub>3</sub>	Dhaincha + seaweed	1.93	1.73	1.82	1.84	7.32	1.8300
T <sub>4</sub>	PSB + <i>Azotobacter</i>	1.82	1.98	1.89	2.02	7.71	1.9275
T <sub>5</sub>	Glyricidia + humic acid	1.95	2.01	1.95	1.84	7.75	1.9375
T <sub>6</sub>	Control with 50%RDF	1.51	1.56	1.62	1.584	6.274	1.5685
	SE $\pm$						0.043165
	CD at 5%						0.12988

glyricidia + humic acid (1.9375), FYM + cattle urine (1.9300) and PSB + *Azotobacter* (1.9275) were on par with each other. The lowest Denier of cocoon was observed in control (1.5685).



# *Discussion*



## Chapter-5

### DISCUSSION

In Maharashtra, sericulture has started since last four decades. It is a new occupation, which gives remunerable income to farm family. Though the efforts were made for mulberry cultivation and silkworm rearing, there are some constraints for low mulberry productivity and quality cocoon production. The average mulberry leaf yield ranges from 9000 to 10000 kg/acre /year in irrigated garden and 4000-5000 kg/acre/yr in rainfed garden and with average cocoon production is 50 kg/100 dfls. Well established and maintained garden yield about 12000-15000 kg leaf per year per acre. Hence the egg consumption per farmer is less. Besides the quantity of leaves produced is not fully utilized for various reasons. It is estimated that only about 85 percentage leaf is being utilized for rearing and the remaining goes waste. It result into less average consumption of layings and low cocoon production per acre.

Many factors decides the productivity and profitability in sericulture but maximization of quality mulberry leaf yield per unit area is most important. Hence attempt had been made to conduct studies on the effect of organic fertilizers for increasing the leaf yield and its effect on economic traits of silkworm *Bombyx mori* L.

Mulberry leaf production in tropics is largely dependent on the application of chemical fertilizer specially nitrogen, phosphorus and potash. It has been recommended that irrigated mulberry in India needs 3000 kg nitrogen, 120 kg phosphorus and 120 kg potash per hectare per

year for optimum leaf yield (i.e. 35 tones per hectare per year) of good quality. High requirement of nitrogenous fertilizers in mulberry to increased cost of cultivation. On the contrary, fertilizers are not only in short supply but also expensive. Small and marginal farmers are unable to apply it or apply only partly and frequently lose cocoon crops due to inferior leaf quality. Due to decrease in dairy animals rearing, there is increase in non availability of farm yard manure which has been recommended for application to mulberry garden at 8 tones per acre per year.

The results of the study on various aspects are discussed here under following sub heading.

## **5.1 Effect of organic manures on physiological parameters of mulberry**

### **5.1.1 Shoot length and leaf area**

The shoot length of mulberry varied in the range 204.00 to 255.75 cm. The treatment, vermicompost + vermiwash was observed significantly superior over all other treatments and it was followed by FYM + cattle urine, PSB + *Azotobacter*. Lowest shoot length of mulberry was recorded in control. Similar trend was found in respect of leaf area.

Murarkar *et al.* (1998) investigated the effect of vermicompost in comparison with farm yard manure and fertilizers on the mulberry leaf yield and reported that full dose of NPK fertilizers +vermicompost and half dose of farm yard manure of 10 cart loads/ha was significantly better than the untreated control for increasing the maximum number of branches, height of the plant, number of leaves per plant and leaf yield per plant.

Reddy *et al.* (2003) also conducted an experiment to determine the effect of FYM and vermicompost on different quantitative and qualitative characters in mulberry. The percentage improvement in leaf yield, plant height and leaf area were considerably high when vermicompost was used. A slight increase in other quantitative characters of mulberry was observed in vermicompost treated plots as compare to FYM.

Similar results were observed by Kherdekar (1996) in respect of leaf area.

#### **5.1.2 Leaf yield per plant (g) and leaf yield per hectare (kg)**

The leaf yield per plant of mulberry varied in the range of 410.00 to 653.75 g. All the treatments were significantly superior over control. The treatment vermicompost + vermiwash was observed significantly superior among the other treatments followed by FYM + cattle urine, PSB + *Azotoabcter*, glyricidia + humic acid and Dhaincha + seaweed. Lowest leaf yield per plant of mulberry was observed in control.

Similar trend was obtained in respect of per hectare leaf yield. Patil *et al.* (2002) observed maximum leaf yield of mulberry with the application of vermicompost. Whereas, Pain (1961) observed that application of FYM increased the foliage yield by 75 per cent as compare to no application.

Purohit *et al.* (1990) reported that green manuring with Dhaincha and sunhemp increased the leaf yield by 18.7 and 8.7 per cent, respectively. Further, they reported that application of green manure improved the fertility of soil and brought sustained increase

in leaf production. Moreover, Singh (1998) reported that application of green manure, resulted to an increased leaf yield and quality of leaf in mulberry.

