IMPACT OF SELECTIVE INTEGRATED MANAGEMENT PRACTICES ADOPTED AGAINST DEFOLIATORS OF CASTOR ON COMMERCIAL CHARACTERS OF THE ERI SILKWORM, *SAMIA CYNTHIA RICINI* BOISDUVAL

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ABSTRACT

A study has been carried out to register the impact of selective integrated management practices imposed for the management of castor defoliators on commercial characters of eri silkworm. The investigation encompasses altogether seven integrated management modules, a control was maintained for comparison. Except for the control, each treatment consist of sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS. The results revealed that the cocoon characters namely cocoon weight, cocoon yield, pupal weight, shell weight, shell yield, shell ratio and silk productivity were statistically better when eri larvae reared on the castor leaves harvested after 12th days after imposition of insecticidal spray when compared to 8th day. These parameters were better with plant based insecticidal treatments [T6: Neem oil @ 2%, T7: Pongamia oil @ 2% and T5: Mahual oil @ 2%] and the treatments that did not receive any insecticides over chemical based treatment [T3: Profenophos 50 EC @ 0.03%]. However, larvae did not spun cocoons in two chemical based treatments [T2: Fenvalerate 20 EC @ 0.02% and T4: Quinalphos 25 EC @ 0.05%]. Thus from the investigation, it can be inferred that, eri silkworms can be safely reared after 12th day of imposition of integrated management practices that include plant based insecticides namely Mahua oil, Neem oil and Pongamia oil @ 2% when compared to chemical based insecticidal sprays for recording superior commercial characters.

Key words: Castor, Chemical based insecticides, Defoliators, Plant based insecticides, *Samia cynthia ricini.*

INTRODUCTION

Apart from the quite popular marvelous mulberry silk, a few other varieties of silks that are equally attractive throughout the world and collectively called as “vanya silks” that comprises

Eri, Muga and Tasar silks. Vanya silks are also known as non – mulberry or partially domesticated wild silks, they in fact, represent finest and richest facets of India's rich culture and tradition. Among them, eri silk is becoming quite popular in recent years and contribute to the tune of 19.48 and 68.25% towards mulberry and non-mulberry silks in India, respectively [Central Silk Board Statistics, 2018-19]. Eri silkworm feed as many as 29 species of hosts, but castor [*Ricinus communis* L.] being the primary host plant for rearing of eri silkworm, its rearing has a wide scope as sizeable area can be brought under castor cultivation in agricultural land to maximize the production of castor oil seeds [Reddy *et al*., 1989, 1999 and 2002].

Among the biological constraints in castor production, undoubtedly insect pests and diseases cause considerable damage to the crop. In India, more than 107 species of insects and six species of mites recorded on castor at different phenological stages of the crop. According to Raghavaiah [2003], many of the pests of castor are of seasonal importance and their management without much use of pesticides should form a priority in eri silkworm rearing. Hence, importance should be given for alternative eco-friendly [non-chemical] strategies for the management of pests in castor.

Castor being primary food plant of eri silkworm, use of insecticides from the chemical origin with different modes of action in management of different feeding habits of pest complex of castor might have induced detrimental effect on different life stages of eri silkworm. Hence, safe techniques must need to be followed by adopting eco-friendly approaches [biorational and its formulations] for the management of pests of castor ecosystem. Management of defoliators through integrated approach is of prime importance to keep the pest population below the level of economic injury. In this context, current investigation has been undertaken by adopting integrated approaches for the management of Lepidopteran defoliating pests of castor and their safety for rearing of eri silkworm for recording commercial characters.

MATERIALS AND METHODS

The castor [variety: DCS-9] crop was raised at a spacing of 90 x 60 cm in plots of 5.0 x 5.0 m adopting Randomized Complete Block Design [RCBD]. The investigation was undertaken at

Zonal Agricultural Research Station, University of Agricultural Sciences [UAS], Gandhi Krishi Vigyan Kendra [GKVK], Bengaluru. The crop was raised as per the package of practices under rainfed condition with protective irrigation as and when required for better crop stand and to maintain required population in the field [Anonymous, 2016]. The insecticides were applied immediately after the pest appearance on the crop. Each treatment was replicated thrice. The selective integrated management practices adopted in the investigation are detailed below:

