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EFFECT OF INM PRACTICES ON THE MORPHOLOGICAL, PHYSIOLOGICAL AND BIOCHEMICAL PARAMETER OF ARJUN LEAF PRIMARY HOST PLANT OF *Antheraea mylitta* D.

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ABSTRACT

The present study was conducted to investigate the effect of Integrated Nutrient Management practices on the different parameter of Arjun leaf the primary host plant of *Antheraea mylitta* D. Eleven different combination with three replication were laid out in Randomized Complete Block Design at the field of Research Extension Centre, Kapistha. The obtained results showed that morphological, Physiological and Biochemical parameter of Arjun leaf showed significant difference. The Arjun leaf length was recorded highest in K_{11} (17cm) was on par with K_9 (17cm). Highest leaf breadth was recorded in K_{10} (6.2cm) was applied with 75%RDF+Poultry manure+ AB+PSB. Leaf weight was recorded highest in K_7 (2.84g), lowest in K_1(1.21g). Number of leaves was recorded highest in K_6 (1816) over the control. The leaf yield was recorded highest in K_{11} (3735). Leaves dry matter production was highest in K_8 (469.56g) over the control. Relative water content was highest in K_5 (87.3%). The initial Electrical Conductivity was recorded highest in K_9 (0.037dSm^{-1}) and after 10 min EC was found to highest in K_9 (0.111dSm^{-1}). The Chlorophyll 'a' was recorded highest in K_9 (3.39), Chl'b'(2.36)and total chlorophyll in K_9(5.75) was recorded highest. The result were found significant due to effect of INM practices which provided the nutrients element needed by plants.

Keywords: ***Antheraea mylitta;*** **Chlorophyll; Nutrient; Poultry manure and Relative water content**

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INTRODUCTION

Forest or wild sericulture is known as non-mulberry sericulture. It arrest forest destruction by permitting the utilization of natural wealth (Jolly *et al*, 2019; Fening *et al.*, 2008). Tasar culture can be carried out in remote forest villages as it does not require electricity, complex machinery, specialized skills etc. it helps in preservation of tradition, skills and improves the status of life in the rural areas by providing attractive source of income (Rubia bukhari *et al.*, 2019). Indiscriminate use of chemical fertilizers leads to environmental pollution as well as deteriorate soil health. Which lead to thrust on organic farming for an eco-friendly sericulture and its potential for improving the sericulture industry. Which improve the leaf, cocoon as well as silk production and quality (Chowdhury P *et al*., 2009). Sericulture depends on many factors which ensure productivity and profitability such as climatic condition, soil health, environmental factors and nutrient management etc. Out of these factors soil health and nutrient management are the most important factor as the yield and quality of leaves directly or indirectly depend on" how the soil is handled" soil is the key factor in this regard (Karlen D.L *et al.*,1997). Forest aboriginal had started rearing of tasar silkworms for centuries. Tasar is a variety of silk mainly produced by tropical tasar silkworm (*Antheraea mylitta* D) and temperate tasar silkworm (*Antheraea proyeli* J) by feeding on primary host plants (Arjun, Asan and Sal), Dozens of secondary host plants and Oak plants (*Querecus sp.)*(Vishaka *et al*., 2020).

The life cycle of Tasar silkworm consist of four stages-Egg, Larva, Pupa and Adult. Egg-The egg is oval in shape, dorso-ventrally flattened and bilaterally symmetrical along the anterio-posterior axis. Larva- The newly hatched larva is dull brownish yellow with black head, measuring about 7mm long and 1 mm diameter and weighs about 8mg. At maturity measures about 13cm long and 2.1 cm diameter and weighs about 50gm. The fully grown larva spins the cocoon by taking the support of one or two leaves and a peduncle to firmly cling to the plant and this is the stage which is exploited for the production of silk. The pupa is killed by boiling in hot water and the thread from the cocoon is extracted. Pupa- It is the resting stage which last for days to months. Moths-Females are bigger (4.5 cm) with a broad abdomen and narrow bipectinate antennae of 1.5 cm long. Males are smaller (4.0cm) with a narrow abdomen and broad antennae. Female lays around 200-300 eggs (Rubia bukhari *et al.*,2019).

