Chapter - IV

Results

4. RESULTS

4.1. SCREENING OF MULBERRY VARIETIES

4.1.1. Total Leaf Yield

The total leaf yield obtained was the highest from S1 (60.30 q/ha) followed by TR10 (39.94 q/ha) . The difference between the two is highly significant (Table 3) . Again , there is no significant differences among the varieties other than TR10 and S1 . The lowest yield was obtained from TR8 (22.74 q/ha) . However , with respect to quantitative yield the varieties can be arranged in the descending order of S1 >TR10 > Kosen > TR4 > C776 > C763 > S779 > TR8.

4.1.2. Chemical Contents of Leaves

Total Protein Content : The total protein content was quite different in the eight mulberry varieties tested (Table 3) .The values were significantly higher in TR8 , TR10 , Kosen and S1 that in the C776 . Again , the total protein content was significantly higher only in the leaves of TR10 (17.81 %) and Kosen (18.09%) than in the other six varieties. The highest protein content was obtained in Kosen . The values in the descending order were Kosen >TR10 >TR8>S1>TR4>C763>S779>S776.

Total Carbohydrate content :The total carbohydrate content was almost of the same pattern as was recorded for total protein content among the varieties (Table 3).The values can be arranged in the descending order of Kosen >TR10>S1>TR8>TR4>C763>S779>C776. However C776 had the lowest content (9.67%) , significantly lower than the values of all other varieties except the S779. The highest carbohydrate content was recorded in Kosen (10.96%) followed by TR10 (10.78%) , there was no significant difference between these two varieties. In the remaining six varieties the carbohydrate contents were significantly lower.

Total Moisture Content : Results on leaf moisture showed a non-significant variation among the varieties tested (Table 3) . TR10 contained the highest moisture content (73.70%) and C763 has the lowest content (72.83%) .

The values of moisture content can be arranged in the descending order of TR10 > Kosen >S1, TR4 > TR8>C776>S779>C763.

4.1.3. Rearing performance

When the fifth instar larvae of the bivoltine races were fed with the leaves of any of the mulberry varieties , there were significant variations with respect to cocoon and shell weights and the SR% (Table 4).

Single Cocoon Weight : Highest cocoon weight was obtained from the leaves of TR10 (1.82g) and the lowest weight from C776 (1.76g). The weights can be arranged in the descending order of TR10>TR4,TR8> Kosen, C763>S1 >S779>C776. The values in these groups differed significantly from each other.

Single Shell Weight : The highest shell weight was obtained from Kosen and TR10 and the lowest value was with the C776 variety . Except the Kosen and TR10, the shell weights obtained from all other varieties differed significantly from each other . The shell weights in the descending order were TR10 , Kosen >S1>TR8>TR4>C763>S779>C776.

Shell Ratio (SR %) : The highest values was recorded in the larvae fed with Kosen (22.22) and lowest one with C776 (18.33) . The values in the descending order were Kosen >TR10>S1>TR8>TR4>C763>S779>C776. There were no significant differences among Kosen , TR10 and S1 , between S779 and C776 , between C763 and S779 and among TR8 , TR4 and C763.

On the whole , the highest leaf yield of S1 variety placed it at the superior most position among the screened varieties. But with respect to biochemical profiles and rearing performance it appeared to have a third rank . Whereas Kosen was significantly a superior variety with respect to quality of leaves but leaf yield was very poor.

4.2.Selection of Superior Variety from Initially Screened Varieties

Among the eight varieties initially screened , S1 TR10 and Kosen appeared as better varieties for the agro-climatic region under study with respect to yield and quality of leaves as well as cocoon qualities of bivoltine races of *B.mori.*

Table 3. Total protein , total carbohydrate and moisture content of the leaves and leaf yield of the mulberry varieties tested in the agro climatic area of Coochbehar district

Mulberry Variety	Total protein(%)	Total carbohydrate (%)	Total moisture (%)	Total leaf yield (q/ha)
C776	16.54	9.67	73.38	25.67
S779	16.94	9.90	73.38	22.98
C763	16.99	10.15	72.83	25.65
TR_4	17.08	10.33	73.61	26.42
TR_8	17.34	10.40	73.51	22.74
TR_{10}	17.81	10.78	73.70	39.94
KOSEN	18.09	10.96	73.67	27.76
S_1	17.33	10.57	73.61	60.30
SEM (±)	0.13	0.05	0.53	2.19
CD at 5%	0.62	0.25	Non-significant	10.84

Table 4. Rearing performance of the bivoltine fifth instar larvae of the breed P_5 x KPGB fed with mulberry leaves of different varieties

Economic character / Mulberry variety	Single Cocoon wt (g)	Single Shell wt. (gm)	SR (%)
C776	1.76	0.32	18.33
S779	1.78	0.33	18.50
C763	1.80	0.34	19.04
TR_4	1.81	0.35	19.55
TR_8	1.81	0.36	19.74
TR_{10}	1.82	0.40	21.98
Kosen	1.80	0.40	22.22
S_1	1.79	0.39	21.79
SEM (±)	0.003	0.005	0.24
CD at5 %	0.01	0.02	1.02

Subsequent investigation was carried out with these three mulberry varieties for assessing the performance of the bivoltine races of *B.mori* , P_5 , KPGB and their two hybrids of crosses (P_5 x KPGB and KPGB x P_5) of three different seasons . Assessment was made on the basis of food consumption and utilization and rearing performance and economic characters . The main objective was to choose the particular mulberry variety on which the performance of the silkworms was the best.

4.2.1. Seasonal Variation of Chemical Contents in Leaves of different Varieties

Seasonal variations of nutrient status of leaves of three mulberry varieties (S_1,TR_{10} and Kosen) was evaluated for subsequent investigation.

4.2.1.1.Total Protein Content (Table - 5)

Seasonal impact : Significant seasonal variation regarding total protein content in the leaves was found. Leaves of autumn contained the highest protein content (18.36%) having non-significant rise over spring (18.22%) and both were followed significantly by leaves of summer (17.83%).

Varietal impact : Significant variation of protein content was obtained among the three varieties . Kosen (18.54%) was significantly superior to TR_{10} (18.21%) and than to S_1 (17.66%) variety.

Season and Variety interaction : Among the three varieties tested during the three seasons , no significant differences were observed in respect of total protein content in their leaves . However , the total protein content was the highest in Kosen during autumn (18.63%) and during spring (18.60%) , and the lowest content was estimated in S_1 variety (17.24%) during summer.

4.2.1.2. Total Carbohydrate content (Table - 6)

Seasonal impact : When the values of the three varieties were taken together , there was significant seasonal differences in the carbohydrate content of leaves . Significantly higher carbohydrate contents were obtained during autumn (10.97%) and spring (10.95%) than in summer (10.77%).

Varietal impact : The carbohydrate content in the leaves of three mulberry cultivars differed significantly. The highest content was obtained on Kosen (11.14%) followed in descending order by TR_{10} (10.95%) and S_1 (10.60%).

Season and Variety interaction : Total carbohydrate content in the leaves was the highest in Kosen variety during spring (11.22%) followed by in autumn (11.18%) and the lowest content was in S_1 variety during summer (10.46%). However , the differences among the varieties with relation to the seasons were non-significant.

4.2.1.3. Moisture Content (Table - 7)

Seasonal impact : Significant differences in the moisture content of the leaves were recorded. The highest moisture content (75.01%) was recorded during autumn followed by spring (73.91%) and by summer (72.59%).

Varietal impact : Non-significant differences in the leaf moisture content were in the three mulberry varieties. However, leaves of Kosen contained the highest moisture content (73.99%).

Season and Variety interaction : Seasonal influence on the moisture content of leaves of different mulberry varieties was not significant. However , S_1 variety during autumn (75.38%) contained the highest moisture and Kosen contained the lowest content during summer (72.30%).

From the overall observations it appeared that the leaves of Kosen variety was superior to other two varieties with respect to total protein and carbohydrate contents. However, the differences among the three varieties in protein and carbohydrate contents as well as the differences in the protein , carbohydrate and moisture contents in three seasons were not significant statistically.

4.2.2. Rearing Performance of Worm as Influenced by Variety over Seasons .

4.2.2.1. Weight of 10 mature larvae

Breed-Season interaction : P_5xKPGB in spring season showed the highest larval weight (49.90g) having non-significant rise over P_5 during autumn (49.68g) and during spring (49.39g) and significant rise over other breeds. Irrespestive of

Table 5 . Total Protein Content of the Leaves (%) of three different mulberry varieties during three different seasons.

Season / Mulberry Variety	Spring	Autumn	Summer	Mean
S_1	17.75	18.00	17.24	17.66
TR_{10}	18.30	18.45	17.87	18.21
Kosen	18.60	18.63	18.38	18.54
Mean	18.22	18.36	17.83	

	SEM(±)	CD at 5%
Season	0.10	0.30
Variety	0.09	0.29
Season x Variety	0.17	Non-significant

Table 6 . Total Carbohydrate Content of the Leaves (%) of three different mulberry varieties during three different seasons.

Season / Mulberry Variety	Spring	Autumn	Summer	Mean
S_1	10.66	10.68	10.46	10.60
TR_{10}	10.98	11.06	10.81	10.95
Kosen	11.22	11.18	11.03	11.14
Mean	10.95	10.97	10.77	

	SEM(±)	CD at 5%
Season	0.06	0.17
Variety	0.06	0.17
Season x Variety	0.10	Non-significant

Table 7 . Total Moisture Content of the Leaves (%) of three different mulberry varieties during three different seasons.

Season / Mulberry Variety	Spring	Autumn	Summer	Mean
S_1	73.38	75.38	72.13	73.63
TR10	74.00	74.32	73.33	73.89
Kosen	74.34	75.34	72.30	73.99
Mean	73.91	75.01	72.59	

	SEM(±)	CD at 5%
Season	0.24	0.70
Variety	0.24	Non-significant
Season x Variety	0.41	Non-significant

breeds , spring and autumn season have no significant variation regarding larval weight. During summer , only the P_5 could attend a better weight (48.0g). Other breeds recorded very poor weights (Table - 8).

Breed-Variety interaction : Larvae of any BV-breed when fed on Kosen variety showed best larval weight followed by TR_{10} and S_1. Highly significant best larval weight was found when P_5 was reared on Kosen (51.24g). P_5 reared on TR_{10} (49.12g) showed the result next to the highest . KPGB reared on S_1 variety (42.75g) showed the lowest larval weight . P_5 larvae fed with S_1 variety could attain the weight only up to 46.70g (Table - 9).

