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REPRODUCTIVE TRAITS OF SILKWORM (*BOMBYX MORI L.*) AS INFLUENCED BY FEEDING OF MULBERRY LEAF RAISED THROUGH THE CONCEPT OF ORGANIC FARMING

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ABSTRACT

An experiment was conducted on reproductive traits of silkworm as influenced by mulberry leaf through application of different sources of organic manures and inorganic fertilizers. The results indicated that, feeding schedule (FS_2) chawki worms fed with S_{36} leaf and late-age worms fed with M_5 leaf and treatment T_{12} Recommended 20 tonnes of compost + 300: 120: 120 kg N, P and K / ha / year through fertilizer were recorded maximum towards pupal weight (1.10 and 1.17 g), rate of pupation (88.45 and 93.17 %), rate of moth emergence (88.37 and 93.60 %), fecundity (478.46 and 502 eggs/ laying), hatchability (89.98 and 92.32 %) and gravid moth weight (0.684 and 0.718 g) respectively and lowest pupal duration (289.39 and 282.07 hrs) and melting percentage (2.85 and 2.0 %) was recorded. However, in interaction effects, FS_2T_{12} contributed more towards pupal weight (1.20 g), rate of moth emergence (95.07 %), rate of pupation (95.0 %) fecundity (523 Nos) and hatchability (95.59 %). But the pupal duration and melting percentage were lower in S_2T_{12} (279.72 h and 1.0 %)and gravid moth weight (0.777 g) was maximum in FS_3T_{11} (chawki worms fed with M_5 leaf and late-age worms fed with S_{36} leaf with a combination of Bio-fertilizers 10 kg each of *Azospirillum* + *Aspergillus awamori*/ha/yr + 20 % recommended N through each of Compost, Green manure, Castor oil cake, vermicompost and fertilizer + remaining P, K through fertilizer.

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INTRODUCTION

Apart from the mulberry yield, leaf quality is most important for productive sericulture. This has necessitated the use of large quantities and frequent application of inorganic fertilizers due to the highly intensive cropping system of mulberry. Nitrogen source is one of the key element in mulberry nutrition and thereby silkworm nutrition. In India, fertilizer prices have been subsidized thereby encouraging the farmers to optimize the usage of fertilizers for maximization of production. But on account of energy crisis and increased fertilizer prices, organic manures are commonly used. Since, organic manures are bulky in nature but contain all the essential nutrients that are required for plant growth and development.

Therefore, organic manures and fertilizer management plays an important role in improving the yield and quality of mulberry. In this context, the concept of organic farming stands out as an alternative. The integrated nutrient management in mulberry has a profound effect on the quality of leaves particularly micronutrients like; iron, zinc and total soluble sugar content. This inturn has a significant effect on the chawki worm and late-age worm performance (Shankar, 1990). The influence of organic based nutrition to mulberry and inturn its effect on reproductive biological traits has not been studied so far. The present experiment was therefore, undertaken to study these aspects since healthy and sound seed in the basis for effective cocoon crop.

MATERIALS AND METHODS

A research study was under taken at Main Research Station, Hebbal, UAS, Bangalore to work out the influence of feeding mulberry leaf raised through the application of recommended quantity of N through different organic and inorganic fertilizers on reproductive traits of silkworm. Silkworm feeding with two different mulberry varieties (S_{36} and M_5) in four feeding schedules (FS) viz., FS_1 (chawki worms fed with S_{36} leaf + late age worms fed with S_{36} leaf), FS_2 (chawki worms fed with S_{36} leaf + late age worms fed with M_5 leaf), FS_3 (chawki worms fed with M_5 leaf + late age worms fed with S_{36} leaf) and FS_4 (chawki worms fed with M_5 leaf + late age worms fed with M_5 leaf) respectively. The leaves of two different mulberry varieties grown under different treatments viz.,

The experiment was conducted with 13 treatments and 3 replications. In each replication 100 worms were maintained. The CSR_2 worms were reared as per package of practices published by Dandin *et al.* (2014). The data was analyzed statistically by using two way factorial RCBD as outlined by Cochron and Cox (2000).