The growth and development of tasar silkworm larvae depend on nutritional contents of leaves (Srivastava *et al.*,2017). The chemical composition of leaves greatly varies based on genotype and application of manures fertilizers. The chlorophyll coloration is related to the amount of nutrients absorbed by the plant from the soil (Follet *et al.*,1981). In vermicompost nutrient are present in plant available form such as nitrates, phosphates and exchangeable calcium and soluble potassium (Edwards,1998, Orozco,1996) and improves the soil physical properties by decreasing bulk density and by increasing the soil water holding capacity. Organic composts are source of plant nutrients which are valuable and inexpensive fertilizer (Khashayar rigi,2014) that create less

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environmental pollution than chemical composts, due to their biological effect and modification of physical and chemical characteristics of soil because the nutrients present are released slowly to be used by the plant (Roe,1997).Organic agriculture promotes and enhances agro-ecosystem, health including biodiversity, biological cycles and soil biological activity (Samman *et al.*,2008).Microorganism present in the soil fixes atmospheric nitrogen, solubilise the insoluble phosphate to soluble phosphate, synthesize growth promoting substances and helps in decomposition of plant residues by releasing vital nutrients and increasing the soil humic contents (Wu *et al.*,2005). Bio-fertilization is a very safe process for human, animal and environment which lower the pollution and cost of fertilization is reduced and also improves the soil biota and minimize the use of chemical fertilizer (Sabashini *et al.*,2007). The protein content of leaves is directly correlated to the weight of cocoons for normal silk production during the 5^{th} instars of the caterpillar water content of leaves serve as one criteria for assessing the quality (Kafian Alexander,1960, Parpieu,B.A.1968). The objective of the present study was to assess the effect of INM practices on the morphological, physiological and biochemical parameters of Arjun leaf.

MATERIALS AND METHODS

The present investigation was carried out at Research Extension Centre, Kapistha to assess the effect of Integrated Nutrient Management practices on the morphological, physiological and biochemical parameters of Arjun leaf. Eleven different combinations with three replication were laid out in Randomized Complete Block Design (Table1).

Table 1: Treatment details (REC, Kapistha)

Treatments denotes	Treatments detail
K_1 :	Absolute control
K_2 :	RDF(N,P and K @100-50-50 kg/h/year)
K_3 :	AB
K_4 :	PSB
K_5 :	75%RDF+PSB
K_6 :	75%RDF+AB
K_7 :	AB+PSB
K_8 :	Poultry manure

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K_9	:	Sheep manure
K_{10}	:	75%RDF+Poultry manure +AB+PSB
K_{11}	:	75% RDF+ Sheep manure +AB+PSB

1. Sample collection and Processing

Leaf sample were collected from each treatments for further analysis.

2. Morphological parameters

The following growth parameters were recorded after the treatments (Mallapa,2015).

2.1 Length and Breadth of Leaf (cm)

Length and Breadth of leaf were measured from each treatment.

2.2 Weight of Single Leaf (g)

Weight of single leaf from each treatment were recorded

2.3 Number of leaves plant^{-1}

Total number of leaves per treatment were counted.

2.4 Leaf Yield (g plant^{-1})

Leaf yield per plant was recorded on fresh weight basis in grams.

2.5 Dry matter production of leaf (g plant^{-1})

Leaves of each treatment were collected randomly and were air dried followed by oven drying 60ºC to a constant weight and expressed in grams.

