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Validation of Performance of Silkworm Race Pure Mysore Reared on different Mulberry Varieties for Grainage Parameters

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Abstract

The performance of multivoltine silkworm race Pure Mysore was evaluated with ten selected varieties of mulberry for various grainage parameters. Except pupal mortality, all the grainage parameters of silkworm differed significantly with different mulberry varieties. Among the selected varieties, the variety V1 has recorded highest values for all the biochemical constituents with least crude fibre content which is advantageous. This was reflected in silkworm reared on the leaves of V1 mulberry variety which has shown improved pupal weight (1.103 g), rate of pupation (93.24 %), moth emergence (94.29 %), fecundity (456.33) and hatchability (98.03 %) with least pupal mortality (1.481 %). While same was minimum with S30 mulberry variety except, pupal mortality which was maximum. The correlation obtained between biochemical constituents of mulberry leaf with grainage parameters of silkworm indicates that, as bio-chemical composition of mulberry leaf increases the grainage parameters also found to be improved except with crude fibre content.

Keywords : Validation, performance, silkworm, race, grainage

Mulberry is the only source as food for silkworm, *Bombyx mori* L. It is a deep rooted perennial crop cultivated in all types of soils. A deficiency of certain nutrients or an imbalance of nutrients in leaves causes some changes in the composition or metabolic activity of larval body. The silk yield can be increased mainly by cultivating variety with good nutritional status as well resistant to pest and disease with better agronomical inputs. The various factors responsible for successful cocoon harvest are mulberry leaf (38.20 %), climate (37.00 %), rearing techniques (9.30 %), silkworm race (4.20 %), silkworm seed (3.10 %) and other factors (8.20 %). Thus, the mulberry leaf quality also plays predominant role in cocoon and grainage parameters as well. Here an attempt has been made to evaluate better performing mulberry variety through silkworm rearing for grainage parameters for the multivoltine prime breed Pure Mysore, which is being predominately used as female parent in the cross breed, which produces the bulk of raw silk production in the Southern India.

Material and Methods

The experiment was carried out at the Department of Sericulture, University of Agricultural Sciences, GKVK, Bengaluru, during the year 2015 and 2016. Ten mulberry varieties evaluated are M5, S13, S30, S34, S36, MR2, RFS175, S54, DD1 and V1. These ten varieties were established in an area of 500 sq. meters. All the cultural operations from time to time were done as per recommendations of Dandin *et al.*, 2003. After 45 days of pruning, leaves were ready to harvest. The leaves were harvested by plucking individual leaves throughout the experiment.

Representative leaf samples were collected separately from each variety 45 days after pruning. Each sample was taken in a paper cover and dried under shade for three days and then the leaf samples were kept in oven at 87±1 ^{o}C for 24 hr to remove the moisture.

Plant samples were analysed for moisture content using the formulae:

$$\text{Moisture (\%)} = \frac{\text{Fresh weight - dry weight}}{\text{Fresh weight}} \times 100$$

Leaf samples, which were subjected for on moisture content estimation, are made into fine powder using a grinder. The powdered samples of leaves were stored in polythene containers with airtight lid and used for chemical analysis *viz.,* carbohydrates

(Dubios *et al*., 1956), proteins (Lowry *et al.,* 1951), crude fibre (A.O.A.C., 1970), chlorophyll A, chlorophyll B and total chlorophyll content (Arnon, 1949) by using standard procedures.

The experiment was conducted in a Complete Randomized Design with Pure Mysore silkworm reared on ten mulberry varieties considered as ten treatments with three replications each. The larvae after emerging out of second moult were divided into three replications. Each replication consisted of 50 silkworms. The silkworm rearing was conducted as per Dandin *et al.* (2003). The harvesting of cocoons was made on fifth day of release of worms on the mountages as per the treatment. Observations were recorded on post cocoon parameters and kept for moth emergence by cut opening cocoons. After moth emergence, mating was allowed as per treatment later recorded fecundity and hatchability per cent.

Pupal weight (g)

Ten cocoons per replication were drawn randomly from each replication on fifth day of spinning and cut open individually to take out pupa and weighed using an electronic balance.

