



## REARING OF ERI SILK WORM AND ITS ECONOMIC VIABILITY TO RAINFED CASTOR FARMERS

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### ABSTRACT

Ericulture, rearing of eri silk worm plays a significant role in rural livelihood security especially among marginalized and weaker sections. Castor (*Ricinus communis* L.) being the primary host plant of eri silk worm *Samia cynthia ricini* Boisduval, its rearing can be taken up, without losing the seed yield. To study the effect of defoliation on seed yield and additional income, eight castor genotypes viz., Haritha, Kranthi, Kiran, DPC-9, PCH-111, PCH-222, GCH-4 and DCH-177 were studied during 2011-12, 2012-13 and 2013-14 kharif and rabi seasons at the Regional Agricultural Research Station, Palem. Significantly no deviation in seed yield was observed from non-defoliated samples, and 30% defoliated plants. The batches reared on the leaves of PCH-111 gave significantly maximum shell yield of 15.1 kg/ ha followed by GCH-4 (14.8 kg/ ha) and PCH-222 (14.6 kg/ ha). By utilizing the 30% defoliated leaf for rearing, significantly more gross returns and net profit were obtained with PCH-111 (Rs. 55,582 and 37,452), GCH-4 (Rs. 55,144 and 37,036) and PCH-222 (Rs. 54,820 and 36,635). On an average almost all the genotypes gave an additional income of Rs. 4000/ ha in addition to the regular seed yield with rearing of the silk worm

**Key words:** *Samia cynthia ricini*, castor, ericulture, defoliation, gross returns, net profit, shell yield, net profit, additional income

Ericulture plays significant role in rural livelihood security especially among marginalized and weaker sections of the society, covering more than 0.18 million families of the country (Ahmed et al., 2015) with an annual production of 4236 mt. Ericulture once confined to the hilly, tribal districts of North Eastern region of India has spread to several other states including Telangana. Compared with the other non-mulberry silkworms, eri silkworm has a very rich harvest. The size of land holdings possessed by small and marginal farmers in Telangana is much below the minimum economically viable sizes earning income almost equal to that of agricultural labourers. Raising agricultural crops alone is not sufficient to sustain livelihood (Rao, 1984). Hence, diversification of agriculture into various income fetching enterprises has become the order of the day. Rainfed castor farming in Telangana has been diversified into eri silkworm cocoon production which ensures additional income. Castor (*Ricinus communis* L.) being the primary host plant of eri silkworm is extensively grown in the state of Telangana. The concept of make use of castor leaves, otherwise going waste, for eri silkworm rearing assures additional income without affecting the main crop yield has been popularised in the state since 2003 (Raghavaiah, 2003; Jayaraj,

2004). Further it is an off-farm activity that ensures gainful family employment (Jaya Prakash et al., 2005; 2006). Castor genotypes will respond differently to defoliation which will affect ultimately the seed yield. Leaf defoliation studies will also be required to know the tolerance limit of genotypes to withstand different levels of defoliation without affecting the seed yield. Therefore, the present study to find out how the rearing of eri silkworm will be economically viable for a rainfed castor farmer.

### MATERIALS AND METHODS

The experiment was conducted at the research farm of Regional Agricultural Research Station (RARS), Palem during kharif and rabi seasons of 2011-12, 2012-13 and 2013-14. The study was focused on the effect of defoliation on seed yield/ additional income with rearing eri silkworms. The randomized block design was followed with eight genotypes of castor viz., Haritha, Kranthi, Kiran, DPC-9, PCH-111, PCH-222, GCH-4 and DCH-177, and replicated thrice. Treatments consisted of four defoliation levels like no defoliation, 30%, 40% and 50%. The plants were hand defoliated at 45, 95 and 135 days after emergence (DAE) so as to synchronize with *Samia c. ricini* Boisduval rearing