3. Physiological Parameters

3.1 Relative water content (RWC)

The RWC of the leaf tissue was estimated according to the method (Slatyer, R.D.,1955). About one g fresh leaves sample was weighed and dipped in 20 ml distilled water for three hour. After three hours, the turgid weight of the leaves was taken and then kept for drying in 90ºC in a hot air oven till the weight became constant. It was expressed in percentage. The RWC was computed as

$$\text{RWC \%} = \frac{\text{Fresh weight of leaf} - \text{Dry weight of leaf}}{\text{Turgid weight-Dry weight}} \times 100$$

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3.2 Electrical Conductivity of leaf

The electrical conductivity of the leaf was estimated using the method of Bower and Wilcox, 1965. About 1 gm of fresh leaf was taken then dipped in 50 ml distilled water for 10 min. After 10 min EC was measured using an electrical conductivity meter and then kept in a water bath at 60º C for 10 min and EC was measured.

4. Biochemical parameters

4.1 Chlorophyll estimation

Chlorophyll content of the leaves was determined by procedure described by Hiscox and Israelstam,1979 . The Chlorophyll a, b and total content of leaf (mg/g fresh weight) were computed using the formula suggested by Arnon,1949 .

$$\text{Chlorophyll 'a'} = \frac{12.7(A663) - 2.69(A645)}{1000g \times \text{Weight of leaves(g)}} \times \text{Volumes}$$

$$\text{Chlorophyll 'b'} = \frac{22.9(A645) - 4.68(A663)}{1000g \times \text{Weight of leaves(g)}} \times \text{Volumes}$$

$$\text{Total Chlorophyll} = \frac{22.2(A645) - 8.02(663)}{1000g \times \text{Weight of leaves(g)}} \times \text{Volumes}$$

5. Statistical Analysis

Statistical analysis was carried out using ANOVA and SPSS 20.0 and Duncan's Multiple Range Test (DMRT) was used to determine significance of the difference between individuals means (Gomez and Gomez,1984).

RESULTS AND DISCUSSION

The leaf morphological, physiological and biochemical parameters were found to be significant.

1. **Morphological parameters of Arjun leaf**
   a. **Growth parameters**

   The organic resources improves growth parameters, leaf yield and quality due to proper decomposition, mineralization, solubilizing effects and sufficient nutrient availability. This was corroborated with the finding of Das *et al*.,1990, Setua *et al.*,2007 and Sudhakar *et al.*,2000 and due to slow and steady release of nutrients in addition to supply of important macro and micronutrients besides supply of N and P by nitrogen fixing bacteria and phosphorus solubilizing bio-inoculants respectively(Khan and Pariari,2012, Rashmi *et al*,2006 and B. Mallapa *et al*,2016). The leaf length and breadth showed significant difference after the application of different treatments. Highest mean of leaf length 17 cm

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was recorded in K_9 and K_{11} while mean of leaf breadth was recorded in K_{10} (6.2cm) was on par with K_7 (6cm). The leaf weight was recorded highest in K_7 (2.84gm) was applied with AB+PSB. Highest number of leaves was recorded in K_6 (1816) which was applied with 75%RDF+AB followed by K_8(1806). Increase in number of leaves per plant, average leaf length, leaf width, plant girth was reported by P.S. Choudhuri *et al.*,2016, M.K.Singh,2012 and B. Mallapa *et al.*,2016 reported increase in leaf number per plant. Increase in plant height, number of shoots, number of leaves, leaf area index, dry matter production and leaf yield in mulberry was reported by Dalal and Nandkar,2006 and Rajeshwari *et al.*,2006. The fresh leaf yield ranged from 1542-3735g/plant with a mean of 3094.78 g/plant. The highest leaf yield was recorded in K_{11} (3735g) was applied with 75% RDF +Sheep manure +AB+PSB was followed by K_9(3730g) and K_8(3718g). Increase in fresh weight of leaves, dry weight of leaves of tomato due to combined application of organic and inorganic fertilizer was reported by Meenakumari T and Shekhar M,2012. Leaf weight is directly related to the level of N applied (Pushkarnath 1976 and Taya *et al.*,1994). The leaf dry matter production ranged from 114.75-469.56 g/plant with a mean of 267.88g/plant. The highest dry matter was recorded in K_8 (469.56g) was applied with poultry manure. Lowest dry matter was recorded in control i.e.K_1 (114.75g). Increase in dry matter production is due to release of nitrogen from the organic waste and fixation of nitrogen by the biofertilizer which contributed to the higher nitrogen uptake (V. Kumar *et al.*,2007).Increase in dry matter content was reported by R.L. Ram *et al.*,2017.