Treatments details

T0	:	Control
T1	:	Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS
T2	:	Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Fenvalerate 20 EC @ 0.02%
T3	:	Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Profenophos 50 EC 0.03%
T4	:	Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Quinalphos 25 EC @ 0.05%
T5	:	Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Mahua oil @ 2%
T6	:	Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Neem oil @ 2%
T7	:	Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Pongamia oil @ 2%

Eri silkworm rearing operations were conducted from the day of brushing to spinning as per the procedure out lined by Dayashankar [1982]. The average temperature and relative humidity recorded during rearing stood at 24.69^{o}C and 75.11%, respectively. The eri silkworms were reared in plastic trays covered by nylon mesh to prevent the mixing of larvae. The trays were kept treatment and replication-wise as these worms are highly motile during later instars [fourth and fifth]. One hundred larvae were used for the experimentation and the treatments were replicated thrice. The experiment was laid out as completely randomized design [CRD].

In order to determine the safety of integrated management practices against defoliators of castor for recording the commercial characters of eri silkworm, the leaves from each treatment

[8th and 12th day of treatment imposition] were utilized to rear the eri silkworm under laboratory conditions. The ripened eri silkworms were picked up from the rearing trays, transferred to plastic box type crates separately. The cocoons were harvested on sixth day after mounting. The commercial characters of eri silkworm namely cocoon weight, cocoon yield, pupal weight, shell weight, shell yield, shell ratio and silk productivity were recorded. The data was analyzed adopting one-way Analysis of Variance [ANOVA] using SPSS statistical package [Ver. 21.0] [Gomez and Gomez, 1984].

RESULTS

The results emanated from the current study are tabulated in Tables 1 to 3 and are presented in the following paragraphs:

Cocoon weight: Weight of cocoons differed significantly [*p≤0.01;* F-value=2003.8** and *p≤0.01;* F-value=633.3**] when they were formed from the eri worms reared on the leaves harvested after 8th and 12th days of application of pesticides to castor crop. At 8th day, highest cocoon weight [3.701g] was recorded in T0 [Control] followed by T1 [Cucumber+*T.chelonis* @ 2 lakh eggs/ha at 30 DAS] [3.438g]. Further, T5 [Mahuva oil @2%] [3.315g] and T6 [Neem oil @ 2%] [3.139g], T7 [Pongamia oil @ 2%] [2.641g] and T3 [Profenophos 50 EC @ 0.03%] [2.632g] were found next in the order with later being the least with respect to cocoon weight. However, larvae did not spun cocoons in T2 [Fenvalerate 20EC @ 0.02%] and T4 [Quinalphos 25 EC @ 0.05%]. At 12th day, cocoon weight was more in T7 [Pongamia oil @ 2%] [3.474g] followed by T1 [Cucumber+*T.chelonis* @ 2 lakh eggs/ha at 30 DAS] [3.459g] and it was at par with T0 [Control] [3.360g]. Further, T5 [Mahuva oil @ 2%] [3.322g], T6 [Neem oil @ 2%] [2.925g], T3 [Profenophos 50 EC @ 0.03%] [2.891g] and T4 [Quinalphos 25 EC@0.05%] [2.819g] were found next in the order with later being the least with respect to cocoon weight. Further, larvae did not spun cocoons in T2 [Fenvalerate 20EC @ 0.02%].

Cocoon yield: Significant difference [*p≤0.01;* F-value=2008.8** and *p≤0.01;* F-value=634.03**] was evident with respect to yield of cocoons when they were formed from eri worms reared on the leaves harvested after 8th and 12th days of imposition of selective integrated management

practices on castor crop. At 8th day after imposition of treatments, highest cocoon yield [88.83 kg/100 layings] was recorded in T0 [Control] followed by T1 [Cucumber + *T.chelonis* @ 2 lakh eggs/ha at DAS] [82.53 kg]. Further, T5 [Mahuva oil @ 2%] [79.56 kg], T6 [Neem oil @ 2%] [75.34 kg], T7 [Pongamia oil @ 2%] [63.39 kg] and T3 [Profenophos 50 EC @ 0.03%] [63.17 kg] were found next in the order with later being the least with respect to cocoon yield. The larvae did not spun cocoons in T2 [Fenvalerate 20 EC @ 0.02%] and T4 [Quinalphos 25 EC @ 0.05%]. However, at 12th day after imposition of treatments, significantly higher cocoon yield of 83.37 kg/100 layings was recorded in T7 [Pongamia oil @ 2%] followed by T1 [Cucumber + *T. chelonis* @ 2 lakh eggs/ha at 30 DAS] and T0 [Control] recorded cocoon yield of 83.00 and 80.65 kg, respectively. Further, T5 [Mahuva oil @ 2%] [79.73kg], T6 [Neem oil @ 2%] [70.19kg], T3 [Profenophos 50 EC @ 0.03%] [69.38 kg] and T4 [Quinalphos 25 EC @ 0.05%] [67.65kg] were found next in the rank with later treatment found to be lower among the treatments with respect to cocoon yield. The larvae did not spun cocoons in T2 [Fenvalerate 20 EC @ 0.02%].