RESULTS

The results on the influence of feeding mulberry leaf raised through the organic farming concept on reproductive traits are tabulated in Tables 1, 2 and 3 and are interpreted hereunder. Pupal weight and Pupal duration were found to be influenced by the application of N through different sources of organic manures and inorganic fertilizers. Significantly higher pupal weight and lesser pupal duration were registered in T_{12} Recommended 20 tones compost + 300: 120: 120 kg N, P and K / ha / year through fertilizer (1.17 g and 282.07 h). Increase in pupal weight and shorter pupal duration may be due to advancing onset of pupation and also due to metabolic activities. Thus helps in increasing the quantitative traits of silkworm. The treatment combination T_{12} had influenced significantly higher rate of moth emergence (93.60 %) compared to the control T_{13} (80.42 %). Among various treatments, T_{11} Bio-fertilizers 10 kg each of *Azospirillum* + *Aspergillus awamori*/ha/yr + 20 % recommended N through each of Compost, Green manure, Castor oil cake, vermicompost and fertilizer + remaining P, K through fertilizer recorded significantly higher pupation rate (93.17 %) followed by T_{12} (93.11 %) compared to others.

T_1 : 100 % recommended N through Compost
T_2 : 50 % recommended N through Compost + 50 % recommended N and remaining P, K through fertilizer
T_3 : 100 % recommended N through Green manure (*Glyricidia maculata*)
T_4 : 50 % recommended N through Green manure + 50 % recommended N and remaining P, K through Fertilizer
T_5 : 100 % recommended N through Castor oil cake
T_6 : 50 % recommended N through Castor oil cake + 50 % recommended N and remaining P, K through Fertilizer
T_7 : 35 % recommended N through Compost + 30 % recommended N through Castor oil cake + 35 % recommended N through Green manure
T_8 : 100 % recommended N through Vermicompost
T_9 : 50 % recommended N through Vermicompost + 50 % recommended N and remaining P, K through Fertilizer
T_{10} : Bio-fertilizers 10 kg each of *Azospirillum* + *Aspergillus awamori*/ha/yr + 25% recommended N through each of Compost, Green manure, Castor oil cake and vermicompost
T_{11} : Bio-fertilizers 10 kg each of *Azospirillum* + *Aspergillus awamori*/ha/yr + 20 % recommended N through each of Compost, Green manure, Castor oil cake, vermicompost and fertilizer + remaining P, K through fertilizer
T_{12} (control) : Recommended 20 tonnes compost + 300: 120: 120 kg N, P and K / ha / year through fertilizer
T_{13} (control) : Only fertilizer 300: 120: 120 kg of N, P and K / ha / year

Table 1: Pupal weight (g) and Pupal duration (h) as influenced by feeding of leaf obtained by application of N through different sources of organic manures and inorganic fertilizers

Treatments (T)	Pupal weight (g) and Pupal duration (h)								Mean	
	Feeding Schedules (FS)								(T)	
	FS_1		FS_2		FS_3		FS_4			
	PW	PD	PW	PD	PW	PD	PW	PD	PW	PD
T_1	1.07	292.74	1.08	295.67	1.06	293.57	1.04	293.18	1.06	293.79
T_2	1.07	291.18	1.09	292.16	1.03	291.20	1.07	293.28	1.06	291.95
T_3	1.09	291.87	1.06	291.06	1.06	293.32	1.07	292.10	1.07	292.09
T_4	1.08	291.39	1.09	291.14	1.06	294.45	1.06	293.30	1.07	292.54
T_5	1.05	289.24	1.04	287.68	1.03	292.57	1.03	294.69	1.03	291.04
T_6	1.08	286.00	1.10	283.14	1.07	289.65	1.07	287.15	1.08	286.48
T_7	1.04	291.15	1.10	295.19	1.05	293.78	1.06	293.15	1.06	293.32
T_8	1.06	287.69	1.09	294.22	1.03	295.20	1.05	293.22	1.05	292.58
T_9	1.10	283.07	1.10	284.57	1.08	284.74	1.07	285.38	1.09	285.44
T_{10}	1.09	288.50	1.11	288.27	1.11	291.24	1.09	291.12	1.10	289.78
T_{11}	1.14	282.89	1.17	282.15	1.11	285.41	1.14	286.90	1.14	284.34
T_{12}	1.15	283.55	1.20	279.72	1.15	283.44	1.18	281.57	1.17	282.07
T_{13}	1.03	297.52	1.06	297.15	1.04	305.24	1.02	302.72	1.03	300.65
Mean (S)	1.08	288.98	1.10	289.39	1.06	291.83	1.07	291.35		