Season- Variety interaction : Significant variation were observed . Larvae fed on leaves Kosen variety during spring (50.08g) and during autumn (50.05g) were significantly superior in larval weight to others followed by TR_{10} variety during spring (48.87g) and during autumn (48.52g) where variations were non-significant . Larvae fed on the leaves of any of the varieties during summer had shown poor larval weight , the lowest being of the larvae fed with S_1 leaves (39.54g) (Table - 10).

Breed - Season-Variety interaction : P_5 when reared on Kosen during autumn season (52.10g) gave significantly the highest larval weight , followed by P_5 x KPGB on Kosen during spring (51.50g) and then by P_5 on Kosen during spring (51.03g). However, the differences in larval weights among these three categories were non-significant . The lowest larval weight (36.10g) was recorded when KPGB was reared on S_1 variety during summer (Table -11).

From the overall results , it was observed that higher larval weights were obtained during spring and autumn season from P_5 of the pure breeds and P_5xKPGB of the two hybrids when they were fed with leaves of Kosen variety.

4.2.2.2. Single Cocoon Weight

Breed-Season interaction : Both the hybrids during spring season showed significantly the best single cocoon weight (2.13g) over the two pure breeds . Except in case of P5 the results during the summer were significantly very poor. On the whole during spring all the four breeds performed best followed by during autumn. Irrespective of season P_5 was the best performer, KPGB x P_5 breed during summer gave the lowest cocoon weight (1.62g) (Table -12).

Table 8. Effect of silkworm breed and season on the weight of 10 mature fifth instar larvae (g) .

Silkworm breed / Season	P_5	KPGB	KPGB X P_5	P_5 X KPGB
Spring	49.39	47.78	48.84	49.90
Autumn	49.68	46.92	48.46	48.32
Summer	48.00	37.28	39.00	40.50

SEM (±) 0.23
CD at 5 % 0.64

Table 9. Effect of silkworm breed and mulberry variety on the weight of 10 mature fifth instar larvae (g) .

Silkworm breed / Mulberry variety	P_5	KPGB	KPGB X P_5	P_5 X KPGB
S_1	46.70	42.75	44.08	45.12
TR_{10}	49.12	44.27	45.44	46.19
Kosen	51.24	44.96	46.78	47.19

SEM (±) 0.23
CD at 5 % 0.64

Table10. Effect of season and mulberry variety on the weight of 10 mature fifth instar larvae (g) .

Season / Mulberry variety	Spring	Autumn	Summer
S_1	47.99	46.46	39.54
TR_{10}	48.87	48.52	41.38
Kosen	50.08	50.05	42.67

SEM (±) 0.19
CD at 5% 0.56

Table 11. Effect of silkworm breed , season and mulberry variety on the weight of 10 mature fifth instar larvae (g.)

Silkworm breed	Mulberry variety	Season		
		Spring	Autumn	Summer
P5	S1	47.67	47.30	45.13
	TR10	49.47	49.63	48.27
	Kosen	51.03	52.10	50.60
KPGB	S1	47.39	44.77	36.10
	TR10	47.54	47.83	37.43
	Kosen	48.42	48.16	38.30
KPGB x P5	S1	48.00	46.77	37.47
	TR10	49.17	48.23	38.93
	Kosen	49.27	50.37	40.60
P5 x KPGB	S1	48.90	47.00	38.47
	TR10	49.30	48.40	40.87
	Kosen	51.50	49.57	41.87

SEM (±) 0.39
CD at 5% 1.11

Breed-Variety interaction : P_5 breed reared on leaves of Kosen performed the best (2.19g) regarding single cocoon weight having a significant higher value over the others . Kosen when fed to any of the breeds showed better cocoon weight. Relatively better results were obtained from P_5 and P_5xKPGB when fed with the leaves of TR_{10} (2.04g and 1.95 g respectively). Similarly the P_5 also performed well (1.98g) when reared on the leaves of S_1 variety while KPGB showed the lowest value (1.84g) (Table -13).

Season - Variety interaction : Though Kosen is the best variety and spring in the best season so far as the single cocoon weight was considered , leaves of Kosen used for rearing during spring and autumn showed significantly better cocoon weights than the others. During spring the leaves of TR_{10} variety and S_1 variety when fed to the larvae also gave good results . But during the summer , leaves of any of the varieties could not produce appreciately good cocoon weights, the poorest weight was on S_1 variety (1.66g) (Table -14).

Breed- Season -Variety interaction : Higher single cocoon weight was obtained from the combination of P_5xKPGB , Kosen and spring (2.21g) as well as autumn (2.20g) , the differences between the two seasons was non-significant. A similar result was obtained from P_5 breed on Kosen during autumn (2.21g) . Lower cocoon weights were recorded during summer , when S_1 variety was fed to the hybrid KPGB x P_5 (1.55g) and to the pure breed KPGB (1.56g) (Table - 15).

Likewise the larval weight , single cocoon weight also followed the similar trend and thus higher values were obtained during the favourable spring and autumn seasons from P_5 x KPGB and P_5 when the leaves of Kosen were fed to the larvae.

4.2.2.3. Single Shell Weight

Breed -Season interaction : During spring KPGB breed showed the highest single shell weight (0.43g) followed significantly by P_5xKPGB during autumn (0.42g). P_5 and both the hybrids during spring and KPGB x P_5 during autumn showed relatively better performance (0.41g) . Any breed during summer gave the worst performance placing P_5 x KPGB at the lowest position (0.31g) (Table -16).

Table :12 Effect of silkworm breed and season on the single cocoon weight (g.)

Silkworm breed / Season	P_5	KPGB	KPGB X P_5	P_5 X KPGB
Spring	2.06	2.05	2.13	2.13
Autumn	2.07	1.97	2.02	2.10
Summer	2.07	1.69	1.62	1.65

SEM (+) 0.01
CD at 5 % 0.04

Table :13. Effect of silkworm breed and mulberry variety on the single cocoon weight (g.)

Silkworm breed / mulberry variety	P_5	KPGB	KPGB X P_5	P_5 X KPGB
S_1	1.98	1.84	1.86	1.89
TR_{10}	2.04	1.92	1.92	1.95
KOSEN	2.19	1.94	1.98	2.04

SEM (+) 0.01
CD at 5 % 0.04

Table :14. Effect of season and mulberry variety on the single cocoon weight (g.)

Season / Mulberry variety	Spring	Autumn	Summer
S_1	2.05	1.97	1.66
TR_{10}	2.08	2..02	1.76
Kosen	2.14	2.12	1.85

SEM (±) 0.01
CD at 5% 0.03

Table15. Effect of silkworm breed , season and mulberry variety on the single cocoon weight

Silkwormbreed	Mulberry variety	Season		
		Spring	Autumm	Summer
P5	S1	2.01	1.97	1.96
	TR_{10}	2.08	2.05	1.98
	Kosen	2.09	2.21	2.08
KPGB	S1	2.03	1.93	1.56
	TR10	2.03	1.98	1.75
	Kosen	2.09	1.98	1.76
KPGB X P5	S1	2.07	1.96	1.55
	TR10	2.13	1.99	1.64
	Kosen	2.18	2.10	1.67
P5 X KPGB	S1	2.09	2.01	1.58
	TR10	2.10	2.07	1.67
	Kosen	2.21	2.20	1.70

SEM (±) 0.0235
CD at 5% 0.066

Breed- Variety interaction : Non-significant differences were observed among the breeds though P_5 , reared on leaves of Kosen , showed the best shell weight (0.41g) followed by all other breeds fed with Kosen variety (0.40g) (Table - 17).

Season - Variety interaction : When larvae fed with the leaves of Kosen during spring gave the best shell weight (0.43g) followed significantly by the result in autumn (0.42g) . Larvae fed with the leaves of TR_{10} during spring (0.41g) and during autumn (0.40g) showed relatively better performance. During summer the larvae showed poor performance irrespective the leaves of any variety , the worst was being on the leaves of S_1 variety (0.31g) (Table -18).

Breed- Season -Variety interaction : P_5xKPGB among the four breeds and hybrids produced the highest shell weight with the leaves of Kosen during spring (0.44g) followed by P_5 x KPGB on Kosen during autumn (0.43g) . However differences in shell weight among these treatments were non-significant. Interestingly , the TR_{10} variety gave a consistantly good shell weight irrespective of breeds and seasons. P_5 was the only breed which showed better performance on S_1 variety even during summer (Table -19).

From the overall observation it can be summerised that the pure breeds produced higher shell weights during adverse season whereas the hybrids during the favourable season. Kosen variety further proved superior to other cultivars with respect to production of higher shell weight.

4.2.2.4. Shell Ratio

Breed- Season interaction : Both the hybrids (KPGB x P_5 = 20.33 & P_5 x KPGB = 19.95) during autumn and both the pure breeds (P_5 = 20.02 & KPGB = 19.89) during spring performed better than the others. During summer , P_5 (17.07) suffered a set back in its performance (Table -20).

Breed-Variety interaction : Larvae when reared on Kosen performed best for shell ratio particularly for the breeds KPGB and KPGB x P_5. The other breeds reared either on Kosen or on other mulberry varieties had yielding low ratio (Table -21).

Season - Variety interaction : During spring , the larvae fed with leaves of Kosen (19.98) , TR_{10} (19.88) or S_1 variety (19.68) and the larvae reared

Table :16. Effect of silkworm breed and season on the Single Shell Weight (g.)

Silkworm breed / Season	P_5	KPGB	KPGB X P_5	P_5 X KPGB
Spring	0.41	0.43	0.41	0.41
Autumn	0.39	0.39	0.41	0.42
Summer	0.35	0.33	0.32	0.31

SEM (±) 0.003
CD at 5 % 0.010

Table :17. Effect of silkworm breed and mulberry variety on the Single Shell Weight (g.)

Silkworm breed / Mulberry variety	P_5	KPGB	KPGB X P_5	P_5 X KPGB
S_1	0.37	0.36	0.36	0.37
TR_{10}	0.38	0.38	0.39	0.38
Kosen	0.41	0.40	0.40	0.40

SEM (±) 0.003
CD at 5 % Non-significant

Table :18. Effect of season and mulberry variety on the Single Shell Weight (g.)

Season / Mulberry variety	Spring	Autumn	Summer
S_1	0.40	0.39	0.30
TR_{10}	0.41	0.40	0.33
Kosen	0.43	0.42	0.35

SEM (+) 0.003
CD at 5 % 0.01

Table :19. Effect of silkworm breed , season and mulberry variety on Single Shell Weight (g.)

