Research Paper :

Studies on the performance of castor genotypes on rearing cocoon of eri silkworm

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SUMMARY

Castor, *Ricinus communis* L. is an important non-edible oil seed crop, the leaves of which also serves as a primary food for the eri silkworm, *Samia cynthia ricini* Boisduval. A study was undertaken to evaluate the different castor genotypes for their suitability in eri silkworm rearing. Eight castor genotypes were evaluated by providing leaves of these genotypes throughout the larval stage. Eri worms nourished with leaves of DCS-85 genotype registered significantly higher ERR of 92.00 per cent while, it was lower with GCH-4 (83.33%). Similarly, DCS-85 genotype recorded higher cocoon weight (27.78 g/10), cocoon yield (250.5 g/100 worms and 75.14 kg/100 DFLs), shell weight (3.415 g/10) and shell yield (9.237 kg/ 100 DFLs) and these traits were lower with GCH-4 (24.50g 200.1 g, 60.02 kg, 2.715 g and 6.651 kg, respectively). The eri worms fed on leaves of DCS-85 were found superior in respect of shell ratio (12.29%), silk productivity (4.879 cg/day) and fibroin (78.25%) and sericin (21.55%), while these were inferior with GCH-4 (11.08%, 3.620 cg, 72.10% and 27.65%, respectively). Eri pupae formed by the worms nourished with leaves of DCS-9 registered higher pupal weight of 25.90 g/10 and the same was lower with GCH-4 (21.76 g/10). However, fecundity was more with DCS-85 genotype (340 eggs/ laying) and it was least with GCH-4 (275 eggs). Further, egg hatching ranged between 95.00 to 98.00 per cent.

Key words : Castor, *Ricinus communis*, Eri silkworm, *Samia cynthia ricini*

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Apart from the marvelous mulberry silk, which is quite popular world over, there are few other varieties that are equally attractive. They are collectively termed as '*Vanya Silks*' comprising of Tasar, Eri and Muga silks. Also known as non-mulberry or wild silks, they infact represent finest facets of India's richest culture and tradition. Among them, eri silk is becoming popular in recent years. In India, ericulture has got great potentiality since the castor leaves are available abundantly in nature and castor cultivation is also done for commercial seed production. Among different host plants, castor is the primary host plant of eri silkworm and castor also plays an important role in oilseed production in the country. The factors like abundant availability of castor, multivoltine nature of silkworm, low cost of rearing, assured crop and simple traditional spinning devices have encouraged rearers to take up ericulture as a commercial proposition.

The quality of leaves provided to the worms for feeding has been considered as the prime factor influencing the production of good cocoon crop (Ravikumar, 1988). It has been observed that growth, development and cocoon yield are influenced by the castor genotype and quality of leaves fed to the worms. Castor is rich in varietal composition and many local and high yielding varieties / hybrids are widely grown in Assam and other parts of the country (Sannappa, 1997). The selection of castor genotypes is an important factor for better growth and development of eri silkworm for higher productivity in terms of cocoon yield. In this context, the present study was undertaken to find out the suitable castor genotypes for dual purpose of ericulture and seed production.

MATERIALS AND METHODS

An experiment on the performance of castor genotypes in respect of economic traits of eri silkworm, *Samia cynthi ricini* Boisduval was carried out during 2005-06. The castor varieties *viz*., 48-1, Kranti and Local – green non-powdery and hybrids *viz*., DCS-9, DCH-177, GCH-4, DCH-32 and DCS-85 were procured from the Directorate of Oilseeds Research, Hyderabad and Directorate of Research, University of Agricultural Sciences, Dharwad. The seeds of eight castor genotypes were sown in last week of June during 2006 in the premises of the Department of Sericulture, UAS, GKVK, Bangalore which is located at a latitude of $12^0$58’ North, longitude of $77^0$35’ East and altitude of 930 meters above the mean sea level with spacing of 0.9m x 0.45 m with a plot size of 5.0 x 4.0 m and the crop was raised as per recommended package of practices under rainfed conditions and the experiment was laid out in a randomized complete block design with three replications (Anonymous, 2000).