Table 2. Leaf morphological characters [leaf length (cm), breadth (cm), leaf weight (g leaf^{-1}), No. of leaves plant^{-1}, leaf yield plant^{-1} and total leaves dry matter production (g plant^{-1})] *Terminalia arjuna* as influenced by various INM practices at REC, Kapistha

Treatments	Leaf length	Leaf breadth	Leaf weight	No. of leaves	Leaf yield	Leaves DMP
K1	11.6^{g}	4.2^{g}	1.21^{d}	1275^{e}	1542^{f}	114.75^{i}
K2	12.5^{f}	4.6^{f}	1.35^{d}	1345^{e}	1814^{e}	161.4^{h}
K3	13.2^{ef}	4.9^{e}	1.82^{c}	1619^{c}	2941^{d}	242.85^{e}
K4	14.0^{cd}	5.9^{b}	1.84^{c}	1766^{ab}	3242^{c}	211.92^{f}
K5	14.4^{bc}	5.2^{d}	1.74^{c}	1698^{b}	2961^{d}	365.58^{b}
K6	14.9^{b}	5.8^{bc}	1.96^{c}	1816^{a}	3557^{b}	308.72^{c}
K7	16.3^{a}	6^{ab}	2.84^{a}	1309^{e}	3665^{ab}	261.8^{d}
K8	15^{b}	5^{de}	2.08^{c}	1806^{a}	3718^{ab}	469.56^{a}

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K9	17^{a}	5.6^{c}	2.56^{c}	1452^{d}	3720^{ab}	188.76^{g}
K10	13.6^{de}	6.2^{a}	2.16^{b}	1457^{d}	3142^{c}	305.97^{c}
K11	17^{a}	5.8^{bc}	2.44^{c}	1509^{d}	3735^{a}	315.38^{c}
Mean	**14.50**	***5.38***	***2.00***	***1550***	***3094.78***	***267.88***
Range	***11.60-17.00***	***4.20-6.20***	***1.21-2.84***	***1275-1816***	***1542-3735***	***114.75-469.56***
SEm.±	***0.27***	***0.08***	***0.03***	***24.66***	***48.18***	***5.02***
LSD (P=0.05)	***0.79***	***0.23***	***0.08***	***73.27***	***143.12***	***14.90***

2. Physiological parameters of Arjun leaf

a. Relative water and EC content

The physiological parameters were found to be significantly due to INM practices. The Relative Water Content (RWC) ranged from 66.83-87.30(%) with a mean of 77.96%. The highest RWC was observed in treatment K_5 (87.35%) was applied with 75%RDF+PSB was followed by K_7 (85.76%). RWC indicate the internal plant water status under drought conditions(Parsons and Howe,1984).Leaf pigment get damaged by water deficit as reported by (Montag U and Woo,1990; Nilsen and Orcuts,1996), due to production of Reactive Oxygen Species(ROS) such as O_2^- and H_2O_2 lead to lipid peroxidation and thus chlorophyll destruction(Mirnoff,1993, Foyer *et al*.,1994). The Chlorophyll is destroyed by water deficit and formation also prevented (Lessani and Mojtahedi, 2002).The EC content was found significant due to different nutrient application. The EC content ranged from 0.025-0.037dSm^{-1} with a mean of 0.031dSm^{-1} and after 10 min water bath treatment the EC ranged from 0.057-0.111 dSm^{-1} with a mean of 0.090dSm^{-1}. The EC index salt concentration and related to the amount of ions available to plants in the root zone (Nemali KS, Van lersel MW,2004).