Silkworm breed	Mulberry variety	Season		
		Spring	Autumm	Summer
P5	S1	0.40	0.36	0.34
	TR10	0.42	0.38	0.33
	Kosen	0.42	0.41	0.38
KPGB	S1	0.43	0.38	0.29
	TR10	0.42	0.39	0.33
	Kosen	0.43	0.40	0.35
KPGB x P5	S1	0.39	0.40	0.29
	TR10	0.41	0.41	0.33
	Kosen	0.42	0.42	0.34
P5 x KPGB	S1	0.40	0.41	0.29
	TR10	0.41	0.42	0.32
	Kosen	0.44	0.43	0.32

SEM (±) 0.01
CD at 5 % 0.02

Table 20. Effect of silkworm breed and season on Shell Ratio (%)

Silkwormbreed / Season	P5	KPGB	KPGB X P5	P5X KPGB
Spring	20.02	20.87	19.14	19.38
Autumn	18.64	19.89	20.33	19.95
Summer	17.07	19.08	19.61	18.90

SEM (±) 0.15
CD at 5% 0.43

Table 21. Effect of silkworm breed and mulberry variety on Shell Ratio (%)

Silkwormbreed / Mulberry variety	P5	KPGB	KPGB X P5	P5X KPGB
S_1	18.63	19.68	19.21	19.24
TR_{10}	18.53	19.83	19.81	19.53
Kosen	18.54	20.32	20.03	19.44

SEM (±) 0.15
CD at 5% 0.43

Table 22. Effect of season and mulberry variety on Shell Ratio (%)

Season / Mulberry variety	Spring	Autumn	Summer
S_1	19.68	19.69	18.23
TR_{10}	19.88	19.81	18.60
Kosen	19.98	19.60	19.18

SEM (±) 0.1533
CD at 5 % 0.431

during autumn on TR10 (19.81) and S1 variety (19.69) showed significantly better result than the others , the differences among them are non-significant . Leaves of no variety can prevent the reduction of SR% during summer . The S1 showed the lowest (18.23) SR% (Table -22).

Breed-Season-Variety interaction : KPGB fed with the leaves of S1 variety during spring season showed the highest shell ratio (21.05) followed closely by KPGB on TR10 during spring (20.84). However, the difference was not significant. The lowest shell ratio was obtained when P5 breed was reared on TR10 during summer (16.80) (Table-23).

From the above results , it can be summarised that higher value of shell ratio was obtained from pure breeds during spring , from hybrids during autumn when the leaves of TR10 or S1 variety were fed to the larvae and during summer it was higher especially from KPGB x P5 hybrid on leaves of any variety , preferable Kosen.

4.2.2.5. Absolute Silk Content

Breed - Season interaction : Significant differences were observed.During spring, KPGB(4019.78g) , P5 xKPGB(4012.89g) and KPGB x P5 (3975.00g) showed significantly higher silk content than the others. Any breed during autumn produced a consistently good silk content while no breed during summer could give good silk content (Table -24).

Breed- Variety interaction : Kosen leaves when fed to P5 x KPGB , showed best silk content (3305.33g) , followed non-significantly by KPGB x P5 (3239.56g) and TR10 fed to P5 x KPGB (3229.78g) and followed significantly by the other breeds. Pure breeds on any mulberry variety showed poor silk content (Table -25).

Season- Variety interaction : During spring , Kosen variety leaves , when fed to larvae , gave the best silk content (4036.58g) which was non-significantly higher than obtained from TR10 variety (3958.67g) and was significantly higher than the others. During autumn, larvae fed with any variety of leaves , showed good performance while summer season showed poorest performance putting TR10 at the last level (1765.42g) (Table- 26).

Table :23. Effect of silkworm breed , season and variety on Shell Ratio (%)

Silkworm breed	Mulberry variety	Season		
		Spring	Autumn	Summer
P5	S1	19.93	18.48	17.55
	TR10	20.06	18.74	16.80
	Kosen	20.06	18.70	16.87
KPGB	S1	21.05	19.66	18.34
	TR10	20.84	19.83	18.82
	Kosen	20.73	20.17	20.08
KPGB x P5	S1	18.71	20.44	18.49
	TR10	19.22	20.40	19.81
	Kosen	19.42	20.16	20.52
P5 x KPG B	S1	19.01	20.20	18.52
	TR10	19.39	20.26	18.93
	Kosen	19.73	19.39	19.25

SEM (±) 0.27
CD at 5% 0.75

Table 24. Effect of silkworm breed and season on Absolute Silk Content (g).

Silkwormbreed / Season	P5	KPGB	KPGB X P5	P5X KPGB
Spring	3845.67	4019.78	3975.00	4012.89
Autumn	3156.67	3003.11	3693.00	3796.89
Summer	1873.89	1684.22	1849.11	1914.44

SEM (±) 35.19
CD at % 99.33

Table 25. Effect of silkworm breed and mulberry variety on Absolute Silk Content (g)

Silkwormbreed / Mulberry variety	P5	KPGB	KPGB X P5	P5X KPGB
S_1	2927.00	2880.44	3118.00	3189.11
TR_{10}	2918.22	2910.67	3159.56	3229.78
Kosen	3031.00	2916.00	3239.56	3305.33

SEM (±) 35.19
CD at 5% 99.33

Table 26. Effect of season and mulberry variety on Absolute Silk Content (g)

Season / Mulberry variety	Spring	Autumn	Summer
S_1	3894.75	3305.83	1885.33
TR_{10}	3958.67	3439.58	1765.42
Kosen	4036.58	3491.83	1840.50

SEM (±) 30.47
CD at 5% 86.01

Breed -Season- Variety interaction : Absolute silk content was significantly higher when the larvae of P_5 x KPGB hybrid were fed with the leaves of Kosen variety (4206.33g) followed by KPGB x P_5 on Kosen (4106.00g), then KPGB on TR_{10} (4050.33g) and by others during spring . Absolute silk content was always lower in summer season irrespective of variety and breed and the lowest being from KPGB on TR_{10} (1627.00g) (Table -27) .

From the overall observation it was found that Kosen was the most promising variety of all the seasons. Spring was the best among the three seasons and P_5 x KPGB hybrid was the best breed among the four breeds so far as the absolute silk content was concerned.

4.2.2.6. Effective Rate of Rearing in Weight (ERR wt)

Breed -Season interaction : Except during summer the hybrids express highly significant better seasonal effect than the pure breeds. During spring, KPGB x P_5 (20.79kg) and P_5 x KPGB (20.70kg) were found to produce the highest ERR in wt. significantly followed by others. During autumn , P_5 x KPGB produced better result (19.04kg) , but in summer , P_5 breed (10.97kg) gave the highest ERR wt.(Table -28).

Breed -Variety interaction : P_5 x KPGB showed better performance when reared on leaves of any variety , the best being from Kosen (16.95kg). However, there was no significant differences in the values any breed when reared on TR_{10} or S_1 (Table-29) .

Season -Variety interaction : Larvae reared on leaves of any variety during spring showed better performance than in autumn and than during summer . During spring , Kosen (20.22kg) and TR_{10} (19.93kg) were better than the others . Also S_1 produced better result during spring (19.82kg) than during autumn . Any variety of leaves during summer showed poor ERR wt. , however, S_1 was significantly better (10.36kg) than Kosen (9.66kg) and TR_{10} (9.47kg) (Table - 30).

Breed -Season- Variety interaction : P_5xKPGB when fed with the leaves of Kosen variety during spring (21.32kg) was found to produce the highest ERR wt. followed by KPGB x P_5 on Kosen during spring (21.18kg) . However, their

Table :27. Effect of silkworm breed , season and mulberry variety on Absolute Silk Content (g.)

Silkworm breed	Mulberry Variety	Season		
		Spring	Autumn	Summer
P5	S1	3840.00	2858.00	2083.00
	TR10	3861.33	3194.00	1699.33
	Kosen	3835.67	3418.00	1839.33
KPGB	S1	4010.67	2901.33	1729.33
	TR10	4050.33	3050.67	1627.00
	Kosen	3998.33	3053.33	1696.33
KPGB x P5	S1	3828.00	3693.33	1832.67
	TR10	3991.00	3673.67	1814.00
	Kosen	4106.00	3712.00	1900.67
P5 x KPGB	S1	3900.33	3770.67	1896.33
	TR10	3932.00	3836.00	1921.33
	Kosen	4206.33	3784.00	1925.67

SEM (±) 60.94
CD at 5% 172.02

Table 28. Effect of silkworm breed and season on Effective Rate of Rearing (in weight) [ERR (wt.)] (kg.)

Silkwormbreed / Season	P5	KPGB	KPGB X P5	P5 X KPGB
Spring	19.21	19.25	20.79	20.70
Autumn	16.93	15.10	18.16	19.04
Summer	10.97	8.84	9.39	10.13

SEM (±) 0.12
CD at 5% 0.35

Table 29. Effect of silkworm breed and mulberry variety on Effective Rate of Rearing (in weight) [ERR (wt.)] (kg.)

Silkwormbreed / Mulberry variety	P5	KPGB	KPGB X P5	P5 X KPGB
S_1	15.53	14.41	16.15	16.47
TR_{10}	15.47	14.49	15.92	16.45
Kosen	16.10	14.29	16.27	16.95

SEM (±) 0.12
CD at5% 0.35

Table 30. Effect of season and mulberry variety on Effective Rate of Rearing (in weight) [ERR (wt.)] (kg.)

Season / Mulberry variety	Spring	Autumn	Summer
S_1	19.82	16.74	10.36
TR_{10}	19.93	17.35	9.47
Kosen	20.22	17.84	9.66

SEM (±) 0.11
CD at 5% 0.30

difference was not significant. KPGB breed on Kosen variety during summer gave worst result (8.45kg) (Table -31) .

From the overall observations it can be summarised that hybrids showed better ERR wt on Kosen variety during spring and autumn seasons. But during summer better performance was recorded from pure breeds , especially , from P_5 when fed on leaves of S_1 variety.

4.2.2.7. Effective Rate of Rearing in Number (ERR no.)

Breed- Season interaction : In any season hybrids were found better than pure breeds and spring season was the best followed by autumn . Summer season showed poor survivability. During spring , KPGB x P_5 (9777.78) and P_5xKPGB (9711.11) showed the best performance while KPGB during summer (5255.66) have the worst result , non-significantly lower than the value of P_5 (5322.22) and significantly those of the others (Table-32).

Breed -Variety interaction : Any variety with hybrids showed better performance than with pure breeds and S_1 variety gave better result than TR_{10} and Kosen . Leaves of S_1 variety fed to P_5 x KPGB (8522.22) and KPGB x P_5 (8511.11) offered the best result followed by others having significant difference. KPGB when fed on leaves of Kosen suffered from highest mortality (7222.22) (Table -33) .

Season -Variety interaction : During spring , S_1 (9883.33) and TR_{10} (9558.33) performed best followed by others at significant levels. Any variety in autumn showed better result than any variety in summer . Kosen & TR_{10} variety during summer showed very poor performance (5258.33and 5400.00 respectively) (Table-34).