Anilkumar and Jhon. (2000) reported that combined application of Azospirillum, vermicompost and PSB had significant effect on total leaf production, leaf dry matter production, stem dry matter production and total dry matter production.

Reddy *et al.* (2003) compared the effect of FYM and vermicompost on different quantitative and qualitative characters in mulberry. The percentage improvement in leaf yield, plant height and leaf area were considerably high when FYM + vermicompost was applied.

## **5.2 Effect of organic manures on silkworm**

### **5.2.2 Larval duration (days) and ten mature larval weight**

In the current studies all the treatments showed non significant results. Vermicompost + vermiwash showed lowest larval duration followed by PSB + *Azotoabcter*. However, All the treatments showed significant results of ten mature larval weight. Among all the treatments, maximum weight was observed vermicompost + vermiwash followed by FYM + cattle urine application.

Investigations of Kherdekar *et al.* (2000) revealed that the vermicompost + NPK enhanced silkworm larval weight.

Matsumura (1954) reported that fifth instar larvae demand less water in leaves than younger ones. They need to have leaves containing protein to large extent.

### **5.2.3 Disease percentage**

The data on disease percentage indicated. The remarkable decrease in disease percentage in Vermicompost + vermiwash treatments followed by FYM +cattle urine application.

These findings are in conformity with Kherdekar *et al.* (2000) who observed reduced mortality in silkworm fed with mulberry leaves obtained from the plots with application of vermicompost + NPK.

## **5.3 Cocoon characters**

### **5.3.1 Single cocoon weight, cocoon yield per 10000 larvae brushed (kg) and shell weight (g).**

The result of single cocoon weight recorded in all the treatments were significantly superior over control. The treatment vermicompost + vermiwash observed significantly superior among all other treatments. cocoon weight was recorded in control.

The results in respect of cocoon yield per 10000 larvae brushed indicated that, maximum cocoon yield was observed in vermicompost + vermiwash

The highest shell weight was observed in vermicompost + vermiwash application.

Similar results were noted by Kherdekar *et al.* (2000). They reported that feeding silkworm with mulberry leaves obtained from the plots of application of vermicompost with NPK resulted in increased single cocoon weight, cocoon yield and shell weight

The present findings are in conformity with Jadhav *et al.* (2000). They concluded that application of vermicompost increased the cocoon weight and cocoon yield.

### **5.3.2 Shell percentage**

Shell percentage was observed significantly high in all the treatments over control except Dhaincha + seaweed. The highest shell percentage was observed in vermicompost + vermiwash.

### **5.3.3 Effective rate of rearing (ERR) (By number)**

All the treatments showed better effective rate of rearing than control. The maximum ERR observed in vermicompost + vermiwash.

### **5.4.1 Filament length**

The filament length was observed significantly more in all the treatments than control. The maximum filament length was observed in vermicompost + vermiwash.

Similar findings were reported by Kherdekar *et al.* (2000). They reported that feeding the mulberry leaves obtained from the plots application of vermicompost with NPK treated plots resulted in increased the filament length.

#### **5.4.2 Filament weight**

All the treatments were non significant over control in respect of filament weight except vermicompost + vermiwash. The highest filament weight observed in vermicompost + vermiwash,

#### **5.5 Denier**

The highest Denier of cocoon was observed in vermicompost + vermiwash, whereas the lowest Denier was due to the application of FYM + cattle urine.



*Summary and  
Conclusions*



## Chapter-6

### SUMMARY AND CONCLUSION

The plant needs adequate supply of nutrients and minerals from soil for the growth and development.

The MYs X CSR<sub>2</sub> silkworm hybrid utilized as experimental material which was procured from Maharashtra State Department of Sericulture Research. This was reared on mulberry variety V-1 at Sericulture Research Unit, MAU, Parbhani grown by supplying different organic sources viz. vermicompost , FYM, dhaincha, PSB, *Azotobacter* and glyricidia.

The experiment was conducted in the rearing house at Sericulture Research Unit, Marathwada Agricultural University, Parbhani

Different sources of organic manures such as vermicompost + vermiwash, FYM + cattle urine, dhaincha + seaweed, PSB + *Azotoabcter* glyricidia + humic acid, control with 50% RDF was applied in the plot. Observations on the different physiological parameters such as shoot length, leaf area, leaf yield and economic traits of silkworm were taken. The findings of the present investigations are summarized below.

1. The shoot length of mulberry varied in the range of 204.00 to 255.75 cm. It was observed highest due to application of vermicompost + vermiwash in whereas, the shoot length of mulberry was lowest due to application of 50 per cent RDF.
2. The leaf area of mulberry varied in the range of 176.50 to 259.50 cm<sup>2</sup>. It was highest due to application of vermicompost +

vermiwash in the mulberry, whereas the leaf area of mulberry was lowest due to application of 50 per cent RDF.