The eri silkworms (White – plain breed) were reared by following cellular rearing techniques by feeding all the eight castor genotypes as individual treatments starting from brushing till cocoon spinning in three replications with 200 larvae per treatment. Observations on rearing (larval weight and duration, effective rate of rearing, cocoon and shell yield), cocoon (cocoon and shell weight, shell ratio, silk productivity, fibroin and sericin) and grainage (rate of pupation, pupal weight, pupal duration, rate of moth emergence, fecundity and egg hatching) parameters were considered for evaluation. The rearing practices followed for eri silkworm was as per Dayashankar (1982). The data showing values in the percentage were subjected to angular transformation (Snedecor and Cochran, 1979). The data were analyzed statistically as outlined by Sundararaj *et al*. (1972) at 5% level of significance.

RESULTS AND DISCUSSION

The data on the effect of feeding leaves of different castor genotypes on economic parameters of eri silkworm are tabulated in Tables 1, 2, 3, 4 and 5 and discussed in the light of previous works here under.

Rearing parameters:

Larval weight:

Eri silkworms fed on leaves of selected castor genotypes exhibited marked difference in larval weight during first, second, third and fourth instars, while was non – significant during fifth instar. Worms nourished with leaves of DCS-85 recorded higher larval weight (0.074, 0.179, 1.725 and 10.26 g/10) together with Local genotype (0.070, 0.172, 1.600 and 9.821 g). However, larval weight was lower with GCH-4 genotype (0.056, 0.155, 1.390 and 7.100 g, respectively). These results are in conformity with the observations of Sachan and Bajpai (1973), Dookia (1980), Basaiah (1988), Patil *et al.* (2000), Jayaramaiah and Sannappa (2000a), Govindan *et al.* (2002a; 2002b), Sarmah *et al.* (2002) and Ramakrishna Naika *et al.* (2003) who observed differences in larval weight when eri worms were fed with leaves of different castor genotypes. The variation noticed in larval weight of eri reared on different genotypes might be attributed to the variations in the composition of foliar nutrients of these genotypes.

Larval duration:

Selected castor genotypes had seldom influenced the larval duration during first, fourth and fifth instars and also total larval duration, whereas second and third instars were significantly influenced by the castor genotypes (Table 2). During second and third instars, larval duration was shorter (3.50 and 4.00 days) with Kranti, DCH-177, DCS-85 and Local genotypes, while the same was longer (4.00 and 4.50 days) with DCS-9, 48-1, GCH-4 and DCH-32 genotypes. Sachan and Bajpai (1973), Dookia (1980), Basaiah (1988), Jayaramaiah and Sannappa (2000a), Govindan *et al.* (2002a; 2002b) and Ramakrishna Naika *et al*. (2003) also observed variation in larval duration

Table 1: Effect of feeding leaves of selected castor genotypes on larval weight of young and late-age eri silkworm

Genotypes	Young-age (g / 10 larvae)			Late – age (g / 10 larvae)	
	I Instar	II Instar	III Instar	IV Instar	V Instar
1. DCS-9	0.060	0.162	1.461	8.251	68.19
2. 48-1	0.059	0.160	1.425	8.190	67.77
3. Kranti	0.064	0.164	1.510	9.592	68.10
4. DCH-177	0.065	0.166	1.525	9.765	70.15
5. GCH-4	0.056	0.155	1.390	7.100	62.25
6. DCH-32	0.059	0.159	1.398	7.260	64.19
7. DCS-85	0.074	0.179	1.725	10.26	75.28
8. Local	0.070	0.172	1.600	9.821	74.00
F-test	*	*	*	*	NS
S. E. ±	0.003	0.005	0.047	0.171	4.457
C. D. (P=0.05)	0.008	0.014	0.140	0.513	-

NS : Non-significant

when they were nourished with leaves of various castor genotypes.