Breed -Season -Variety interaction : The ERR no. was better in KPGB x P_5 hybrid when the larvae were reared on the leaves of S_1 variety during spring(9900.00) followed by P_5 x KPGB on S_1 during spring (9833.33). However, the difference between the two values was non-significant. During summer , both the pure breeds produced lower value (4800.00) when the leaves of Kosen were fed to the larvae (Table -35).

Table :31. Effect of silkworm breed , season and mulberry variety Effective Rate of Rearing (in weight) [ERR (wt.)](kg.)

Silkworm breed	Mulberry variety	Season		
		Spring	Autumn	Summer
P5	S1	19.26	15.47	11.87
	TR10	19.24	17.05	10.11
	Kosen	19.12	18.27	10.92
KPGB	S1	19.05	14.75	9.43
	TR10	19.42	15.40	8.65
	Kosen	19.29	15.14	8.45
KPGBx P5	S1	20.46	18.07	9.91
	TR10	20.77	18.01	9.00
	Kosen	21.18	18.41	9.26
P5 x KPG B	S1	20.52	18.67	10.24
	TR10	20.27	18.94	10.13
	Kosen	21.32	19.51	10.01

SEM (±) 0.21
CD at 5% 0.60

Table 32. Effect of silkworm breed and season on Effective Rate of Rearing (in number) [ERR (no.)]

Silkwormbreed / Season	P5	KPGB	KPGB X P5	P5 X KPGB
Spring	9333.33	9400.00	9777.78	9711.11
Autumn	8155.56	7677.78	9011.11	9088.89
Summer	5322.22	5255.56	5811.11	6164.44

SEM (±) 48.96
CD at 5% 138.20

Table 33. Effect of silkworm breed and mulberry variety on Effective Rate of Rearing (in number)[ERR (no.)]

Silkwormbreed / Mulberry variety	P5	KPGB	KPGB X P5	P5 X KPGB
S_1	7844.44	7888.89	8511.11	8522.22
TR_{10}	7566.67	7422.22	8088.89	8288.89
Kosen	7400.00	7222.22	8000.00	8133.33

SEM (±) 48.96
CD at 5% 138.20

Table 34. Effect of season and mulberry variety on Effective Rate of Rearing (in number)[ERR (no.)]

Season / Mulberry variety	Spring	Autumn	Summer
S_1	9883.33	8500.00	6241.67
TR_{10}	9558.33	8566.67	5400.00
Kosen	9425.00	8383.00	5258.33

SEM (±) 42.40
CD at 5% 119.69

Table :35. Effect of silkworm breed , season and mulberry variety Effective Rate of Rearing (in number) [ERR (no.)]

Silkworm breed	Mulberry variety	Season		
		Spring	Autumn	Summer
P5	S1	9600.00	7866.67	6066.67
	TR10	9266.67	8333.33	5100.00
	Kosen	9133.33	8266.67	4800.00
KPGB	S1	9400.00	7633.33	6033.33
	TR10	9566.67	7766.67	4933.33
	Kosen	9233.33	7633.33	4800.00
KPGB x P5	S1	9900.00	9233.33	6400.00
	TR10	9733.33	9033.33	5500.00
	Kosen	9700.00	8766.67	5533.33
P5 x KPGB	S1	9833.33	9266.67	6466.67
	TR10	9466.67	9133.37	6066.67
	Kosen	9633.33	8866.67	5900.00

SEM (±) 84.80
CD at 5% 239.37

From the overall result , it was found that better ERR no. was obtained during favourable seasons when the leaves of S_1 variety were fed to the larvae of hybrids.

4.2.2.8. Fecundity

Breed -Season interaction : Hybrids showed better fecundity than the pure breeds. Summer and autumn were the favourable seasons for fecundity. KPGB x P_5 breed during summer showed the highest fecundity (634.44) followed by significant difference with P_5 x KPGB during summer (625.89) and than by others. KPGB had poor fecundity at any season (Table -36) .

Breed -Variety interaction : KPGB x P_5 was the best performing breed and Kosen variety was better than others. P_5xKPGB (623.33) and KPGB x P_5 (622.44) reared on the leaves of Kosen had the best fecundity while both the hybrids reared on the leaves of TR_{10} was found better (KPGB x P_5 = 622.00 & P_5 x KPGB =618.78) . KPGB on S_1 variety produced the lowest number of eggs (Table -37).

Season -Variety interaction : During summer Kosen variety was the best for fecundity (622.17) followed significantly by TR_{10} variety (616.50) though the difference was non-significant. Also the difference between Kosen and TR_{10} during autumn is non significant . Except a Kosen other two varieties produced very poor result during spring (Table -38) .

Breed -Season -Variety interaction : Effect of season , variety and breeds , studied under present investigation , have found no significant influence on fecundity . However, higher fecundity was obtained from KPGB x P_5 hybrid fed on leaves of Kosen variety during summer (637.33) and lowest being from KPGB on S_1 during spring (Table -39) .

From overall observations it can be concluded that summer and autumn are the better seasons. The Kosen variety and hybrids , especially the KPGB x P_5, are the better variety and breeds respectively though the three factor interaction had no significant differences.

Table 36. Effect of silkworm breed and season on fecundity (no.)

Silkwormbreed / Season	P5	KPGB	KPGB X P5	P5 X KPGB
Spring	611.78	585.89	614.78	610.33
Autumn	607.44	604.89	612.78	615.33
Summer	600.00	599.67	634.44	625.89

SEM (±) 1.86
CD at 5% 5.25

Table 37. Effect of silkworm breed and mulberry variety on fecundity (no.)

Silkwormbreed / Mulberry variety	P5	KPGB	KPGB X P5	P5 X KPGB
S_1	600.22	587.44	617.56	609.44
TR_{10}	605.11	598.00	622.00	618.78
Kosen	613.89	605.00	622.44	623.33

SEM (±) 1.86
CD at 5% 5.25

Table 38. Effect of season and mulberry variety on fecundity (no.)

Season / Mulberry variety	Spring	Autumn	Summer
S_1	596.58	608.08	606.33
TR_{10}	606.92	609.50	616.50
Kosen	613.58	612.75	622.17

SEM (±) 1.61
CD at 5% 4.55

Table :39. Effect of silkworm breed , season and mulberry variety on Fecundity (no.)

Silkworm breed	Mulberry variety	Season		
		Spring	Autumn	Summer
P5	S1	605.67	603.33	591.67
	TR10	612.00	603.33	600.00
	Kosen	617.67	615.67	608.33
KPGB	S1	574.67	608.33	584.33
	TR10	584.67	606.00	603.33
	Kosen	598.33	605.33	611.33
KPGB x P5	S1	607.67	614.00	631.00
	TR10	618.33	612.67	635.00
	Kosen	618.33	611.67	637.33
P5 x KPGB	S1	598.33	611.67	618.33
	TR10	612.67	616.00	627.67
	Kosen	620.00	618.33	631.67

SEM (±) 3.23
CD at 5% Non - significant

4.2.3. Quality of cocoon as influenced by variety

4.2.3.1. Filament length (Table-40)

Breed - Specific differences : Hybrids produced longer filament than the pure breeds. KPGB x P5 provided the highest filament length (812.64m) followed by P5 x KPGB (782.72m) . The lowest filament length was obtained from KPGB (755.31m).

Varietal differences : No significant differences was observed between S1 (776.60m) and Kosen (777.92m) . But the filament length was significantly higher in TR10 (782.33m).

Breed-Variety interaction : The average filament length was the highest (818.0m) in KPGB x P5 when reared on Kosen. In the same hybrid the values were 812.67m when reared on TR10 and 807.25m when reared on S1 . All the values differed significantly . The lowest average length (745.33m) obtained from KPGB reared on Kosen.

4.2.3.2. Reelability (Table -41)

Breed Specific differences : Pure breeds showed better quality for reeling of the filaments. The P5 ranking first (89.44%) , followed significantly by KPGB (88.67%) and then significantly by P5xKPGB (88%).

Varietal differences : The larvae reared on the S1 variety recorded the best reelability (89.83%) followed significantly by TR10 (87.58%) and then by Kosen (87.50%).

Breed -Variety interaction : Higher reelability (90%) was observed in both the pure breeds (P5 and KPGB) and in the hybrid of KPGB x P5 when the larvae were fed with the leaves of S1 variety. The differences in the values between these breeds and that of the rest of the breeds were not significant. The least value (85%) was obtained in the hybrid of KPGB x P5 reared on the leaves of Kosen.

4.2.3.3. Denier (Table -42)

Breed-Specific differences : For this character the P5 (3.50) was significantly superior to KPGB x P5 (3.35) and then to KPGB (3.30).

Table :40. Effect of silkworm breed and mulberry variety on Filament Length (mt.)

Silkworm breed / Mulberry Variety	P_5	KPGB	KPGB x P_5	P_5 x KPGB	Mean
S_1	764.67	755.25	807.25	779.25	776.60
TR_{10}	770.42	765.33	812.67	780.92	782.33
Kosen	760.33	745.33	818.00	788.00	777.92
Mean	765.14	755.31	812.64	782.72	

	SEM (±)	CD at 5%
Breed	1.39	2.86
Variety	1.20	2.47
Breed x Variety	2.41	4.97

Table :41. Effect of silkworm breed and mulberry variety on Reelability (%)

Silkworm breed / Mulberry Variety	P_5	KPGB	KPGB x P_5	P_5 x KPGB	Mean
S_1	90.00	90.00	90.00	89.33	89.83
TR_{10}	88.67	87.33	86.33	88.00	87.58
Kosen	89.67	88.67	85.00	86.67	87.50
Mean	89.44	88.67	87.11	88.00	

	SEM (±)	CD at 5%
Breed	0.31	0.64
Variety	0.27	0.56
Breed x Variety	0.54	1.11

Table :42. Effect of silkworm breed and mulberry variety on Denier

Silkworm breed / Mulberry variety	P_5	KPGB	KPGB x P_5	P_5 x KPGB	Mean
S_1	3.49	3.27	3.29	3.28	3.33
TR_{10}	3.52	3.36	3.35	3.28	3.38
Kosen	3.48	3.26	3.41	3.38	3.38
Mean	3.50	3.30	3.35	3.31	

	SEM (±)	CD at 5%
Breed	0.01	0.02
Variety	0.01	0.02
Breed x Variety	0.02	0.04

Varietal differences : Both TR_{10} and Kosen (3.38) proved significantly better than S_1 (3.33).

Breed-Variety interaction : The highest value of denier was recorded from the P_5 breed (3.52) when the larvae were fed with the leaves of TR_{10}. This result was followed by P_5 breed fed on S_1 (3.49) and Kosen variety (3.48). The lowest value of denier was observed in KPGB hybrid fed with the leaves of Kosen.