	Feeding Schedules (FS)		Treatments (T)		Interactions (FS × T)	
	PW	PD	PW	PD	PW	PD
F-Test	*	*	*	*	*	*
SEm ±	0.0016	0.254	0.0028	0.457	0.0057	0.914
CD at 5 %	0.0044	0.703	0.0079	1.266	0.0157	2.534

PW = Pupal weight
PD = Pupal duration
Note: FS_1 : Chawki worms fed with S_{36} leaf + Late age worms fed with S_{36} leaf
FS_2 : Chawki worms fed with S_{36} leaf + Late age worms fed with M_5 leaf
FS_3 : Chawki worms fed with M_5 leaf + Late age worms fed with S_{36} leaf
FS_4: Chawki worms fed with M_5 leaf + Late age worms fed with M_5 leaf

Table 2. Rate of pupation and moth emergence (%) as influenced by feeding of leaf obtained by application of N through different sources of organic manures and inorganic fertilizers

Treatments (T)	Rate of pupation and Rate of moth emergence (%)								Mean (T)	
	Feeding Schedules (FS)									
	FS_1		FS_2		FS_3		FS_4			
	ROP	RME	ROP	RME	ROP	RME	ROP	RME	ROP	RME
T_1	87.16	85.14	85.15	87.23	84.27	84.21	83.72	83.17	85.07	84.93
T_2	86.73	85.22	84.72	84.92	84.79	85.13	84.84	83.69	85.27	84.74
T_3	85.50	82.71	83.18	83.91	82.57	81.18	85.13	83.33	84.09	82.78
T_4	87.43	85.83	85.93	85.23	84.21	83.26	86.18	86.43	85.94	85.18
T_5	83.35	83.42	84.38	83.20	81.75	79.38	84.74	85.45	83.56	82.86
T_6	93.31	88.96	94.44	91.64	89.67	86.93	89.23	88.44	91.66	88.99
T_7	85.12	85.71	87.82	87.37	83.85	84.70	87.33	85.55	86.03	85.83
T_8	87.23	85.21	88.03	86.99	86.07	84.88	85.02	85.30	86.59	85.99
T_9	91.63	91.27	92.03	93.57	90.18	89.12	89.53	88.72	90.84	90.67
T_{10}	91.27	90.12	92.77	94.22	89.22	90.62	93.34	91.18	91.65	91.53
T_{11}	92.35	91.70	94.27	94.81	92.25	90.29	93.80	91.12	93.17	91.98
T_{12}	93.36	93.96	95.00	95.07	89.34	92.17	94.72	93.32	93.11	93.60
T_{13}	81.63	82.79	82.14	80.64	81.39	79.22	80.72	79.05	81.47	80.42
Mean (S)	88.16	87.08	88.45	88.37	86.12	85.41	87.46	86.51		

	Feeding Schedules (FS)		Treatments (T)		Interactions (FS × T)	
	ROP	RME	ROP	RME	ROP	RME
F-Test	*	*	*	*	*	*
SEm ±	0.1104	0.163	0.1991	0.295	0.3982	0.590
CD at 5 %	0.3016	0.453	0.5518	0.817	1.1035	1.635

ROP = Rate of pupation
RME = Rate of moth emergence

Note: FS_1 : Chawki worms fed with S_{36} leaf + Late age worms fed with S_{36} leaf
FS_2 : Chawki worms fed with S_{36} leaf + Late age worms fed with M_5 leaf
FS_3 : Chawki worms fed with M_5 leaf + Late age worms fed with S_{36} leaf
FS_4: Chawki worms fed with M_5 leaf + Late age worms fed with M_5 leaf

Table 3: Fecundity (eggs/laying) and Hatchability (%) as influenced by feeding of leaf obtained by application of N through different sources of organic manures and inorganic fertilizers