Rate of pupation (%)

Pupation rate was calculated by using the formula:

$$\text{Rate of Pupation (\%)} = \frac{\text{No. of larvae pupated}}{\text{No. of larvae spun cocoons}} \times 100$$

Pupal mortality (%)

Pupal mortality rate was calculated by using the formula:

$$\text{Pupal mortality rate (\%)} = \frac{\text{No. of pupa dead}}{\text{Total No. of pupa}} \times 100$$

Fecundity and hatching percentage

A sample of 5 dfls each per replication was taken and the total number of eggs per dfl was found out and average was calculated for each replication. The total number of eggs laid and the number of eggs hatched were counted replication wise in each laying. Hatching percentage was calculated by the formula.

$$\text{Hatching (\%)} = \frac{\text{No. of eggs hatched}}{\text{Total No. of eggs / laying (fecundity)}} \times 100$$

Rate of moth emergence (%)

Moth emergence percentage was calculated based on the number of pupae transformed into adults and was computed using the formula:

$$\text{Rate of moth emergence (\%)} = \frac{\text{No. of moths emerged}}{\text{No. of pupae kept for moth emergence}} \times 100$$

Statistical analysis

In order to know the basic relationship, simple correlation co-efficients were worked out between leaf biochemical constituents of different mulberry varieties versus various grainage parameters of silkworm. The significance was worked out at probability level 0.05 per cent.

Results and Discussion

Biochemical composition: The significant variations observed in the biochemical composition of leavesof different mulberry varieties (Table I).V1, S36 and S13 genotypes has recorded highest values for leaf moisture content, carbohydrates, crude proteins, chlorophyll A, chlorophyll B and total chlorophyll with least crude fibre content. The varieties S30 and DD1 had least values for all these parameters except for crude fibre content which was found to be maximum. The variation in the leaf biochemical composition among the different mulberry varieties may be attributed to varietal character, agronomic practices followed and prevailing climatic factors during the growth period. The results are in line with findings of Patil *et al.* (2001); Syed Atheeq Ahmed (2002); Sinha *et al.* (2003); Chakravorty *et al.* (2006); Doss *et al.* (2007) and Ghosh *et al.* (2009).

Pupal weight: Maximum pupal weight was registered when silkworms were fed on V1 mulberry leaves (1.103 g) followed by S36 (1.063 g) while the lowest pupal weight was recorded in silkworms which were fed on S30 (0.817 g) mulberry leaves (Table II). The present results are parallel with the findings of Rayar (2011) reported that, silkworm reared on V1 (13.16 g / 10 pupa) mulberry leaves found to be

TABLE I

Biochemical composition of different mulberry varieties

Varieties	Leaf moisture (%)	Carbohydrates (%)	Crude protein (%)	Crude fibre (%)	Chlorophyll - a (mg / g)	Chlorophyll - b (mg / g)	Total Chlorophyll (mg / g)
M5	69.77 (56.64)	20.98 (27.26)	16.72 (24.14)	10.70 (19.09)	1.400	0.508	1.908
S13	73.62 (59.09)	23.60 (29.06)	17.91 (25.04)	9.60 (18.05)	1.530	0.784	2.315
S30	66.18 (54.44)	19.50 (26.20)	16.29 (23.80)	10.86 (19.24)	1.323	0.405	1.728
S34	72.89 (58.63)	22.45 (28.28)	17.56 (24.77)	9.84 (18.28)	1.478	0.692	2.170
S36	75.35 (60.23)	24.66 (29.77)	17.97 (25.08)	9.47 (17.92)	1.614	0.801	2.415
MR2	70.81 (57.29)	21.83 (27.85)	17.33 (24.60)	9.96 (18.39)	1.420	0.682	2.103
RFS175	72.99 (58.68)	23.03 (28.68)	17.68 (24.87)	9.65 (18.09)	1.523	0.697	2.220
S54	70.16 (56.89)	21.54 (27.65)	17.06 (24.39)	10.17 (18.60)	1.410	0.513	1.923
DD1	68.58 (55.91)	20.43 (26.87)	16.56 (24.01)	10.78 (19.17)	1.377	0.415	1.792
VI	76.31 (60.87)	25.80 (30.52)	18.35 (25.367)	9.42 (17.87)	1.620	0.809	2.429
F - test	*	*	*	*	*	*	*
SEm±	0.49	0.15	0.05	0.04	0.0017	0.0016	0.0022
CD at 5 %	1.51	0.46	0.17	0.14	0.0056	0.0049	0.0068

* : Significant at 5 %; Figures in the parentheses are angular transformed values

superior over S41, S54 and M5 for pupal weight. Venkatesh and Rayar (2005) reported that V1 (14.72 g / 10 pupae) is superior over M5 (14.39 g / 10 pupae) for pupal weight. Similarly, the present results are in close association with the findings of Patil *et al*. (2001); Venkatesh Kumar *et al*. (2014) which uphold the present findings.