Pupal weight: Weight of pupae too differ considerably [*p≤0.01;* F-value=2297.8** and *p≤0.01;* F-value=537.4**] both at 8th and 12th days after imposition of selective integrated management practices. Notably, at 8th day, pupal weight was higher [3.191g] in T0 [control] followed by T1 [Cucumber + *T. chelonis* @ 2 lakh eggs/ha at 30 DAS] [2.966g]. The treatments T5 [Mahuva oil @ 2%] [2.804g], T6 [Neem oil @ 2%] [2.696g], T7 [Pongamia oil @ 2%] [2.275g] and T3 [Profenophos 50 EC @ 0.03%] [2.198g] were found next best with respect to pupal weight with later being the least among the treatments. However, at 12th day after imposition of treatments, significantly highest pupal weight was recorded in T1 [Cucumber + *T. chelonis* @ 2 lakh eggs/ha at 30 DAS] [2.920g] followed by T7 [Pongamia oil @ 2%] [2.908g], T0 [Control] [2.849g] and T5 [Mahuva oil @ 2%] [2.796g]. Further, T6 [Neem oil @ 2%] [2.418g], T4 [Quinalphos 25 EC @ 0.05%] [2.319g] and T3 [Profenophos 50EC @ 0.03%] [2.278g] were found next in the order with later being the least in respect of pupal weight. However, larvae did not spun cocoons in T2 both at 8th and 12th days after imposition of treatments and T4 at 12th day after imposition of treatments.

Shell weight: Weight of cocoon shells also varied notably [*p≤0.01;* F-value=632.8** and *p≤0.01;* F-value=237.5**] among the selective integrated management practices both 8th and 12th days after imposition of treatments. At 8th day, significantly highest shell weight [0.499 g] was registered both in T0 [Control] and T5 [Mahuva oil @ 2%] followed by T1 [Cucumber + *T. chelonis* @ 2 lakh eggs/ha at 30 DAS] recorded 0.461g. In the other three treatments namely T6 [Neem oil @ 2%] and T3 [Profenopos 50 EC @ 0.03%] recorded shell weight of 0.431g and 0.422g, respectively and weight of shell was lowest [0.354g] in T7 [Pongamia oil @ 2%]. At 12th day after imposition of treatments, highest shell weight of 0.539g was recorded in T3 [Profenophos 50EC @ 0.03%] followed by T7 [Pongamia oil @ 2%] recorded shell weight of 0.492g. Further, T1 [Cucumber+*T.chelonis* @ 2 lakh eggs/ha at 30 DAS], T5 [Mahuva oil2%], T0 [Control] and T6 [Neem oil @ 2%] recorded shell weight of 0.465, 0.452, 0.437 and 0.433g, respectively and shell weight was lowest [0.426g] in T4 [Quinalphos 25 EC @0.05%]. However, shell weight was not recorded in treatments T2 [Fenvalerate 20EC @ 0.02%] and T4 [Quinalphos 25 EC @0.05%] at 8th day and T2 [Fenvalerate 20EC @ 0.02%] at 12th day after imposition of treatments due to poor larval survival and non-spinning of larvae.