Treatments (T)	*Fecundity (eggs/laying) and Hatchability (%)*								*Mean*	
	Feeding Schedules (FS)									
	FS_1		FS_2		FS_3		FS_4			
	Fecundity	Hatchability	Fecundity	Hatchability	Fecundity	Hatchability	Fecundity	Hatchability	Fecundity	Hatchability
T_1	457.00	85.45	462.00	86.58	457.00	83.58	457.00	84.46	458.25	85.01
T_2	462.00	86.68	469.00	91.07	460.50	85.67	462.00	84.71	463.37	87.28
T_3	459.00	84.74	462.00	86.36	458.50	84.73	460.00	84.78	459.87	85.15
T_4	466.00	86.58	472.00	87.71	462.00	85.37	465.00	85.81	466.04	86.37
T_5	462.00	85.82	463.00	87.90	456.00	85.16	459.00	84.62	460.00	86.07
T_6	478.00	87.86	483.00	90.67	479.00	86.53	481.00	86.69	480.25	87.94
T_7	471.00	86.73	477.00	88.78	463.00	84.66	467.00	86.50	469.50	86.66
T_8	469.00	87.64	481.00	89.60	466.50	86.06	468.50	87.12	471.37	87.60
T_9	485.00	90.61	486.00	92.59	479.00	87.57	482.00	88.27	483.00	89.76
T_{10}	491.00	92.05	493.00	94.21	485.00	88.14	487.00	88.81	489.00	90.80
T_{11}	499.00	93.18	506.00	94.22	487.00	90.66	491.00	89.17	495.75	91.81
T_{12}	499.00	93.08	523.00	95.59	491.00	90.04	495.00	90.57	502.00	92.32
T_{13}	434.00	82.59	443.00	84.53	433.00	80.72	434.00	81.24	436.00	82.27
Mean (S)	471.73	87.92	478.46	89.98	467.50	86.13	469.82	86.44		

	Feeding Schedules (FS)		Treatments (T)		Interactions (FS × T)	
	Fecundity	Hatchability	Fecundity	Hatchability	Fecundity	Hatchability
F-Test	*	*	*	*	*	*
SEm ±	0.321	0.147	0.580	0.265	1.160	0.531
CD at 5 %	0.891	0.408	1.607	0.736	3.215	1.472

Note: FS_1 : Chawki worms fed with S_{36} leaf + Late age worms fed with S_{36} leaf
FS_2 : Chawki worms fed with S_{36} leaf + Late age worms fed with M_5 leaf
FS_3 : Chawki worms fed with M_5 leaf + Late age worms fed with S_{36} leaf
FS_4: Chawki worms fed with M_5 leaf + Late age worms fed with M_5 leaf

While treatments such as T_1 100 % recommended N through Compost (85.07 5), T_4 50 % recommended N through Green manure + 50 % recommended N and remaining P, K through Fertilizer (85.94 %) and T_8 100 % recommended N through Vermicompost (86.59 %) were on par with each other with respect to pupation rate. Silkworm fed with leaf by application of T_{12} and T_{11} recorded significantly higher fecundity (502.00 and 495.75 eggs/laying) compared to control (436.00 eggs/laying).

Hatchability percentage was significantly influenced by the application of different sources of organic manures and inorganic fertilizers. However, hatchability was significantly higher in T_{12} (92.32 %) whereas, lower hatchability were found in control T_{13} (82.27 %). Melting percentage was significantly lower in T_{12} (2.0 %) followed by T_{10} (2.12 %). Significantly maximum gravid moth weight was encountered in T_{11} (0.726 g) compared to control (0.673 g) (Table 4). Feeding of chawki worms with S_{36} and late-age worms with M_5 mulberry leaf

Table 4. Melting percentage and gravid moth weight (g) as influenced by feeding of leaf obtained by application of N through different sources of organic manures and inorganic fertilizers