Rate of pupation: Rate of pupation is the index of cocoon yield and health. The silkworm registered highest rate of pupation when they were fed on V1 mulberry leaves (93.24 %) followed by S36 (92.51 %) (Table II). While the lowest rate of pupation was noticed in silkworms which were fed on S30 (84.70 %) mulberry leaves. These observations are in conformity with findings of Syed Atheeq Ahmed (2002) also reported that highest rate of pupation observed in the silkworm fed with V1 (93.01 %) mulberry leaves than M5, S13 and S36 mulberry leaves. Doddaswamy *et al*. (2009) and Dayananda *et al*. (2016), also observed that rate of pupation of multivoltine breeds is in the range of 80-95 per cent which uphold the present findings.

TABLE II

Grainage parameters of mulberry silkworm (Pure Mysore) as influenced by different mulberry varieties

Varieties	Pupal weight (g)	Rate of pupation (%)	Pupal mortality (%)	Rate of moth emergence (%)	Fecundity (No.)	Hatchability (%)
M5	0.887	85.74 (67.89)	2.480 (7.30)	77.14 (61.47)	426.00	94.29 (76.18)
S13	1.024	91.72 (73.28)	2.256 (8.64)	93.33 (75.11)	444.00	96.47 (79.19)
S30	0.817	84.70 (67.00)	3.464 (8.78)	72.38 (58.34)	418.00	92.27 (73.87)
S34	0.978	88.80 (70.53)	1.551 (5.85)	90.48 (72.06)	441.33	95.77 (78.15)
S36	1.063	92.51 (74.16)	1.449 (5.65)	93.33 (75.41)	451.33	97.56 (81.06)
MR2	0.946	88.63 (70.32)	2.344 (7.11)	86.67 (68.77)	437.33	95.88 (78.32)
RFS175	1.005	88.31 (70.19)	2.308 (7.04)	87.62 (69.42)	441.67	96.60 (79.43)
S54	0.928	85.82 (67.89)	2.480 (7.30)	84.76 (67.32)	430.00	94.50 (76.43)
DD1	0.853	85.62 (67.72)	4.148 (11.37)	74.29 (59.62)	420.67	93.34 (75.05)
Vl	1.103	93.24 (74.96)	1.481 (4.06)	94.29 (76.47)	456.33	98.03 (82.02)
F- TEST	*	*	NS	*	*	*
SEm±	0.007	1.211	1.288	2.171	1.653	0.335
CD at 5 %	0.022	3.876	4.122	6.947	5.289	1.072

* : Significant at 5 %**;** NS : Non- Significant; Figures in the parentheses are angular transformed values

Pupal mortality: The pupal mortality percentage of silkworm breed (Pure Mysore) did not differ significantly among different mulberry varieties (Table II). However, pupal mortality rate was minimum in the silkworm reared on S36 mulberry leaves (1.449 %) followed by V1 (1.481 %). Pupal mortality was significantly maximum when silkworm reared on DD1 (4.148 %) mulberry leaves. The current findings are comparable with the Fazli Subhan *et al*. (2013) who studied the effect of four mulberry species on performance of *Bombyx mori* L. and reported that, mulberry species had no significant effect on pupal mortality of silkworm. However, it was recorded that mean values of pupal mortality was maximum for larvae fed on *M. rubra* (3.00 %) followed by *Morus alba* (2.75 %), *M. latifolia* (2.25 %), *M. nigra* (1.25 %).

Rate moth emergence: The silkworms registered highest percentage of moth emergence when they were fed on V1 mulberry leaves (94.29 %) followed by S36 (93.33 %) (Table II). While, the lowest rate of moth emergence was recorded in silkworms fed with S30 (72.38 %) mulberry leaves. Similarly, Durande *et al.* (2012) reported the highest moth emergence was observed due to larvae fed on leaves of variety V1 (95.33 %) followed by S1635. Rayar (2011) recorded the highest moth emergence percentage in the V1 (90.00 %) mulberry leaves fed silkworm followed by S41, S54 and M5. Syed Atheeq Ahmed (2002) also reported that maximum moth emergence percentage observed in the silkworm fed with V1 (93.34 %) mulberry leaves than M5, S13 and S36 mulberry leaves.