ERR:

Significantly higher ERR was recorded when eri worms were reared on leaves of DCS-85 (92.00%) followed by Local (91.00%). However, ERR was less (83.33%) when worms were nourished with leaves of GCH-4 (Table 3). Difference in ERR was observed among the castor genotypes used as feed by earlier workers (Jayaramaiah and Sannappa, 2000a and 2002; Govindan *et al.,* 2002a and 2002b; Pandey, 2003; Sarmah *et al.,* 2002).

Cocoon and shell yield:

Cocoon and shell yields are the final indicators of the produce in ericulture from the rearers point of view. Significantly higher cocoon and shell yields were recorded on DCS-85 genotype (250.5 g/100 worms, 75.14 and 9.237 kg/100DFLs) followed by Local genotype (246.4 g, 73.92 and 9.070 kg). Eri worms fed on leaves of GCH-4 registered lower cocoon (200.1 g, 60.02 kg) and shell yields (6.651 kg) (Table 3). The difference in cocoon and shell yields might be attributed to the fact that these genotypes had higher influence on cocoon weight, shell weight and ERR which accounted for variation in cocoon and shell yield. These results are found similar to the findings of Jayaramaiah and Sannappa (2002) and Govindan *et al.* (2002b; 2003a) who recorded variation in cocoon and shell yield with castor genotypes offered as food. Further, Teotia *et al.* (2003) obtained shell yield of 8-9 kg/100 DFLs among commercial farmers in the North – Eastern states of Assam, Nagaland and Meghalaya. As per Mahobia *et al*. (2005), cocoon yield in eri ranged from 47.79 to 63.45 kg with an average of 56.02 kg/100DFLs.

Table 2: Influence of feeding leaves of selected castor genotypes on larval duration of young and late-age eri silkworm

Genotypes	Young – age (days)			Late – age (days)		Total (days)
	I Instar	II Instar	III Instar	IV Instar	V Instar	
1. DCS-9	4.50	4.00	4.50	4.50	7.50	25.00
2. 48-1	4.50	4.00	4.50	4.50	7.50	25.00
3. Kranti	4.00	3.50	4.00	4.25	7.00	22.75
4. DCH-177	4.00	3.50	4.00	4.25	7.00	22.75
5. GCH-4	4.50	4.00	4.50	4.50	7.50	25.00
6. DCH-32	4.50	4.00	4.50	4.50	7.50	25.00
7. DCS-85	4.00	3.50	4.00	4.25	7.00	22.75
8. Local	4.00	3.50	4.00	4.25	7.00	22.75
F-test	NS	*	*	NS	NS	NS
S.E. ±	0.191	0.144	0.144	0.144	0.206	0.775
C.D. (P=0.05)	-	0.433	0.433	-	-	-

NS - Non-significant

Table 3: Effect of feeding leaves of selected castor genotypes on rearing parameters of eri silkworm

Genotypes	Effective rate of rearing (ERR) (%)	Cocoon weight (g/10)	Cocoon yield		Shell weight (g/10)	Shell Yield (kg/100 DFLs)
			(g / 100 worms)	(kg/100 DFLs)		
1. DCS-9	85.33 (67.55)	25.85	216.2	64.85	2.925	7.338
2. 48-1	85.00 (67.34)	25.61	213.3	63.99	2.890	7.222
3. Kranti	88.00 (69.74)	26.49	228.4	68.53	3.100	8.020
4. DCH-177	88.33 (68.86)	26.65	230.7	69.21	3.190	8.284
5. GCH-4	83.33 (65.96)	24.50	200.1	60.02	2.715	6.651
6. DCH-32	84.00 (66.52)	24.77	203.9	61.17	2.800	6.915
7. DCS-85	92.00 (73.86)	27.78	250.5	75.14	3.415	9.237
8. Local	91.00 (72.56)	27.63	246.4	73.92	3.390	9.070
F-test	*	*	*	*	*	*
S.E. ±	1.733	0.476	8.956	1.32	0.064	0.069
C.D. (P=0.05)	5.197	1.426	26.67	3.95	0.191	0.207