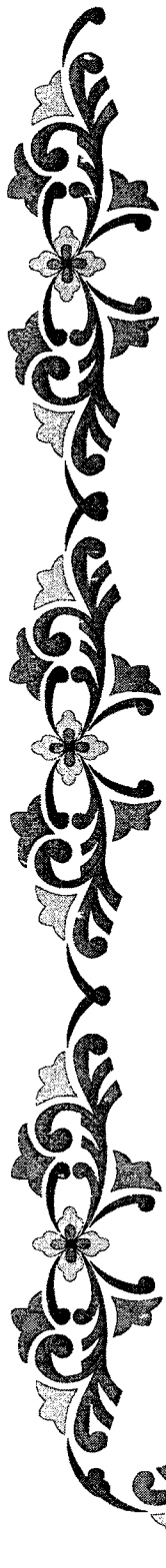
3. The leaf yield per plant of mulberry varied in the range of 410.00 to 653.75 g. It was highest due to application of vermicompost + vermiwash. Whereas, low due to the application of 50 per cent RDF.
4. The leaf yield per hectare of mulberry varied in the range of 33956 to 54476 kg. It was maximum due to application of vermicompost + vermiwash and minimum due to application of 50 per cent RDF..
5. The larval duration of mulberry silkworm was varied in the range of 22.40 to 23.82 days. It was observed more due to application of 50 per cent RDF to the mulberry. Whereas larval duration of mulberry silkworm was less due to the application of the vermicompost + vermiwash.
6. The ten larval weight (g) varied in the range of 34.625 to 38.8000 g. The ten larval weight was maximum due to application of vermicompost +vermiwash to the mulberry. Whereas the ten larvae weight was minimum due to application of 50 per cent RDF.
7. The disease percentage was highest in plots treated with application of 50 per cent RDF to the mulberry, whereas it was less due to the application of the vermicompost +vermiwash.

8. The single cocoon weight varied in the range of 1.1725 to 1.3525 g. It was observed more due to application of vermicompost + vermiwash to the mulberry. Whereas the single cocoon weight was less due to application of 50 per cent RDF.
9. The cocoon yield per 10000 larvae brushed varied in the range of 11.725 to 13.525 kg. It was observed highest due to application of vermicompost + vermiwash to the mulberry. Whereas the cocoon yield per 10000 larvae brushed was lowest due to application of 50 per cent RDF.
10. The single shell weight (g) of silkworm varied in the range of 0.1900 g to 0.2525 g. It was highest due to application of vermicompost + vermiwash.
11. The shell percentage varied in the range of 16.03 to 18.635. The shell percentage was maximum due to application of vermicompost + vermiwash to the mulberry, whereas it was minimum due to application of 50 per cent RDF.
12. The effective rate of rearing (ERR) by number varied in the range of 9150 to 9800. The ERR was maximum due to application of vermicompost + vermiwash to the mulberry, whereas, it was minimum due to application of 50 per cent RDF.
13. The filament length of cocoon varied in the range 655.50 to 813.25 m. It was more due to application of vermicompost + vermiwash. Whereas, less due to application of 50 per cent RDF.
14. The filament weight of cocoon varied in the range of 0.1400 to 0.2025 g. It was maximum due to application of vermicompost

+ vermiwash, whereas the filament weight of cocoon was minimum due to application of 50 per cent RDF.

15. The Denier of cocoon varied in the range of 1.5685 to 2.2300. The Denier of cocoon was highest due to application of vermicompost + vermiwash. Whereas, it was less due to application of 50 per cent RDF.

Thus, it is concluded that the application of vermicompost @ of 10 ton/ha. and vermiwash to mulberry could be useful from physiological parameters of the plants as well as larval and cocoon production point of view of silkworms.