From the overall observation, it was found that the results of average quality of cocoon was rather inconsistant and more of the breeds or the varieties showed better result for all the characters considered for assessing cocoon quality. However , better filament length , weight and reelability were obtained from the hybrid , KPGB x P_5 whereas better denier was recorded from the pure breed KPGB . With regard to the varieties higher filament length , and denier were obtained from Kosen but the better reelability was recorded from S_1 . Hence, the result can be summarised as KPGB x P_5 hybrid and Kosen can be considered as the best breed and the best variety respectively for better quality silk cocoon in the agroclimatic zone of terai.

4.2.4. Consumption and Utilization Efficiencies of Food as influenced by variety over seasons

The nutritional efficiencies of the fifth instar larvae of two bivoltine silk worm breeds and their two reciprocal hybrids were studied on three mulberry varieties such as S_1 , TR_{10} and Kosen during three seasons. The important results are discussed below.

4.2.4.1. Consumption Indices (fifth instar larva)

Larval duration : Larval duration was the lowest when the larvae of P_5 x KPGB hybrid were reared on the leaves of Kosen variety during summer (5.25 days), followed by on the leaves of TR_{10} variety (5.50days). But both the pure breeds (P_5 and KPGB) took longer duration on leaves of S_1 variety during spring (7.50 days) (Table -43) .

Table :43. Effect of breed , variety and season on duration of larval period of fifth instar larva (days)

Breed	Variety	Season		
		Spring	Autumn	Summer
P5	S1	7.50	7.00	6.25
	TR10	7.00	6.75	6.25
	Kosen	7.00	6.75	6.25
KPGB	S1	7.50	7.00	6.00
	TR10	7.25	6.75	5.75
	Kosen	7.25	6.75	5.75
KPGB x P5	S1	7.00	6.25	5.75
	TR10	7.00	6.25	5.75
	Kosen	6.75	6.25	5.75
P5 x KPGB	S1	7.00	6.25	5.75
	TR10	7.00	6.25	5.50
	Kosen	6.75	6.25	5.25

Food ingestion : Larvae of KPGB breed fed with the S1 variety of leaves during spring showed the highest food intake (13.38g) followed by P5 (13.08g) . KPGB x P5 hybrid larvae reared on Kosen variety during summer consumed the lowest amount of food (7.07g) indicating wide seasonal variation on food intake by the larvae (Table-44).

Food balance : Food balance was the highest in KPGB on S1 variety during spring (7.73g) followed by in P5 (7.59g) and the lowest was in KPGB x P5 on leaves of Kosen variety during summer (3.75g) (Table - 45) .Food balance had high positive co-relation with food ingesion (+0.99) (Table - 52).

Weight gained by larva : The larvae of P5 breed when fed with the leaves of Kosen variety gained the maximum weight during spring and autumn seasons (0.90g) and the lowest value was obtained from the larvae of KPGB and P5 x KPGB on S1 and TR10 respectively during summer season (0.77g) (Table -46).

From the overall observations , it can be summarized that shorter larval duration was accompanied by lower food intake and food balance which ultimately reflected in lower gain in weight by the larvae during summer as compared with these parameters during spring when higher gain in weight by the larvae was associated with the higher duration and higher food balance.

Higher larval duration , food ingestion and food balance did not always lead to higher gain in larval weight as noted when the larvae were fed with the leaves of S1 variety , where the highest gain in weight was obtained when leaves of Kosen variety were fed during the same season i.e., during spring. Kosen variety further proved its superiority to TR10 and S1 through maintaining consistency in all the seasons which is evident from shorter larval duration , lower ingestion and lower food balance but higher gain in weight even in summer. Since the pure breeds had higher larval duration , higher food ingestion and better food balance , the gain in larval weight was also higher than that of both the hybrids.

4.2.4.2. Nutritional Efficiencies (fifth instar larva)

Consumption Index (C.I.) : Higher consumption index were obtained during summer season when the leaves of S1 variety were fed to P5 x KPGB (2.06)

Table :44. Effect of breed , variety and season on Food Ingestion (g.) by a fifth instar larva

Breed	Variety	Season		
		Spring	Autumn	Summer
P5	S1	13.08	12.10	10.28
	TR10	9.60	8.57	8.28
	Kosen	9.00	8.25	7.56
KPGB	S1	13.38	12.00	10.43
	TR10	10.02	8.63	8.34
	Kosen	9.21	8.30	7.23
KPGB x P5	S1	12.62	11.29	9.97
	TR10	9.33	8.25	8.00
	Kosen	8.73	7.89	7.07
P5 x KPGB	S1	12.43	11.40	9.97
	TR10	9.42	8.18	8.00
	Kosen	8.52	8.13	7.17

Table :45. Effect of breed , variety and season on Food Balance (g.) by a fifth instar larva

Breed	Variety	Season		
		Spring	Autumn	Summer
P5	S1	7.59	7.02	5.96
	TR10	5.30	4.76	4.53
	Kosen	4.77	4.35	4.04
KPGB	S1	7.73	7.00	6.08
	TR10	5.52	4.78	4.64
	Kosen	4.88	4.40	3.83
KPGB x P5	S1	7.36	6.54	5.87
	TR10	5.18	4.55	4.39
	Kosen	4.63	4.19	3.75
P5 x KPGB	S1	7.23	6.65	5.85
	TR10	5.18	4.53	4.40
	Kosen	4.52	4.31	3.82

Table 46. Effect of silkworm breed , season and mulberry variety on weight gain by a fifth instar larva

Breed	Variety	Season		
		Spring	Autumm	Summer
P5	S_1	0.87	0.84	0.82
	TR_{10}	0.88	0.86	0.82
	Kosen	0.90	0.90	0.84
KPGB	S_1	0.85	0.83	0.77
	TR_{10}	0.86	0.85	0.80
	Kosen	0.86	0.86	0.81
KPGB X P5	S_1	0.87	0.86	0.80
	TR_{10}	0.87	0.87	0.80
	Kosen	0.88	0.88	0.81
P5 X KPGB	S_1	0.86	0.85	0.78
	TR_{10}	0.87	0.87	0.77
	Kosen	0.87	0.88	0.79

followed by KPGB x P_5 (2.01) and the lowest value was obtained during autumn when the leaves of Kosen variety were fed to P_5 (1.25) (Table-47).

Growth Rate (G.R.) : The P_5 x KPGB breed when on Kosen variety during summer showed the highest rate of growth (0.18) followed closely by P_5 x KPGB reared on the leaves of TR_{10} during summer (0.17) . However, the lowest G.R. was recorded in both the pure breeds when reared on the leaves of S_1 variety during spring (0.12) (Table -48).

Approximate Digestability (A.D.) : The highest AD was recorded during summer when the leaves of S_1 were fed to the KPGB x P_5 (58.88%) , followed closely by its reciprocal P_5 x KPGB (58.68%) and the lowest was by P_5 when the leaves of Kosen variety were allowed to consume during autumn (52.73%) (Table-49). Moreover A.D. showed positive co-relation with food ingestion (+0.81) and food balance (+0.86) (Table-52).

Efficiency of conversion of ingested food (E.C.I.) : KPGB x P_5 hybrid showed higher ECI when the leaves of Kosen variety was fed to the larvae during summer (11.46%) , followed by autumn (11.15%) and the lowest value was recorded in KPGB fed with the leaves of S_1 variety during spring (6.35%) (Table -50). E.C.I. had strong negative co-relation with food ingestion (-0.96) and food balance (-0.97) (Table -52).

Efficiency of conversion of digested food (E.C.D.) : E.C.D. followed the trend similar to that of E.C.I .and here also the larvae of KPGB x $P_5$when fed with the leaves of Kosen variety during summer showed the highest E.C.D. (21.06%) followed by during autumn (21.00%) and least being from KPGB fed with the leaves of S_1 variety during spring season (11.00%) (Table-51). E.C.D. had strong positive co-relation with E.C.I. (+0.99) and negative co-relation with food ingestion (-0.94) , and food balance (-0.97),and A.D. (-0.93) (Table -52).

In a critical review of the results of different indices of nutritional efficiencies it was observed that during summer higher values were obtained for consumption index, growth rate, apporoximate digestibility , efficiency of conversion of ingested and digested food whereas lower nutritional efficiencies were observed during spring and autumn.

Lower consumption index and approximate digestibility was substantiated by higher conversion efficiencies in larvae fed on Kosen variety through due to higher C.I. and digestibility , the values of conversion efficiencies were the

Table :47. Effect of breed , variety and season on Consumption Index (C.I.)

Breed	Variety	Season		
		Spring	Autumn	Summer
P5	S1	1.83	1.88	1.87
	TR10	1.43	1.35	1.51
	Kosen	1.30	1.25	1.34
KPGB	S1	1.92	1.88	2.09
	TR10	1.47	1.39	1.68
	Kosen	1.35	1.31	1.43
KPGB x P5	S1	1.90	1.92	2.01
	TR10	1.39	1.39	1.62
	Kosen	1.32	1.32	1.41
P5 x KPGB	S1	1.89	1.96	2.06
	TR10	1.42	1.38	1.75
	Kosen	1.31	1.36	1.61

Table :48. Effect of breed , variety and season on Growth Rate (G.R.)

Breed	Variety	Season		
		Spring	Autumn	Summer
P5	S1	0.12	0.13	0.15
	TR10	0.13	0.14	0.15
	Kosen	0.13	0.14	0.15
KPGB	S1	0.12	0.13	0.15
	TR10	0.13	0.14	0.16
	Kosen	0.13	0.14	0.16
KPGB x P5	S1	0.13	0.15	0.16
	TR10	0.13	0.15	0.16
	Kosen	0.13	0.15	0.16
P5 x KPGB	S1	0.13	0.15	0.16
	TR10	0.13	0.15	0.17
	Kosen	0.13	0.15	0.18

Table :49. Effect of breed , variety and season on Approximate Digestibility (A.D.)

Breed	Variety	Season		
		Spring	Autumn	Summer
P5	S1	58.03	58.02	57.98
	TR10	55.21	55.54	54.71
	Kosen	53.00	52.73	53.44
KPGB	S1	57.77	58.33	58.29
	TR10	55.09	55.39	55.64
	Kosen	52.99	53.01	52.97
KPGB x P5	S1	58.32	57.93	58.88
	TR10	55.52	55.15	54.88
	Kosen	53.04	53.11	53.04
P5 x KPGB	S1	58.17	58.33	58.68
	TR10	54.99	55.38	55.00
	Kosen	53.05	53.01	53.28

Table :50. Effect of breed , variety and season on Efficiency of Conversion of Ingested food (E.C.I.)