cycle. Removed leaf yield from different defoliation levels and total seed yield was quantified. The crop received recommended dose of fertilizers and after every defoliation, the crop was supplemented with nitrogen @ 20 kg/ ha and K<sub>2</sub>O @ 15 kg/ ha. For evaluation of less susceptible accession among the selected genotypes insect infestation was recorded on 20 randomly selected genotypes by counting the number of larvae/ plant in case of defoliators and number of hoppers on top, middle and bottom leaf of the plant along with hopper burn scale (0 – No foliage drying; 1 – Up to 10% drying; 2 – 10.1 to 25% drying; 3 – 25.1 to 50 % drying; 4 – above 50% drying) (Anonymous, 1998). *Samia c. ricini* rearing was conducted in ericulture laboratory established at the RARS, Palem following the standard rearing methods adopted by Dayashankar (1982). Cost of eri silkworm rearing/ 100 dfls, number of eri dfls reared/ ha, eri shell yield were calculated. Similarly cost of cultivation and seed yield/ ha were computed. The economics pertaining to castor cultivation and eri silkworm rearing were computed separately so as to calculate the additional income generated through ericulture. The yield components were subjected to statistical analysis and standard error and significant difference between values were determined following one way ANOVA.

## RESULTS AND DISCUSSION

**Pest incidence Vs castor genotypes:** Three defoliators viz., semilooper, tobacco caterpillar and hairy caterpillars, leafhopper and leaf miner were

reported during the study. A few castor accessions viz., Haritha, PCH-111, PCH-222 were found tolerant to defoliators during particular years (Lakshmi Narayanamma et al., 2010). However, the infestation of *Empoasca flavescens* was higher than the defoliators and *Liriomyza trifolii*. The varietal preference of castor genotypes to leafhopper indicated that DCH-177 was highly preferred with 104.7 hoppers/ 3 leaves/ plant followed by DPC-9 with 85.5 hoppers/ 3 leaves/ plant (Lakshmi et al., 2005). GCH-4 and PCH-111 were least preferred and recorded 29.2 and 40.1 hoppers/ 3 l/ plant respectively (Table 1). Morphological attributes particularly bloom character was the most important factor in imparting resistance against the sucking pests. GCH-4 had a waxy coating on all parts of the plant (triple bloom), while DCH-177 had waxy coating only on the stem (single bloom) (Lakshminarayana, 2003). Minimum temperature did not show significant influence on *E. flavescens* incidence in all the genotypes except in PCH-111. Morning and evening relative humidity showed significant and negative influence in all most all the genotypes except in Haritha and GCH-4. Similar observations were recorded by Mortale et al., (2007) who observed that *E. flavescens* exhibited significant and negative correlated with maximum temperature.

**Defoliation vs seed yield:** To know the effect of defoliation on seed yield, leaf number removed ranged from 3 to 8, 4 to 12 and 5 to 15 at 30, 40 and 50% defoliation levels. Exact defoliation levels could not be imposed as definite number of whole leaves was

Table 1. Incidence of *E. flavescens* in genotypes of castor (2011-12, 2012-13, 2013-14)

Genotype	Leafhoppers/ 3l/ plant						Mean
	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	
Haritha	30.4	39.8	26.3	46.4	54.6	62.8	43.4
Kranthi	38.6	60.4	52.8	52.8	49.1	72.4	54.4
Kiran	48.6	52.8	60.4	67.4	42.5	60.4	58.7
DPC-9	50.6	102.8	90.2	78.1	80.9	110.4	85.5
PCH-111	30.4	39.2	29.5	39.2	40.8	20.8	40.1
PCH-222	26.8	42.5	33.5	38.4	62.5	56.9	45.1
GCH-4	30.4	22.5	14.8	30.6	30.2	26.4	29.2
DCH-177	62.1	125.6	110.4	90.4	105.6	120.5	107.4
Influence of weather parameters							
Genotype	Rainfall	RHM	RHE	T max	T min	Evaporation	Wind speed (km/ hr)
Haritha	0.00	0.17	-0.18	0.27	0.16	0.14	-0.42*
Kranthi	-0.01	0.20*	-0.33	0.27	0.00	0.32	0.07
Kiran	0.28*	-0.37*	-0.28	-0.36*	0.30	0.44*	0.48**
DPC-9	-0.21*	-0.48**	-0.18	0.40*	0.18	0.43*	0.20
PCH-111	-0.18	0.28*	-0.37*	0.34	0.39*	0.47**	0.51**
PCH-222	-0.00	-0.37*	-0.41*	0.28	0.07	0.33	0.22
GCH-4	0.01	0.14	-0.24	0.25	-0.02	0.41*	-0.07
DCH-177	0.00	0.42**	-0.31*	-0.32*	0.27	0.52**	0.38