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# *Appendix*



## APPENDIX-I : Weekly weather data for the year 2007 at Parbhani

MW	Dates	RF (mm)	Rainy days	Temp °C		Humidity %		EVP (mm)	BSS (Hrs.)	W.S. (kmph)
				Max.	Min.	AM	PM			
01	01-07 Jan.	0.0	0.0	28.8	9.0	78	37	4.1	10.3	2.7
02	08-14 Jan.	0.0	0.0	29.0	10.7	74	36	4.1	10.3	2.9
03	15-21 Jan.	0.0	0.0	30.9	10.9	75	28	4.2	10.4	2.7
04	22-28 Jan.	0.0	0.0	31.7	12.6	72	29	4.4	10.6	3.1
05	29-04 Feb.	0.0	0.0	32.5	15.1	72	27	5.7	10.2	3.8
06	05-11 Feb.	0.0	0.0	33.3	14.9	72	24	5.9	10.3	3.5
07	12-18 Feb.	0.0	0.0	30.7	12.8	73	36	6.0	10.5	4.7
08	19-25 Feb.	0.0	0.0	32.1	13.1	70	23	6.3	10.9	4.7
09	26-04 Mar.	0.0	0.0	33.6	15.0	66	22	6.6	11.0	4.3
10	05-11 Mar.	0.0	0	34.9	17.4	64	25	7.0	10.6	5.1
11	12-18 Mar.	0.0	0	35.3	18.2	58	21	8.8	9.6	5.5
12	19-25 Mar.	0.0	0	38.5	19.5	50	18	8.8	9.3	3.5
13	26-01 Apr.	0.0	0	39.4	18.7	43	14	10.7	10.2	4.4
14	02-08 Apr.	0.0	0	41.0	21.9	40	13	10.9	10.0	4.0
15	09-15 Apr.	0.0	0	40.2	21.9	45	16	10.9	10.2	4.4
16	16-22 Apr.	10.4	1	37.1	20.2	59	31	7.3	8.5	5.7
17	23-29 Apr.	0.0	0	41.4	21.1	42	12	9.5	11.8	4.7
18	30-06 May	0.0	0	42.5	24.3	42	16	11.8	10.9	5.0
19	07-13 May	4.8	1	42.0	23.7	52	16	11.6	10.5	8.1
20	14-20 May	0.5	0	41.0	24.7	49	18	12.1	12.2	8.8
21	21-27 May	0.0	0	40.1	25.0	49	21	12.0	11.6	7.6
22	28-03 June	2.2	0	39.0	24.7	61	29	10.5	9.7	5.8
23	04-10 June	68.8	2	37.1	22.6	71	37	7.0	7.5	7.2
24	11-17 June	59.8	1	36.2	22.7	75	42	7.2	10.0	6.3
25	18-24 June	52.4	3	34.2	21.9	82	56	4.3	7.0	8.0
26	25-01 July	72.4	4	31.9	20.9	86	61	2.9	2.8	7.8
27	02-08 July	14.8	2	31.7	21.0	80	60	4.9	6.0	9.3
28	09-15 July	0.0	0	32.1	20.8	76	53	4.8	3.5	6.5
29	16-22 July	17.8	1	33.3	21.3	79	53	5.0	6.2	4.7
30	23-29 July	108.8	4	32.2	19.6	85	64	3.8	6.4	4.1
31	30-05 Aug	2.2	0	31.4	20.2	82	64	4.4	6.0	4.4
32	06-12 Aug	15.4	2	30.9	18.9	83	65	4.5	5.4	6.8
33	13-19 Aug	2.5	0	31.4	19.3	84	59	4.5	4.2	5.4
34	20-26 Aug	72.6	4	31.8	19.8	85	58	4.9	7.2	4.6
35	27-02 Sept	165.7	4	31.2	20.4	94	68	4.1	5.9	3.3
36	03-09 Sep	24.2	1	31.1	20.9	83	62	4.5	6.2	3.8
37	10-16 Sep	25.5	3	32.3	20.4	88	62	4.4	8.0	3.7
38	17-23 Sep	105.6	6	30.5	17.5	93	72	3.6	4.0	4.1
39	24-30 Sep	20.2	2	31.8	20.3	86	62	3.9	8.3	3.1
40	01-07 Oct.	0.0	0	32.6	18.4	79	44	5.5	9.1	4.3
41	08-14 Oct.	0.0	0	33.5	15.3	77	44	5.8	9.7	2.6
42	15-21 Oct.	0.0	0	33.1	13.8	75	33	4.4	10.0	2.7
43	22-28 Oct.	0.0	0	32.3	10.4	76	38	4.6	10.4	5.1
44	29-04 Nov.	16.2	1	31.2	16.2	81	48	4.3	6.7	3.6
45	05-11 Nov.	0.0	0	33.1	13.7	77	36	4.8	10.1	2.2
46	12-18 Nov.	0.0	0	31.5	9.8	78	29	4.4	10.0	2.7
47	19-25 Nov.	0.0	0	29.4	7.6	77	30	4.1	10.5	3.2
48	26-02 Dec.	0.0	0	29.6	8.6	73	32	4.1	9.1	3.2
49	03-09 Dec.	0.0	0	28.1	9.9	77	31	4.0	7.1	3.5
50	10-16 Dec.	0.0	0	29.9	12.7	68	38	4.4	8.7	2.8
51	17-23 Dec.	0.0	0	30.0	12.6	69	33	4.8	9.9	4.4
52	24-31 Dec.	0.0	0	28.7	12.1	62	27	4.1	8.6	1.9
	<b>Total</b>	<b>853.8</b>								

MW = Meteorological week  
BSS = Bright sunshine hours

RF = Rainfall      EVP = Evaporation  
WS = Wind speed