Shell yield: Yield of cocoon shells differed markedly [*p≤0.01;* F-value=634.6** and *p≤0.01;* F-value=238.9**] among the selective integrated management practices adopted against defoliators of castor both at 8th and 12th days after their imposition. At 8th day, significantly highest shell yield [11.98 kg/100 layings] was recorded in T5 [Mahuva oil 2%] followed by T0 [Control] [11.97 kg], T1 [Cucumber + *T. chelonis* @ 2 lakh eggs/ha at 30 DAS] [11.06 kg], T6 [Neem oil @ 2%] [10.33 kg] and T3 [Profenophos 50 EC @ 0.03%] [10.13 kg]. Significantly lowest shell yield was recorded in T7 [Pongamia oil @ 2%] [8.496 kg]. However, at 12th day after imposition, highly significant difference was recorded with respect to shell yield with highest shell yield [12.94 kg/layings] was recorded in T3 [Profenophos 50 EC @ 0.03%] followed by T7 [Profenophos 50 EC @ 0.03%] and T1 [Cucumber + *T. chelonis* @ 2 lakh eggs/ha at 30 DAS] both recorded shell yield of 11.81 and 11.16 kg, respectively. Significantly lowest shell yield was recorded in rest of the three treatments *viz.*, T5 [Mahuva oil @ 2%], T0 [Control], T6 [Neem oil @2%] and T4 [Quinalphos 25 EC @0.05%] recorded shell yield of 10.85, 10.50, 10.39 and 10.21 kg, respectively. However, at 8th day, in T2 [Fenvalerate 20 EC @ 0.02%] and T4 [Quinalphos 25

EC @0.05%] and at 12th day, in T2 [Fenvalerate 20 EC @ 0.02%] larvae did not survive and spun the cocoons.

Shell ratio: Shell ratio *I.e.*, ratio of shell to cocoon also differed considerably [*p≤0.01;* F-value=1355.4** and *p≤0.01;* F-value=245.8**] both 8th and 12th day after imposition of selective integrated management practices on castor crop. At 8th day, significantly highest shell ratio [16.04%] was recorded in T3 [Profenophos 50EC @ 0.03%] followed by T5 [Mahuva oil @ 2%] [15.05%]. Treatments T6 [Neem oil @2%] and T0 [Control] recorded shell ratio of 13.71 and 13.47%, respectively. Further, both T1 [Cucumber + *T. chelonis* @ 2 lakh eggs/ha at 30 DAS] and T7 [Pongamia oil @2%] recorded a shell ratio of 13.40%, respectively. With respect to 12th day after imposition of treatments, significantly highest shell ratio [18.71%] was recorded in T3 [Profenophos 50 EC @ 0.03%] followed by T4 [Quinalphos 25 EC @ 0.05%] [15.10%], T6 [Neem oil @ 2%] [14.82%] and T7 [Pongamia oil@2%] [14.17%]. Plant based treatments, T5 [Mahuva oil@ 2%] and T1 [Cucumber + *T. chelonis* @ 2 lakh eggs/ha at 30 DAS] and T0 [Control] recorded a shell ratio of 13.61, 13.44 and 13.01%, respectively. Interestingly, larvae did not survive/spun cocoons in both T2 [Fenvalerate 20EC @ 0.02%] and T4 [Quinalphos 25EC @ 0.05%] at 8th day and T2 [Fenvalerate 20EC @ 0.02%] at 12th day after imposition of treatments.

Silk productivity: Silk productivity refer to shell weight to weight of matured larvae. Silk productivity did vary significantly [*p≤0.01;* F-value=153.6** and *p≤0.01;* F-value=172.5**] both at 8th and 12th days after imposition of selective integrated management practices on castor crop. At 8th day, significantly higher silk productivity [6.670 cg/day] was recorded in T5 [Mahuva oil @ 2%] together with T0 [Control] [6.665 cg/gay], T1 [Cucumber + *T. chelonis* @ 2 lakh eggs/ha at 30 DAS] [6.051 cg/day] and T6 [Neem oil @ 2%] [6.008 cg/day]. Both T3 [Profenophos 50 EC @ 0.03%] and T7 [Pongamia oil @ 2%] were on par with each other by recording silk productivity of 5.508 and 4.861 cg/day, respectively. However, at 12th day after imposition of treatments, significantly highest silk productivity [6.881 cg/day] was recorded in T3 [Profenophos 50 EC @ 0.03%] closely followed by T7 [Pongamia oil @ 2%] [6.583 cg/day]. Other three treatments *viz.*, T1 [Cucumber + *T.chelonis* @ 2 lakh eggs/ha at 30 DAS], T5 [Mahuva oil @ 2%], T6 [Neem oil @ 2%] and T0 [Control] recorded silk productivity of 5.946,

5.903, 5.659 and 5.587 cg/day, respectively. Significantly lowest silk productivity of 4.915 cg/day was found in T4 [Quinalphos 25 EC @ 0.05%]. However, eri larvae did not survive/spun cocoons in T2 [Fenvalerate 20 EC @ 0.02%] and T4 [Quinalphos 25 EC @ 0.05%] at 8th day and T2 [Fenvalerate 20EC @ 0.02%] at 12th day after imposition of selective integrated management practices.