removed. On an average 28, 39 and 52% leaf area was removed during three seasons from 30, 40 and 50% defoliation respectively. Significantly no deviation in seed yield was observed from non- defoliation plot and 30% defoliated plants. With 40% defoliation more than 5% yield loss was observed in DCH-177, GCH-4 and PCH-222 genotypes, while with 50% defoliation, the highest yield gap of 20% was observed in DCH-177, while it was 18 and 17% in Kranthi and DPC-9 respectively. On an average, the yield gap was more than 15% in all most all the genotypes at 50% defoliation (Fig. 1). When castor plants were defoliated in the vegetative stage (on/before 45 DAE), they were able to replace all the leaf area lost in a short time and apparently the defoliation in this phase had no impact on the plant. Indeed, there are several studies with crops like soybean, peanut, wheat and sunflower concluding that one event of defoliation on initial stages of vegetative growth had no impact, or in some cases a positive effect on yields (Gazzoni and Moscardi, 1998; Shafiullah et al., 2000; Endan et al., 2006; Ahmadi and Joudi, 2007), although, yield reductions are related when two sequential defoliations were applied (Reichert and Costa, 2003).

**Economics and benefit cost ratio:** The cost of castor cultivation pertaining to varieties is Rs. 14,760/-, while for hybrids the cultivation cost is Rs. 15,160/-, difference being due to seed cost. Significantly maximum seed yield was in PCH-111 (1501 kg/ ha), GCH-4 (1492 kg/ ha) closely followed by PCH-222 (1485 kg/ ha); accordingly gross returns and net profit was high with these genotypes. The CB ratio based on cost of castor cultivation is more with PCH-111 (1:2.93) followed by PCH-222 (1:2.88) (Table 2). On compiling the pooled data of six seasons, cost of eri silkworm rearing was significantly more with PCH-222 (Rs. 3025/-) followed by PCH-111 (Rs. 2970/-) as the genotypes accounted for more number of eri layings/ ha i.e. 275 and 270, respectively. However, it was less with DPC-9 (Rs. 2354/-), which accounted for least

number of eri layings reared/ ha (214). Jayaramaiah and Chinnaswamy (1998) estimated that 200 eri dfls can be reared from the leaf obtained from one ha @ 25% defoliation, which fetches an additional income of Rs. 3000/-

All the genotypes exerted significant influence on the shell yield. The batch of eri silkworms reared on the leaves of PCH-111 recorded significantly maximum shell yield of 15.1 kg/ ha followed by GCH-4 (14.8 kg/ ha) and PCH-222 (14.6 kg/ ha). These results are in conformity with those of Lakshmi Narayanamma et al. (2013) that the cocoons spun by the worms fed on PCH-111 and GCH-4 genotypes gave significantly superior shell weight. Significantly lowest shell yield was observed I with the leaves of DPC-9 (11.8 kg/ ha). Sannappa and Jayaramaiah (1999) and Devaiah and Dayashankar (1982) opined that the shell weight varied with type of hosts provided at the larval stage. If the castor crop is grown for the seed purpose alone, significantly more gross returns and net profit could be realized by growing PCH-111 (Rs. 48,032 and 32,872) followed by GCH-4 (Rs. 47,744 and 32,584). By utilizing the 30% defoliated leaf for eri silkworm rearing, significantly more gross returns and net profit was recorded with PCH-111 (Rs. 55,582 and 37,452), GCH-4 (Rs. 55,144 and 37,036) and PCH-222 (Rs. 54,820 and 36,635). On an average all most all the genotypes recorded an additional income of Rs. 4000/ ha in addition to the regular seed yield. These results are in conformity with the results of Misra (1999) that when castor was grown only for seed production the net profit was Rs. 2345/ ha, while the net profit was Rs. 5406/- when grown for both seed cum eri cocoon production. Further, Misra (2001) reported 16% net profit when castor was used for seed production and 34% with cocoon production. Suryanarayana et al., (2003) obtained net income of Rs. 11,105/ acre/ year through eri silkworm rearing. On the other hand, Pandey (2003) could get net income of Rs. 3000/ ac. Marked differences in the net cost: benefit ratio was observed among genotypes when they were used both for seed and eri cocoon production. Significantly higher CB ratio was observed with PCH-111 (1:3.44), GCH-4 (1:3.19) and PCH-222 (1:3.18), while the CB ratio was least with DCH-177 (1:2.22).