Breed	Variety	Season		
		Spring	Autumn	Summer
P5	S1	6.65	6.94	7.98
	TR10	9.17	10.04	9.90
	Kosen	10.00	10.91	11.11
KPGB	S1	6.35	6.92	7.38
	TR10	8.58	9.85	9.59
	Kosen	9.34	10.36	11.20
KPGB x P5	S1	6.89	7.62	8.02
	TR10	9.32	10.55	10.00
	Kosen	10.08	11.15	11.46
P5 x KPGB	S1	6.92	7.46	7.82
	TR10	9.24	10.64	9.63
	Kosen	10.21	10.82	11.02

Table :51. Effect of breed , variety and season on Efficiency of Conversion of Digested food (E.C.D.)

Breed	Variety	Season		
		Spring	Autumn	Summer
P5	S1	11.46	11.97	13.76
	TR10	16.60	18.07	18.10
	Kosen	18.87	20.69	20.79
KPGB	S1	11.00	11.86	12.66
	TR10	15.58	17.78	17.24
	Kosen	17.62	19.37	21.15
KPGB x P5	S1	11.82	13.15	13.63
	TR10	16.80	19.12	18.22
	Kosen	19.01	21.00	21.60
P5 x KPGB	S1	11.89	12.78	13.33
	TR10	16.80	19.21	17.50
	Kosen	19.25	20.42	20.68

Table 52. Correlation Matrix of Rearing performance , nutritional efficiencies and chemical contents of leaf of three mulberry varieties (S1 , TR10 & Kosen)

	L.du	FI	FB	Wtg	CI	GR	AD	ECI	ECD	L.Wt	ERRwt	CWt	Swt	SR%	ASC	ERRno.	FEC	PRO	CAR	MOIS
L.du	1.00000																			
FI	.57714**	1.00000																		
FB	.60838**	.99516**	1.00000																	
Wt.G	.71475**	.12908	.05824	1.00000																
CI	-.14103	.70938**	.76477**	-.54143**	1.00000															
GR	-.98036**	-.59021**	-.52400**	-.69654**	.11014	1.00000														
AD	.11053	.51167**	.86399**	.29062	.90579**	-.13641	1.00000													
ECI	-.41408*	-.96063**	-.97460**	-.10632	-.83814**	.43476*	-.89972**	1.00000												
ECD	.36692	.94463**	.96601**	.14164	.85917**	.38771*	-.95310**	.99606**	1.00000											
L.Wt.	.70727**	.10074	.07221	.92001**	-.54526**	-.67898**	.30143	.11670	.15135	1.00000										
ERR wt.	.78198**	.36957	.36349	.89913**	.29156	-.78089**	-.04942	-.17086	.13463	.81845**	1.00000									
C.wt.	.66835**	.08519	.01567	.89617**	.54992**	-.66755**	-.32557	.13287	.17065	.95064**	.79569**	1.00000								
S.wt	.70281**	.14076	.06306	.91099**	-.51337**	-.66896**	-.32294	.08284	.12679	.85170**	.89980**	.87519**	1.00000							
SR%	.23929	.08046	.03902	.31259	-.16203	-.18001	-.17526	.01142	.03913	.10585	.42956*	.07270	.53768**	1.00000						
ASC	.76511**	.35816	.29049	.87877**	-.29167	-.75458**	-.06818	-.16205	-.12435	.77697**	.98992**	.74098**	.91661**	.54819**	1.00000					
ERR no.	.75581**	.46201**	.40496*	.81388**	-.15034	-.75585**	.08468	-.28874	-.25802	.70018**	.97539**	.64780**	.81942**	.50911**	.97905**	1.00000				
FEC	-.65713**	-.51611**	-.49526**	-.16305	-.20596	.53436**	-.33684*	-.48317**	-.46618**	-.21595	.21144	.25442	-.20743	.03272	-.20799	-.19566	1.00000			
PRO	-.37717*	-.93389**	-.95174**	.09513	-.82369**	.41111*	-.89950**	.96658**	.96813**	.12193	-.18606	.12885	.09956	.06064	-.16755	-.30303	.41908*	1.00000		
CAR	.39886*	.93630**	.95291**	.06749	-.81010**	.43274*	-.89984**	.96888**	.97115**	.09709	-.21673	.10973	.07597	.05239	-.19773	-.33441*	.42955*	.99753**	1.00000	
MOIS	-.44536**	-.34405*	-.31288	-.57812**	.05643	.39817*	-.10048	.19253	.17919	-.53129**	-.56971**	-.47964**	-.57596**	-.33046*	-.57280**	-.56113**	.15198	.07585	.10957	1.00000

*, ** Significant at 5 % and 1 % level of significance respectively

L.Du = Larval Duration , FI = Food Ingestion , FB = Food Balance , Wt.G. = Weight Gain , CI = Consumption Index , GR = Growth Rate, AD = Approximate Digestability , ECI = Efficiency of Conversion of Ingested food , ECD = Efficiency of Conversion of digested food, L.Wt. = Larval Weight, ERR wt. = Effective Rate of Rearing (in weight) , C wt. = Single Cocoon weight, S wt. = Single Shell weight , SR% = Shell Ratio, ASC= Absolute silk Content , ERR no. = Effective Rate of rearing (in number) , FEC = Fecundity , PRO = Protein Content of Leaf , CAR = Carbohydrate Content of leaf MOIS = Moisture Content of leaf.

highest in S1. From the above results it was also observed that hybrids recorded higher rate of growth and digestibility as well as conversion efficiencies though consumption index was low as compared to those of pure breeds.

4.3. Enrichment of Nutritional Quality of Leaves through manipulation of Fertilizer Supplementation and its Impact on Silkworm

From the foregoing result Kosen variety appeared to be the best of the three varieties so far as the nutritional efficiencies, important rearing parameters and cocoon yield and quality of cocoon of silkworms were concerned . But the leaf yield was very poor even less than half that of the S1 and two-third that of the TR10. Superiority of Kosen to other two varieties was due to its inherent higher nutritive value of leaves which was ultimately reflected on the higher nutritional efficiencies , and consequent cocoon yield and quality . However , yield of mulberry leaves must be taken into consideration as an important selection criteria for variety. In other to exploit the high yield potential of the S1 variety in this region feasibility of enrichment in the quality of leaves through manipulation of fertility level was explored. This would minimise the yield quality gap of the leaves and boost up the production of quality silk.

Leaves of S1 variety were raised using different levels of fertilizer [0:0:0 kg NPK/ha(F0) , 40:20:20 kg NPK /ha(F1), 80:40:40 kg NPK/ha (F2) , 120:60:60 kg NPK/ha (F3) and 160:80:80 kg NPK/ha (F4)]. Such leaves produced from three different levels of fertilizer were used to rear the larvae of 2 pure breeds (P5 and KPGB and 2 hybrids (P5xKPGB and KPGB x P5) during the three seasons.

The results on quality of leaves , rearing performance , nutritional efficiencies and cocoon quality of the bivoltine worms were recorded.

4.3.1. Nutrient Contents of Leaves due to Fertilizer Supplementation S1 mulberry leaves

4.3.1.1. Total Protein Content (Table -53)

Seasonal impact : Significant differences observed among the seasons , the highest level in autumn (18.16%) , intermediate quantity during spring (17.72%) and the lowest during summer (16.89%).

Impact of Fertilizer : Increased level of fertilizer increased the protein content. At F0 fertilizer level the protein content was 10.92% which was far below the value of the F1 level of fertilizer (14.71%). This in turn was far lower than in the F2 level (18.17%). Further increase of protein content from F2 to F3 (20.54%) was not so high but the difference was significant . But the difference of the values between F3 and F4 (23.61%) was again greater.

Season -Fertilizer interaction : The leaves raised under F4 fertilizer level during spring season showed significantly the highest total protein content (24.50%) followed by during autumn (23.66%) and the lowest was during spring in the leaves raised under F0 level (9.24%) . During summer the protein content in leaves increased with the increased level of fertilizer to 18.35% in case of F3 and to 22.66% in case of F4 level of fertilizer.

4.3.1.2. Total Carbohydrate Content (Table -54)

Seasonal impact : There was no significant difference between autumn (11.54%) and spring (11.33%) values but the carbohydrate content of both the seasons were significantly higher than that of the summer (10.70%) leaves.

Impact of Fertilizer : Significant differences were observed among the carbohydrate contents obtained from different doses of fertilizer. Carbohydrate content of leaves increased with the increased dose of fertilizer , the highest value was in case of F4 level (16.27%) , followed sequentially by F3 (13.36%) and F2 (11.37%).

Season -Fertilizer interaction : Likewise the total protein content , the carbohydrate content in the leaves followed the same trend being significantly highest at F4 fertilizer level during spring (16.89%) followed by in autumn at the same F4 level (16.30%). Significant upliftment of carbohydrate content in the leaves was observed with the increased level of fertilizer.

4.3.1.3. Moisture Content (Table-55)

Seasonal impact : Autumn leaves had the highest moisture content (75.17%) followed significantly by that of spring leaves (73.30%) which was again significantly followed by that of summer leaves (72.47%).

Table 53. Total protein content of the leaves raised from different fertilizer level during three different seasons

Season / Fertilizer	Spring	Autumn	Summer	Mean
F_0	9.24	11.34	12.18	10.92
F_1	12.99	16.53	14.60	14.71
F_2	19.34	18.52	16.64	18.17
F_3	22.51	20.76	18.35	20.54
F_4	24.50	23.66	22.66	23.61
Mean	17.22	18.16	16.89	23.61

	SEM (±)	CD at 5%
Season	0.12	0.35
Fertilizer	0.16	0.46
Season x Fertilizer	0.28	0.80

Table 54. Total carbohydrate content of the leaves raised from different fertilizer level during three different seasons

Season / Fertilizer	Spring	Autumn	Summer	Mean
F_0	5.29	6.35	6.76	6.14
F_1	7.79	9.89	8.76	8.81
F_2	12.10	11.57	10.46	11.37
F_3	14.58	11.59	11.89	13.36
F_4	16.89	16.30	15.63	16.27
Mean	11.33	11.54	10.70	

	SEM (±)	CD at 5%
Season	0.49	0.42
Fertilizer	0.04	0.10
Season x Fertilizer	0.11	0.32

Table 55. Total moisture content of the leaves raised from different fertilizer level during three different seasons

Season / Fertilizer	Spring	Autumn	Summer	Mean
F_0	70.61	73.59	70.12	71.44
F_1	72.63	74.96	70.81	72.80
F_2	73.30	75.39	72.18	73.62
F_3	74.87	75.95	74.30	75.04
F_4	75.07	75.98	74.93	75.33
Mean	73.30	75.17	72.47	

	SEM (±)	CD at 5%
Season	0.27	0.79
Fertilizer	0.35	1.02
Season x Fertilizer	0.61	Non-significant

Impact of Fertilizer : Significant differences were observed in the leaf moisture content obtained from the different fertilizer levels. Leaves raised under F4 (75.33%) and F3 (75.04%) had higher moisture content followed significantly by F2 (73.62%)and others.