Figures in the parentheses are angular transformed values

Cocoon parameters:

Cocoon weight, shell weight and shell ratio: Cocoons formed by the worms fed on leaves of selected castor genotypes exhibited significant variation in cocoon traits. Significantly, higher cocoon weight (27.78 g/10), shell weight (3.415 g/10) and shell ratio (12.29%) were recorded on DCS-85 and Local genotype (27.63 g, 3.390 g and 12.26%, respectively). However, worms fed on leaves of GCH-4 recorded the least (24.50 g, 2.715 g and 11.08%). The fact of higher nutritional status of leaves of DCS-85 and Local castor genotypes has been reflected in higher cocoon and shell weights and shell ratio (Table 3 and 4). These observations are in conformity with the findings of Dookia (1980), Basaiah (1988), Sannappa and Jayaramaiah (1999), Patil *et al.* (2000), Govindan *et al.* (2002a; 2003b) and Ramakrishna Naika *et al*. (2003) for cocoon characters. Further, varied shell ratio resulting in different genotypes in the present study is in conformity with those of Hazarika and Hazarika (1996) and Pandey (2003). The observed variation in respect of cocoon characters may be a reflection of the nutritional status of the castor genotypes as evidenced by the correlation co-efficients worked out for foliar constituents with cocoon traits (Jayaramaiah and Sannappa, 2000b and Chandrappa *et al.*, 2005).

Silk productivity, fibroin and sericin:

Silk productivity is the unit weight of cocoon shell per day of fifth instar. It was more when eri worms were reared on leaves of DCS-85 (4.879 cg/day) followed by Local genotype (4.843 cg). However, it was least with GCH-4 (3.620 cg). The improvement in silk productivity is attributed to the fact that, feeding worms with leaves of Local genotype enhanced the shell weight and shortened the duration of fifth instar inturn contributing for higher silk productivity (Table 4). Castor genotypes exerted significant influence on secretion of sericin, while it was non-significant with fibroin secretion. Fibroin content ranged from 72.10 (GCH-4) to 78.25 per cent (DCS-85). While sericin was significantly less with DCS-85 (21.55%) along with Local genotype (21.70%) and the same was more with GCH-4 (27.65%). Similarly, Jayaramaiah and Sannappa (2002), Govindan *et al.* (2002a; 2003b) and Ramakrishna Niaka *et al.* (2003)found variation with regard to silk productivity, fibroin and sericin contents among the castor genotypes. Further, these results corroborate with the relationships noticed between foliar constituents and cocoon traits as observed by Basaiah (1988), Jayaramaiah and Sannappa (2000b) and Chandrappa *et al*. (2005).

Grainage parameters:

Rate of pupation, pupal weight and pupal duration:

Notable variations were evident in respect of pupal weight resulting from castor genotypes when offered as food to eri worms. However, castor genotypes did not influence rate of pupation and pupal duration (Table 5). Rate of pupation ranged from 91.00 (GCH-4) to 98.33 per cent (DCS-85 and Local), while pupal duration from 16.00 (Kranti, DCH-177, DCS-85 and Local) to 18.00 (GCH-4 and DCH-32). Pupal weight was significantly higher with DCS-9 (25.90 g/10) followed by DCS-85 (24.34 g) and Local (24.22 g). However, it was less with GCH-4 (21.76 g). These results are in concurrence with the findings of Dookia (1980), Basaiah (1988), Sannappa and Jayaramaiah (1999) and Govindan *et al.* (2002a; 2003b) with regard to rate of pupation and pupal weight. Further, Patil *et al.* (2000) recorded non-significant

Table 4 : Influence of feeding leaves of selected castor genotypes on cocoon traits of eri silkworm