Fecundity: The silkworms registered highest fecundity when they were fed on V1 (456.33) mulberry leaves followed by S36 (451.33) (Table II). While the least fecundity was recorded in silkworms fed with S30 (418.00) mulberry leaves. These observations are in conformity with earlier findings where the significant difference was observed for the fecundity when the silkworm fed with different mulberry varieties *viz.,* S30, S36, S41, S54, Kanva-2 and Mysore local. Further, they found maximum fecundity when the silkworm fed with S36 mulberry leaves and it was more in silkworm breeds fed with S36 mulberry leaves during winter season. Rayar (2011) observed fecundity is recorded maximum for V1 variety leaves fed silkworm than M5, S54 and S41 mulberry leaves irrespective of breeds. Syed Atheeq Ahmed (2002) also reported that highest rate of fecundity observed in the silkworm fed with V1 (508.33) mulberry leaves than M5, S13 and S36 mulberry leaves.

Hatchability: Feeding with different mulberry varieties showed significant difference in hatchability percentage obtained by feeding with V1 (98.03 %) was superior over S36 (97.56 %) (Table II). While the lowest hatchability per cent was recorded in silkworms fed with S30 (92.27 %) mulberry leaves.

TABLE III

Correlation between biochemical constituents of mulberry with grainage traits of silkworm

Varieties	Moisture content	Carbohydrates	Crude proteins	Crude fibre	Chl. A	Chl. B	Total Chlorophyll
Pupal weight	0.9893 *	0.9909 *	0.9937 *	-0.9683 *	0.9789 *	0.9587 *	0.9851 *
Pupal mortality	-0.8486 *	-0.8112 *	-0.8378 *	0.8370 *	-0.7967 *	-0.8574 *	-0.8494 *
Rate of pupation	0.9380 *	0.9558 *	0.9495 *	-0.9070 *	0.9439 *	0.9514 *	0.9666 *
Moth emergence	0.9405 *	0.9164 *	0.9707 *	-0.9793 *	0.8959 *	0.9640 *	0.9553 *
Fecundity	0.9819 *	0.9799 *	0.9902 *	-0.9687 *	0.9659 *	0.9733 *	0.9809 *
Hatchability	0.9785 *	0.9663 *	0.9802 *	-0.9618 *	0.9573 *	0.9687 *	0.9827 *

* Marked correlations are significant at $p < 0.05$ (N=10)

The earlier reports found that the significant difference was observed when the silkworm breeds fed with different mulberry varieties *viz.,* S30, S36, S41, S54, Kanva 2 and Mysore local. Further, they states that more hatchability percentage results due to silkworm breeds fed with S36 and S41mulberry leaves (Syed Atheeq Ahmed, 2002).

Correlation between the leaf quality and grainage parameters: The correlation obtained between biochemical composition of mulberry leaf with grainage parameters of silkworm indicates that, as chemical composition of mulberry leaf increases the grainage characters were also found to be improved except for crude fibre content (Table III). Positive correlation was obtained between the leaf moisture content, carbohydrates, crude protein and chl-A, chl-B and total chlorophyll with grainage parameters *viz.*, pupal weight, pupation rate, rate of moth emergence, fecundity and hatchability percentage. But, all these grainage parameters were negatively correlated with crude fibre content. All the biochemical constituents has shown negative correlation with pupal mortality whereas, the crude fibre has shown positive correlation which is disadvantageous. Similar results were reported by Patil *et al.* (2001); Syed Atheeq Ahmed (2002) and Rahmathulla (2006).

The grainage parameters of Pure Mysore breed found significant when the silkworms fed on different mulberry varieties. The V1 mulberry variety revealed highest biochemical constituents with best crude fibre content which reflected in good grainage parameters of pure Mysore silkworm breed. The least performance was recorded when the silkworm were fed with S30 mulberry variety. The mulberry varieties S36 and S13 has performed well next to V1 in exhibiting grainage parameters of Pure Mysore.

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