Season-Fertilizer interaction : Seasonal influence on moisture content of leaves raised under different fertilizer status was found non- significant. However, autumn season showed the highest moisture content in leaves raised under F4 level (75.98%).

On the whole during autumn season leaves raised under F4 level contained the highest levels of protein , carbohydrate and moisture contents.

4.3.2. Effect of Fertilizer Supplementation on Rearing Performance of different breeds over seasons

4.3.2.1. Weight of 10 Mature Larvae

Breed - Season interction : Among the four breeds and three seasons studied, there were significant differences in larval weight . The highest weight was attained during spring by P5 x KPGB (46.83g) which was followed by KPGB x P5 (45.86g). The lowest larval weight was found during summer in P5 (35.85g). Moreover , during spring any of the breeds was superior to the other two seasons. During summer none of the breeds could attain good larval weight (Table -56) .

Breed -Fertilizer interaction : P5xKPGB reared on F4 leaves developed the highest larval weight (49.83g) followed by KPGB x P5 reared on the same leaves (49.36g) , the difference was non-significant . The next lower weight was attained by P5xKPGB reared on F3 leaves (48.96g) . The difference from the other two weights were significant. KPGB race fed with the F4 leaves had the highest weight of the two pure breeds (47.60g) which was even significantly lower than the larval weight of hybrid race reared on the leaves of F3 fertilizer level . The lowest larval weight (34.62g) was found in P5 when reared on F0 leaves raised without fertilizer supplementation . The result showed that P5xKPGB reared on the F0 leaves produced higher larval weight (37.84g) than the P5 (37.41g) reared on F1 leaves (Table -57) .

Table 56. Effect of silkworm breed and season on the weight of 10 mature fifth instar larvae(g.)

Season / Fertilizer	P_5	KPGB	KPGB x P_5	P_5 x KPGB
Spring	43.38	45.03	45.86	46.83
Autumn	42.03	42.76	44.32	44.85
Summer	35.85	38.51	40.14	41.27

SEM (±) 0.23
CD at 5 % 0.65

Table 57. Effect of silkworm breed and leaves raised under different fertility status on the weight of 10 mature fifth instar larvae (g.)

Season / Fertilizer	P_5	KPGB	KPGB x P_5	P_5 x KPGB
F_0	34.62	36.11	37.09	37.84
F_1	37.41	38.71	38.93	38.93
F_2	41.09	42.75	44.08	45.12
F_3	43.36	45.33	47.74	48.96
F_4	45.62	47.60	49.36	49.83

SEM (±) 0.30
CD at 5 % 0.83

Table 58. Effect of season and leaves raised under different fertility status on the weight of 10 mature fifth instar larvae (g.)

Season / Fertilizer	Spring	Autumn	Summer
F_0	38.57	36.17	34.51
F_1	41.42	38.74	36.01
F_2	47.37	45.38	37.02
F_3	49.05	47.37	42.62
F_4	49.96	49.79	44.56

SEM (±) 0.26
CD at 5 % 0.72

Season -Fertilizer interaction : No significant variation was found during spring and autumn when the larvae were reared on F4 leaves. But significant differences in larval weight were recorded in all the fertilizer levels within a particular season. The F4 level of fertilizer during spring promoted the non significant highest larval weight (49.96g) than in autumn (49.79g) and the lowest weight in larvae reared on the leaves of F0 level of fertilizer during summer (34.51g) (Table-58).

Breed -Season-Fertlizer interaction : During spring , larval weight of P_5 x KPGB hybrid (51.23g) was found superior when the larvae were fed with the leaves of S1 variety raised under F4 level of fertilization (160:80:80kg NPK/ha) , followed by F3 level (120:60:60kg NPK/ha) (51.17g). The difference between the two levels was non-significant . However, the larval weight of P_5 x KPGB fed with the leaves raised during summer with F4 level was 47.27g. The results indicated the pronounced seasonal effect on the rearing performance which resulted in lower larval weight as compared with that of autumn and spring . Larval weight was the lowest during summer from breeds at F0 level (Table -59) .

From overall observations , it is found that higher level of fertilizer always produced elevated value of larval weight irrespective of seasons,. Larval weight was always higher in favourable seasons like spring and autumn than in unfavourable seasons like the summer , irrespective of the breeds. However, higher larval weight was obtained during spring and autumn from the hybrid P_5 x KPGB and its reciprocal KPGB x P_5 when leaves were fed the leaves raised under higher level of fertilizer (160:80:80 kg NPK/ha).

4.3.2.2. Single Cocoon Weight

Breed -Season interaction : Both the hybrids during spring produced significantly heavier cocoon (1.95g) than by P_5xKPGB during autumn (1.93g) . During summer , P_5 breed showed the poorest performance (1.56g) (Table -60).

Breed -Fertilizer interaction : P_5xKPGB fed on leaves raised under F4 level of fertilizer showed the best result (2.02g) followed by P_5xKPGB reared on F3 leaves (1.99g) and then by KPGB x P_5 reared on F4 leaves (1.98g). The differences were significant upon interaction , P_5 x KPGB reared on leaves of any of the fertilizer combinations produced cocoon weights superior to the other

Table59. Effect of breed , season and leaves raised under different fertility status on the weight of 10 mature larvae (g.)

Silkwormbreed	Fertilizer	Season		
		Spring	Autumm	Summer
P5	F0	36.27	35.33	32.27
	F1	40.40	37.83	34.00
	F2	45.20	43.00	35.07
	F3	46.92	45.07	38.10
	F4	48.13	48.93	39.80
KPGB	F0	38.37	35.67	34.30
	F1	40.80	39.73	35.60
	F2	47.39	44.77	36.10
	F3	48.57	45.37	42.07
	F4	50.03	48.27	44.50
KPGB x P5	F0	39.33	36.63	35.30
	F1	42.07	38.40	36.33
	F2	48.00	46.77	37.47
	F3	49.57	48.73	44.93
	F4	50.33	51.07	46.67
P5 x KPGB	F0	40.33	37.03	36.17
	F1	42.40	39.00	38.10
	F2	48.90	47.00	39.47
	F3	51.17	50.33	45.37
	F4	51.23	50.90	47.27

SEM (±) 0.52
CD at 5% 1.44

breeds when reared on the leaves raised with the same combination of fertilizer. The KPGB was superior in fertilizer trial to P_5 (Table -61).

Season -Fertilizer interaction : Larvae reared on both F3 and F4 leaves during spring resulted in the cocoon weights of 2.08g and 2.09g respectively. The values were significantly superior to the value obtained from F4 level of fertilizer during autumn (2.03g) and F2 level of fertilizer during spring (2.02g) . Fertilizer supplementation can hardly improve the quality of mulberry leaves during summer (Table -62) .

Breed -Season -Fertilizer interaction : Higher single cocoon weight was obtained from P_5 x KPGB during autumn (2.17g) followed by KPGB x P_5 during spring (2.15g) when leaves were fed to the larvae from S_1 variety raised under F4(160:80:80kgNPK/ha) level . These two values differed significantly from all other values which were lower. During summer the larvae of P_5 breed when reared on F_0 leaves recorded the lowest cocoon weight (1.41g) (Table -63).

Likewise in larval weight , single cocoon weight also followed the similar trend and thus higher values were obtained during favourable seasons i.e. spring and autumn from P_5 xKPGB when the leaves , raised under F4 and F3 levels , were fed to the larvae. Moreover, during summer any breed or any fertilizer level could hardly improve the cocoon weight and larvae of any breed during any season could hardly improve the cocoon weight when reared either on F_0 or on F_1.

4.3.2.3. Single Shell Weight

Breed-Season interaction : Result showed non-significant differences though the P_5 x KPGB during spring produced relatively better weight (0.38g) (Table -64).

Breed- Fertilizer interaction : The larvae of P_5 x KPGB when reared on F4 leaves, produced the best shell weight (0.42g) followed by KPGB x P_5 reared also on F4 leaves (0.41g) , by P_5xKPGB reared on F3 leaves (0.40g) . Fertilizer application promoted shell weight in pure breeds, the weights were slightly below the hybrids (Table -65) .

Season- Fertilizer interaction : Spring and autumn seasons had almost a similar fertilizer performance. During summer any fertilizer level produced shell

Table 60. Effect of silkworm breed and season on the single cocoon weight (g.)

Season \ Breed	P5	KPGB	KPGB x P5	P5 x KPGB
Spring	1.83	1.90	1.95	1.95
Autumn	1.79	1.81	1.86	1.93
Summer	1.56	1.60	1.61	1.63

SEM (±) 0.01
CD at 5 % 0.02

Table 61. Effect of silkworm breed and leaves raised under different fertility status on single cocoon weight (g.)

Fertilizer \ Breed	P5	KPGB	KPGB x P5	P5 x KPGB
F0	1.52	1.57	1.57	1.59
F1	1.58	1.62	1.69	1.70
F2	1.78	1.84	1.86	1.89
F3	1.86	1.90	1.94	1.99
F4	1.89	1.93	1.98	2.02

SEM (±) 0.01
CD at 5 % 0.02

Table 62. Effect of season and leaves raised under different fertility status on single cocoon weight (g.)

Fertilizer \ Season	Spring	Autumn	Summer
F0	1.65	1.59	1.47
F1	1.70	1.70	1.53
F2	2.02	1.94	1.57
F3	2.08	1.99	1.70
F4	2.09	2.03	1.75

SEM (±) 0.01
CD at 5 % 0.02

Table 63. Effect of breed , season and leaves raised under different fertility status on single cocoon weight (g.)

Silkwormbreed	Fertilizer	Season		
		Spring	Autumn	Summer
P5	F0	1.59	1.37	1.41
	F1	1.65	1.61	1.46
	F2	1.91	1.85	1.59
	F3	1.98	1.94	1.65
	F4	2.00	1.98	1.71
KPGB	F0	1.64	1.58	1.49
	F1	1.69	1.63	1.53
	F2	2.03	1.93	1.56
	F3	2.07	1.94	1.70
	F4	2.09	1.97	1.74
KPGB x P5	F0	1.68	1.57	1.48
	F1	1.73	1.77	1.56
	F2	2.07	1.96	1.55
	F3	2.13	1.99	1.69
	F4	2.15	2.02	1.76
P5 x KPGB	F0	1.69	1.57	1.50
	F1	1.74	1.79	1.56
	F2	2.09	2.01	1.68
	F3	2.14	2.10	1.74
	F4	2.12	2.17	1.78

SEM (±) 0.01
CD at 5% 0.03

Table 64. Effect of breed and season on single shell weight (g.)