Thus, castor plants were able to completely regrow their leaf area when 30% defoliation occurred during the crop stage without any influence on the seed yield and defoliation, and beyond this level cause a reduction in the seed yield. That 30% defoliated leaf can be utilized

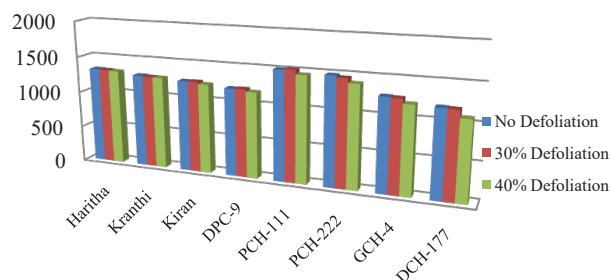


Fig. 1. Defoliation vs. seed yield in castor genotypes (pooled data, 2011-12, 2013-14)

Table 2. Economics of castor seed production/ eri cocoon production with castor genotypes (2011-12- 2013-14)

Genotype	Cost of castor cultivation	Seed yield (kg)*	Gross returns (Rs.)	Net profit (Rs.)	C:B Ratio
Haritha	14,760	1,405	44960	30200	1:1.65
Kranthi	14,760	1,380	44160	29400	1:1.57
Kiran	14,760	1,315	42080	27320	1:1.52
DPC-9	14,760	1,295	41440	26680	1:1.44
PCH-111	15,160	1,501	48032	32872	1:2.93
PCH-222	15,160	1,485	47520	32360	1:2.88
GCH-4	15,160	1,492	47744	32584	1:2.52
DCH-177	15,160	1,392	44544	29384	1:1.36
F-test	-	Sig	Sig	Sig	-
CD at 5%	-	142.21	234.84	148.45	-
SEM±	-	74.24	124.09	102.6	-
Cost of production of eri cocoons/ ha					
Genotype	No. of eri Dfls reared	Cost of eri silkworm rearing (Rs.)	Eri shell yield (kg)**	Gross returns (Rs.)	Net profit (Rs.)
Haritha	262	2,882	13.2	6,600	3,718
Kranthi	238	2,618	12.4	6,200	3,582
Kiran	221	2,431	12.0	6,000	3,569
DPC-9	214	2,354	11.8	5,900	3,546
PCH-111	270	2,970	15.1	7,550	4,580
PCH-222	275	3,025	14.6	7,300	4,275
GCH-4	268	2,948	14.8	7,400	4,452
DCH-177	224	2,464	11.9	5,950	3,486
F-test	Sig	Sig	Sig	Sig	Sig
CD at 5%	3.10	24.21	0.18	39.18	29.24
SEM ±	1.214	4.216	0.072	10.24	8.09
Gross returns and net profit/ ha from castor used for seed production and eri cocoon rearing					
Genotype	Cost of cultivation (Rs.)	Gross returns (Rs.)	Net profit (Rs.)	C:B ratio	
Haritha	17,642	51,560	33,918	1:2.75	
Kranthi	17,378	50,360	32,982	1:2.62	
Kiran	17,191	48,080	30,889	1:2.58	
DPC-9	17,114	47,340	30,226	1:2.55	
PCH-111	18,130	55,582	37,452	1:3.44	
PCH-222	18,185	54,820	36,635	1:3.18	
GCH-4	18,108	55,144	37,036	1:3.19	
DCH-177	17,624	50,494	32,870	1:2.22	
F-test	-	Sig	Sig	-	
CD at 5%	-	535.81	282.4	-	
SEM ±	-	186.12	195.6	-	

\*Castor seed cost- Rs. 32/ kg; \*\*Cost of eri cocoon shell- Rs. 500/ kg

for growing eri silkworms and can get an additional income of Rs. 5000/ ha. However, by utilizing PCH-111, PCH-222 and GCH-4 genotypes farmers can reap higher gross and net returns with more CB ratio.

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