Genotypes	Shell ratio (%)	Silk productivity (cg/day)	Fibroin (%)	Sericin (%)
1. DCS-9	11.32 (19.66)	3.900	76.00 (60.68)	23.20 (28.79)
2. 48-1	11.28 (19.62)	3.853	74.00 (59.35)	25.10 (30.04)
3. Kranti	11.70 (20.00)	4.429	76.10 (60.73)	23.70 (29.13)
4. DCH-177	11.96 (20.19)	4.557	77.26 (61.57)	22.45 (28.28)
5. GCH-4	11.08 (19.44)	3.620	72.10 (59.76)	27.65 (31.72)
6. DCH-32	11.30 (19.64)	3.733	73.20 (58.83)	26.60 (31.04)
7. DCS-85	12.29 (20.52)	4.879	78.25 (62.26)	21.55 (27.66)
8. Local	12.26 (20.50)	4.843	78.10 (62.11)	21.70 (27.76)
F-test	*	*	NS	*
S.E. ±	0.080	0.156	1.231	0.337
C.D. (P=0.05)	0.239	0.467	-	1.010

NS : Non-significant Figures in the parentheses are angular transformed values

Table 5 : Influence of feeding leaves of selected castor genotypes on grainage parameters of eri silkworm

Genotypes	Rate of pupation (%)	Pupal weight (g/10)	Pupal duration (days)	Rate of moth emergence (%)	Fecundity (eggs/laying)	Egg hatching (%)
1. DCS-9	94.66 (77.64)	25.90	17.00	96.00 (80.49)	301	98.00 (82.05)
2. 48-1	94.00 (75.95)	22.69	17.00	96.66 (79.55)	297	97.00 (80.12)
3. Kranti	95.33 (78.47)	23.37	16.00	97.33 (80.61)	312	96.00 (78.72)
4. DCH-177	96.00 (77.24)	23.43	16.00	97.33 (80.71)	316	95.00 (77.12)
5. GCH-4	91.00 (76.85)	21.76	18.00	94.33 (76.35)	275	97.00 (80.12)
6. DCH-32	92.00 (73.73)	21.95	18.00	94.00 (75.95)	290	96.00 (78.52)
7. DCS-85	98.33 (82.81)	24.34	16.00	98.00 (82.05)	340	98.00 (81.91)
8. Local	98.33 (82.45)	24.22	16.00	98.00 (81.95)	328	98.00 (82.05)
F-test	NS	*	NS	NS	*	*
S.E ±	2.546	0.177	0.812	1.939	11.08	1.101
C.D. (P=0.05)	-	0.530	-	-	33.22	3.296

NS : Non-significant   Figures in the parentheses are angular transformed values

influence among the castor genotypes with respect to pupal duration. Jayaramaiah and Sannappa (2000b) and Chandrappa (2005) obtained significant correlation between foliar constituents of castor genotypes with rate of pupation and pupal weight.

Rate of moth emergence, fecundity and egg hatching:

It is evident from Table 5 that castor genotypes seldom influenced the rate of moth emergence and it ranged between 94.00 (DCH-32) to 98.00 per cent (DCS-85 and Local). Fecundity was significantly highest with DCS-85 (340 eggs/laying) and Local genotype (328 eggs) and the same was lowest with GCH-4 (275 eggs). Egg hatching was influenced by castor genotypes with more (98.00%) being in DCS-9, DCS-85 and Local and it was less with DCH-177 (95.00%). Similarly, Basaiah (1988), Sannappa (1997) and Chandrappa *et al*. (2005) found significant positive relation between foliar constituents of castor genotypes and grainage traits of eri silkworm. The present results corroborate with the observations of Sannappa and Jayaramaiah (1999), Patil *et al.* (2000), Govindan *et al.* (2002a; 2003b), Sarmah *et al.* (2002), Pandey (2003) and Ramakrishna Naika *et al.* (2003) who found variation in grainage traits due to the castor genotypes when used for rearing eri silkworm.

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