Table 3 Leaf quality characters [Relative water content (%) and electrical conductivity of leaves (dS m^{-1})] of *Terminalia arjuna* as influenced by various INM practices at REC, Kapistha

Treatments	RWC	EC content	
		Initial	After 10 minutes
K1	66.83^{i}	0.025	0.057
K2	68.17^{h}	0.026	0.072

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K3	84.12[c]	0.027	0.076
K4	83.22[d]	0.037	0.102
K5	87.3[a]	0.027	0.079
K6	74.89[fg]	0.030	0.090
K7	85.76[b]	0.032	0.105
K8	77.74[e]	0.030	0.095
K9	82.56[e]	0.037	0.111
K10	77.69[f]	0.032	0.098
K11	69.36[g]	0.034	0.103
Mean	***77.96***	***0.031***	***0.090***
Range	***66.83-87.30***	***0.025-0.037***	***0.057-0.111***
SEm.±	***0.82***	***0.001***	***0.001***
LSD (P=0.05)	***2.43***	***0.002***	***0.003***

3. Biochemical parameters of Arjun leaf

a. Chlorophyll content

The chlorophyll content was recorded significant. The chlorophyll'a' ranged from 1.10-3.39(mg/l) with a mean of 2.073mg/l. The highest chl 'a' was recorded in K_9 (3.39mg/l) was applied with sheep manure. The chl 'b' was recorded highest in K_9 (2.36mg/l) and lowest inK_1 (0.58mg/l). The total chlorophyll ranged from 1.68-5.75(mg/l) with a mean of 3.407mg/l with highest mean in K_9 (5.75 mg/l) and ;lowest mean in K_1(1.68 mg/l). chlorophyll content Increase due to fertilization. Fertilization enhances the formation of pigments and thus increases chlorophyll (Amany S Al-Eray *et al.*,2016).Nitrogen is one of the structural element of chlorophyll and protein molecules. Fertilization with N influence the chlorophyll content by affecting the formation of chloroplasts and accumulation of chlorophyll (Ray Tucher,2004). Nitrogen plays a greater role in improving the chlorophyll synthesis because it is essential constituents of photosynthesis (Singhal *et al.*,2000). Rashmi et al.,(2009) observed that the total chlorophyll content was maximum with the application of chemical fertilizers along with biofertilizers, compost, vermicompost, green manure and castor cake.

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Table 4 Biochemical characters [crude protein (%), total carbohydrate (mg g^{-1})] and Chlorophyll(mg/l) conent of *Terminalia arjuna* leaves as influenced by various INM practices at REC, Kapistha

Treatments	Chlorophyll content		
	Chlorophyll 'a'	Chlorophyll 'b'	Total Chlorophyll
K1	1.1	0.58	1.68
K2	1.43	0.83	2.26
K3	1.55	0.76	2.31
K4	1.74	1.02	2.76
K5	1.90	1.18	3.08
K6	2.42	1.23	3.65
K7	2.82	1.52	4.34
K8	2.40	1.37	3.77
K9	3.39	2.36	5.75
K10	2.15	2.06	4.21
K11	1.90	1.77	3.67
Mean	**2.073**	**1.335**	**3.407**
Range	***1.10-3.39***	***0.58-2.36***	***1.68-5.75***
SEm.±	***0.04***	***0.02***	***0.05***
LSD (P=0.05)	***0.12***	***0.07***	***0.15***

CONCLUSION

Find indicate that application of INM practices had improved the morphological, physiological and biochemical parameters of Arjun leaf. Based on the present results, it can be recommended to use INM practices in sericulture to get a good quality of leaves and better cocoon production.

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