DISCUSSION

The current results are in conformity with those of Palanidurai [1996], Bhaskar [1997], Asia Mariam [1999] who opined that usage of insecticides in mulberry ecosystem is very much reduced due to its toxic nature to mulberry silkworm. Seelan [1999] inferred that silkworms reared on untreated leaves recorded higher ERR [90%] followed by neem oil, pongamia oil and NSKE [75 to 85%] and lowest [50%] with Dichlorovos and Malathion treated leaves. Subramaniam *et al*. [2010] conducted bio-assay using insecticides and botanicals treated leaves on silkworm hybrid, PM x CSR_2 for neem oil [2%] and pongamia oil [3%] and Dichlorvos after 10th day of their sprays. The insecticides *viz*., Triazophos and Thiomethoxam were safer to silkworm on 15th day, while Acetamiprid was safer on 20th day after spraying.

As per Bhaskar [1997], Dichlorvos and Malathion were non-toxic to silkworm when mulberry crop sprayed on 10th day after pruning and larval mortality due to botanicals like NSKE, Neem oil, Pongamia oil were not observed even on 5th day after spray. According to Mortale [2004], castor crop sprayed with 2% neem oil was found superior over other botanicals in checking the foliage pests of castor. But when castor leaves fed to the eri larvae exhibit some adverse effect on the larval, cocoon and grainage parameters by registering lowest larval weight, highest larval mortality, lowest fecundity and hatching percentage.

A study conducted by Sakthivel *et al*. [2012} revealed that Dichlorvos 76 EC was found effective over other treatments [88.57%], but the chemical was also responsible for eliminating well over 90% of predatory coccinellids and spiders population but the botanicals found relatively safer to silkworm. Further, the combination of neem oil at 3% with fish oil rosin soap at 2% could be used as an alternative to Dichlorvos to manage jassid menace in mulberry ecosystem and also

to conserve the natural enemies. Harish Babu [2015] assessed the safety of 4% NSKE to silkworm, the worms fed with NSKE at 4% treated mulberry leaves on 22nd day after spray recorded lowest larval mortality [2.11%] without affecting the economic parameters of silkworm [PM x CSR_2] when compared to other concentrations.

The current research findings revealed that two plant based insecticides neem, pongamia and one chemical based insecticide Profenophos recorded highest cocoon weight and yield, pupal weight, shell weight and yield shell ratio and silk productivity compared to rest of the other plant/chemical based insecticides. Further, between 8th and 12th day after application of insecticides, 12th day found safer to eri silkworm. The eri larvae in two chemical insecticidal treatments namely Fenvalerate and Quinalphos both at 8th and 12th day after spray did not spun cocoons.

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Table 1: Cocoon weight, cocoon yield and pupal weight of eri silkworm at 8th and 12th day after imposition of selective integrated management practices on castor

Integrated management practice	Cocoon weight [g]		Cocoon yield [kg/100 layings]		Pupal weight [g]	
	8th day	12th day	8th day	12th day	8th day	12th day
T_0 = Control	3.701 ± 0.034	3.360 ± 0.039	88.83±0.814	80.65 ± 0.938	3.191 ± 0.029	2.849 ± 0.031
T_1 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS	3.438 ± 0.013	3.459 ± 0.030	82.53±0.302	83.00 ± 0.720	2.966 ± 0.008	2.920 ± 0.022
T_2 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Fenvalerate 20 EC @ 0.02%	0.000 ± 0.000	0.000 ± 0.000	0.000±0.000	0.000 ± 0.000	0.000 ± 0.000	0.000± 0.000
T_3 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Profenophos 50 EC 0.03%	2.632 ± 0.059	2.891 ± 0.060	63.17±1.402	69.38 ± 1.449	2.198 ± 0.049	2.278 ± 0.073
T_4 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Quinalphos 25 EC @ 0.05%	0.000 ± 0.000	2.819 ± 0.043	0.000±0.000	67.65 ± 1.047	0.000 ± 0.000	2.319 ± 0.030
T_5 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Mahua oil @ 2%	3.315 ± 0.040	3.322 ± 0.063	79.56±0.947	79.73 ± 1.499	2.804 ± 0.034	2.796 ± 0.050
T_6 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Neem oil @ 2%	3.139 ± 0.044	2.925 ± 0.057	75.34±1.047	70.19 ± 1.366	2.696 ± 0.029	2.418 ± 0.052
T_7 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Pongamia oil @ 2%	2.641 ± 0.028	3.474 ± 0.041	63.39±0.675	83.37 ± 0.993	2.275 ± 0.020	2.908 ± 0.034
Mean	2.358 ± 0.293	2.781 ± 0.226	56.60±7.031	66.75 ± 5.416	2.016 ± 0.251	2.311 ± 0.190
F - value	2003.8**	633.3**	2008.8**	634.0**	2297.8**	537.4**