Treatments (T)	Melting percentage and gravid moth weight (g)								Mean (T)	
	Feeding Schedules (FS)									
	FS_1		FS_2		FS_3		FS_4			
	MP	GMW	MP	GMW	MP	GMW	MP	GMW	MP	GMW
T_1	3.00	0.656	2.50	0.662	3.50	0.668	3.50	0.655	3.12	0.660
T_2	3.50	0.664	3.50	0.672	3.00	0.665	3.50	0.664	3.37	0.666
T_3	3.50	0.653	2.50	0.657	4.00	0.652	3.00	0.653	3.25	0.653
T_4	3.50	0.671	3.16	0.677	2.50	0.668	3.00	0.672	3.04	0.672
T_5	4.50	0.653	3.50	0.661	3.50	0.659	3.00	0.653	3.62	0.656
T_6	2.50	0.681	2.50	0.692	3.50	0.675	3.00	0.676	2.87	0.681
T_7	4.50	0.669	3.50	0.678	3.00	0.670	3.00	0.669	3.50	0.671
T_8	4.00	0.671	3.00	0.685	3.16	0.672	4.00	0.671	3.54	0.674
T_9	2.50	0.689	2.50	0.697	3.50	0.679	2.50	0.685	2.75	0.687
T_{10}	1.50	0.691	2.50	0.708	1.50	0.691	3.00	0.689	2.12	0.694
T_{11}	2.50	0.707	2.50	0.723	3.00	0.779	2.50	0.698	2.62	0.726
T_{12}	1.50	0.717	1.00	0.740	3.00	0.708	2.50	0.707	2.00	0.718
T_{13}	3.50	0.642	4.50	0.651	4.50	0.641	3.16	0.639	3.91	0.643
Mean (S)	3.11	0.674	2.85	0.684	3.20	0.679	3.05	0.671		

	Feeding Schedules (FS)		Treatments (T)		Interactions (FS × T)	
	MP	GMW	MP	GMW	MP	GMW
F-Test	*	*	*	*	*	*
SEm ±	0.091	0.0031	0.164	0.0057	0.328	0.0113
CD at 5 %	0.252	0.008	0.454	0.0157	0.909	0.0314

MP = Melting percentage
GMW = Gravid moth weight

Note: FS_1 : Chawki worms fed with S_{36} leaf + Late age worms fed with S_{36} leaf
FS_2 : Chawki worms fed with S_{36} leaf + Late age worms fed with M_5 leaf
FS_3 : Chawki worms fed with M_5 leaf + Late age worms fed with S_{36} leaf
FS_4: Chawki worms fed with M_5 leaf + Late age worms fed with M_5 leaf

influenced various grainage parameters of CSR_2 silkworm breed. The FS_2 feeding schedule stood first for majority of the reproductive traits viz., pupal weight (1.10 g), rate of moth emergence (88.37 %), rate of pupation (88.45 %), fecundity (478.46 eggs/laying), hatchability (89.98 %), melting percentage (2.85 %) and gravid moth weight (0.684 g).

DISCUSSION

These grainage parameters of findings are in close conformity with those of Shankar *et al.,* (1999) and Sannappa *et al.,* (2001). Persual of available literature revealed that no such similar type of work was carried out. The desirable grainage parameters were recorded in T_{12} might be due to the rearing of worms on leaf obtained through the combined use of organic manure and fertilizer. However, T_{11} found to be next best treatment combination, where in different organic manures, biofertilizers with lesser dose of fertilizer were used for raising mulberry leaf. Thus, improvement in grainage parameters could be due to the fact that, these sources provide elements like Ca and S other than nitrogen. Which may be needed for the synthesis of sulphur containing amino acids like cystine and methionine, which may be needed for synthesis of chorion or eggshell development. 'Ca' may also helps in strengthening of the eggshell.

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REFERENCES

Cochran and Cox. 2000. *Experimental Design Procedures for the Behavioural Sciences*, Cole Publishing Company, pp. 319-380.

Dandin, S. B., Jayant Jayaswal and Giridhar, K. 2014. *Handbook of rfSericulture Technologies*, CSB, Bangalore, pp.346-373.

Shankar, M. A. 1990. Nutritional management of mulberry and its effect on silkworm growth and development and silk quality. *Ph. D. Thesis,* UAS, Bangalore. P. 410.

Shankar, M. A., Anithapeter, Rangaswamy, B. T., Siddappakore and Rajegowda, 1999. Grainage parameters of NB_4D_2 breed of silkworm (*Bombyx mori* L.) as influenced by graded levels and different sources of organic manures. *Crop. Res*., 18: 378-382.

Sannappa, B., Devaiah, M. C. and Govindan, R. 2001. Effect of nitrogen levels applied to rainfed mulberry on growth performance of NB_4D_2 silkworm breed of *Bombyx mori* L. *Bull. Indian. Acad. Seri*., 5: 96-104.

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