DAS: Days after spray **: $p \leq 0.01$

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Table 2: Shell weight and shell yield of eri silkworm at 8th and 12th day after imposition of selective integrated management practices on castor

Integrated management practice	Shell weight [g]		Shell yield [kg/100 layings]	
	8th day	12th day	8th day	12th day
T_0 = Control	0.499 ± 0.005	0.437 ± 0.011	11.97 ± 0.113	10.50 ± 0.256
T_1 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS	0.461 ± 0.007	0.465 ± 0.009	11.06 ± 0.158	11.16 ± 0.207
T_2 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Fenvalerate 20 EC @ 0.02%	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
T_3 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Profenophos 50 EC 0.03%	0.422 ± 0.010	0.539 ± 0.013	10.13 ± 0.241	12.94 ± 0.306
T_4 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Quinalphos 25 EC @ 0.05%	0.000 ± 0.000	0.426 ± 0.013	0.000 ± 0.000	10.21 ± 0.320
T_5 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Mahua oil @ 2%	0.499 ± 0.005	0.452 ± 0.013	11.97 ± 0.155	10.85 ± 0.299
T_6 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Neem oil @ 2%	0.431 ± 0.014	0.433 ± 0.014	10.33 ± 0.345	10.39 ± 0.330
T_7 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Pongamia oil @ 2%	0.354 ± 0.012	0.492 ± 0.009	8.496 ± 0.289	11.81 ± 0.203
Mean	0.333 ± 0.041	0.406 ± 0.033	7.995 ± 0.988	9.732 ± 0.790
F - value	632.8**	237.5**	634.6**	238.9**

DAS: Days after spray **: $p \leq 0.01$

Table 3: Shell ratio and silk productivity of eri silkworm at 8th and 12th day after imposition of selective integrated management practices on castor

Integrated management practice	Shell ratio [%]		Silk productivity [cg/day]	
	8thDAS	12thDAS	8thDAS	12thDAS
T_0 = Control	13.47 ± 0.031	13.01 ± 0.203	6.665 ± 0.222	5.587 ± 0.156
T_1 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS	13.40 ± 0.151	13.44 ± 0.136	6.051 ± 0.368	5.946 ± 0.139
T_2 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Fenvalerate 20 EC @ 0.02%	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000	0.000 ± 0.000
T_3 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Profenophos 50 EC 0.03%	16.04 ± 0.134	18.71 ± 0.800	5.508 ± 0.129	6.881 ± 0.053
T_4 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Quinalphos 25 EC @ 0.05%	0.000 ± 0.000	15.10 ± 0.249	0.000 ± 0.000	4.915 ± 0.205
T_5 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Mahua oil @ 2%	15.05 ± 0.109	13.61 ± 0.125	6.670 ± 0.224	5.903 ± 0.220
T_6 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Neem oil @ 2%	13.71 ± 0.277	14.82 ± 0.439	6.008 ± 0.165	5.659 ± 0.136
T_7 = Sowing of cucumber along with castor + release of *Trichogramma chilonis* @ 2 lakh eggs/ha at 30 DAS + Pongamia oil @ 2%	13.40 ± 0.359	14.17 ± 0.104	4.861 ± 0.368	6.583 ± 0.304
Mean	10.63 ± 1.294	12.86 ± 1.076	4.470 ± 0.554	5.184 ± 0.428
F - value	1355.4**	245.8**	153.6**	172.5**

DAS: Days after spray **: $p \leq 0.01$