Season \ Breed	P5	KPGB	KPGB x P5	P5 x KPGB
Spring	0.35	0.37	0.37	0.38
Autumn	0.34	0.35	0.36	0.37
Summer	0.27	0.28	0.29	0.29

SEM (±) 0.002
CD at 5 % Non -significant

Table 65. Effect of silkworm breed and leaves raised under different fertility status on single shell weight(g).

Fertilizer \ Breed	P5	KPGB	KPGB x P5	P5 x KPGB
F0	0.23	0.24	0.25	0.25
F1	0.26	0.28	0.29	0.29
F2	0.35	0.36	0.36	0.37
F3	0.37	0.38	0.39	0.40
F4	0.38	0.40	0.41	0.42

SEM (±) 0.002
CD at 5 % 0.007

Table 66 Effect of season and leaves raised under different fertility status on single shell weight(g).

Fertilizer \ Season	Spring	Autumn	Summer
F0	0.27	0.25	0.22
F1	0.30	0.30	0.25
F2	0.40	0.39	0.29
F3	0.43	0.41	0.32
F4	0.44	0.43	0.34

SEM (±) 0.002
CD at 5 % 0.006

weights only up to performances of larvae during spring and autumn raised on the F1 leaves. During spring , larvae raised on the F4 leaves demonstrated the best result (0.44g) and during summer larvae raised with F0 leaves resulted in the worst result (0.22g) (Table -66).

Breed -Season- Fertilizer interaction : Among the experimental breeds KPGB x P5 produced significantly highest shell weight when raised on F4 leaves during spring (0.46) , followed by P5x KPGB (0.45g) during spring and autumn . Leaves raised from F0 and F1 levels in all the seasons when fed to any of the breeds and hybrids produced lower shell weight (Table-67) .

From the overall observations it can be summarized that the bivoltine hybrids produced higher shell weight in all the seasons than the pure breeds and leaves raised under F4 level during spring proved superiority over others with respect to the production of higher shell weight.

4.3.2.4. Shell Ratio

Breed-Season interaction : Interaction of the two factors showed significant differences in the results. KPGB x P5 during autumn gave the best result (19.24) followed non-significantly by KPGB during autumn (19.19) , P5 x KPGB , KPGB and P5 during spring (19.10 , 19.08, and 19.06 respectively) . During summer none of the breeds could improve the SR% (Table -68) .

Breed-Fertilizer interaction : Leaves of the highest fertilizer level (F4) when fed to the larvae of KPGB x P5 (20.92) showed nonsignificantly best SR% over P5x KPGB (20.71) and significantly over the others . Moreover , KPGB x P5 larvae reared on the leaves of F3 (20.35) was significantly better than P5 or KPGB reared on leaves raised with any level of fertilizer so far the SR% was considered (Table -69) .

Season-Fertilizer interaction : Interaction result showed significant differences. Larvae reared on F4 leaves during spring and autumn gave the best SR% (21.09 and 20.93 respectively) . Larvae reared on the F4 leaves during summer (19.65) could hardly surpass the performance of larvae fed with the leaves of F2 fertilizer level during spring and autumn (19.83 and 20.02 respectively) (Table -70).

Table 67. Effect of breed , season and leaves raised under different fertility status on single shell weight(g).

Silkwormbreed	Fertilizer	Season		
		Spring	Autumm	Summer
P5	F0	0.23	0.24	0.21
	F1	0.28	0.29	0.22
	F2	0.39	0.37	0.28
	F3	0.42	0.39	0.30
	F4	0.42	0.40	0.32
KPGB	F0	0.27	0.25	0.22
	F1	0.28	0.31	0.25
	F2	0.43	0.38	0.29
	F3	0.43	0.40	0.32
	F4	0.44	0.41	0.34
KPGB x P5	F0	0.27	0.25	0.23
	F1	0.32	0.30	0.26
	F2	0.39	0.40	0.29
	F3	0.43	0.42	0.33
	F4	0.46	0.44	0.35
P5 x KPGB	F0	0.28	0.24	0.22
	F1	0.32	0.30	0.26
	F2	0.39	0.41	0.29
	F3	0.43	0.44	0.34
	F4	0.45	0.45	0.36

SEM (±) 0.004
CD at 5% 0.01

Table 68. Effect of breed and season on shell ratio (%)

Season \ Breed	P5	KPGB	KPGB x P5	P5 x KPGB
Spring	19.06	19.08	18.87	19.10
Autumn	18.70	19.19	19.24	18.80
Summer	16.98	17.57	18.02	17.88

SEM (±) 0.08
CD at 5 % 0.22

Table 69. Effect of breed and leaves raised under different fertility status on shell ratio (%)

Fertilizer \ Breed	P5	KPGB	KPGB x P5	P5 x KPGB
F0	15.29	15.59	15.65	15.58
F1	16.52	17.17	17.41	17.29
F2	19.40	19.68	19.21	19.24
F3	19.91	20.14	20.35	20.13
F4	20.11	20.48	20.92	20.71

SEM (±) 0.10
CD at 5 % 0.29

Table 70. Effect of season and leaves raised under different fertility status on shell ratio (%)

Fertilizer \ Season	Spring	Autumn	Summer
F0	16.10	15.60	14.87
F1	17.58	17.59	16.13
F2	19.83	20.02	18.60
F3	20.52	20.77	19.11
F4	21.09	20.93	19.65

SEM (±) 0.09
CD at 5 % 0.25

Breed -Season- Fertilizer interaction : Leaves raised under F4 level when fed to the larvae of KPGB x P5 during autumn resulted in the highest shell ratio (21.62) followed by KPGB x P5 on F3 leaves during autumn (21.31) and under F4 level during spring (21.21) . The values differed from each other significantly . Larvae of KPGB breed when reared on the F2 leaves during spring produced better result (21.05) than or similar to that of the F3 leaves in any season . During summer , when the P5 larvae were fed with the F0 leaves produced the lowest shell ratio (14.62) (Table -71).

From the above results it can be summarized that the higher values of shell ratio was obtained from KPGB x P5 during autumn followed by spring when the leaves were raised under higher fertilizer levels (F4 and F3) . During summer the values of SR% at higher fertilizer levels were similar to those of the lower level (F1) during favourable seasons such as spring and autumn.

4.3.2.5. Absolute silk Content

Breed -Season interaction : In any season the hybrids showed significantly better result than the pure breeds and spring was the best season for any breed. During summer the values were almost half than that of the spring. The highest absolute silk content was recorded in P5 x KPGB during spring (3618.80g) followed significantly by KPGB x P5 during spring (3588.40g) . P5 during summer produced the lowest content (2458.24g). (Table -72)

Breed- Fertilizer interaction : Non-significant differences in the values were recorded testifying the non-significant effect of fertilization on the production of absolute silk content by the breeds (Table -73).

Season -Fertilizer interaction : Seasonal effect on fertilizer application was significant . During spring larvae reared on the leaves of F4 level showed the best result (4321.33g) followed significantly by the larvae reared on the leaves of F3 level (4139.25g) and then by the larvae reared on leaves of F4 level during autumn (3905.75g). The highest dose of fertilizer during summer (2626.75g) could hardly cross the value obtained from the larvae reared on the leaves of F1 level during spring (2719.58g) or F2 level during autumn (3272.67g) . Moreover, the highest dose of fertilizer during autumn (3905.75g) could yield value to the

Table 71. Effect of breed, season and leaves raised under different fertility status on shell ratio.

Silkwormbreed	Fertilizer	Season		
		Spring	Autumm	Summer
P5	F0	15.72	15.53	14.62
	F1	16.73	17.77	15.07
	F2	20.55	19.78	17.86
	F3	21.08	20.20	18.42
	F4	21.20	20.24	18.94
KPGB	F0	16.26	15.64	14.86
	F1	16.54	18.93	16.09
	F2	21.05	19.66	18.36
	F3	20.64	20.76	19.02
	F4	20.92	20.98	19.54
KPGB x P5	F0	15.90	15.71	15.35
	F1	18.45	17.10	16.67
	F2	18.71	20.44	18.49
	F3	20.06	21.31	19.68
	F4	21.21	21.62	19.93
P5 x KPGB	F0	16.54	15.53	14.66
	F1	18.62	16.54	16.70
	F2	19.01	20.20	17.26
	F3	20.28	20.79	19.31
	F4	21.04	20.92	20.18

SEM (±) 0.18
CD at 5% 0.50

Table 72. Effect of breed and season on absolute silk content (g.)

Season \ Breed	P5	KPGB	KPGB x P5	P5 x KPGB
Spring	3230.87	3442.73	3588.40	3618.80
Autumn	2543.53	2706.20	3275.67	3413.67
Summer	1600.33	1811.47	1921.67	1952.53

SEM (±) 31.42
CD at 5 % 87.97

Table 73. Effect of silkworm breed and leaves raised under different fertility status on absolute silk content (g.)

Fertilizer \ Breed	P5	KPGB	KPGB x P5	P5 x KPGB
F_0	1513.44	1672.00	1880.56	1902.78
F_1	1829.78	2019.11	2272.44	2364.78
F_2	2677.56	2880.44	3118.00	3188.67
F_3	3002.56	3215.00	3546.67	3621.11
F_4	3267.39	3480.78	3825.22	3897.89

SEM (±) 40.56
CD at 5 % Non-significant

Table 74. Effect of season and leaves raised under different fertility status onabsolute silk content (g.)

Fertilizer \ Season	Spring	Autumn	Summer
F_0	2324.83	1837.08	1064.67
F_1	2719.58	2279.50	1365.50
F_2	3846.08	3272.67	1779.75
F_3	4139.17	3628.83	2271.00
F_4	4321.33	3905.75	2626.75

SEM (±) 35.13
CD at 5 % 98.36

level of the performance of the larvae reared on the leaves of F2 level during spring (3846.08g) (Table -74).

Breed -Season -Fertilizer interaction : The absolute silk content was significantly higher when leaves were raised under F4 level during spring and fed to the larvae of KPGB x P5 (4521.00g) , followed by P5 x KPGB (4422.00g) . The absolute silk content was always lower during summer in any of the breed when reared on the leaves raised under F0 and F1 levels and the lowest value was obtained from P5 breed reared on the leaves raised under F0 level (1006.00g) (Table -75) .

From the overall observation it was recorded that irrespective of seasons the leaves raised under F4 level produced more silk . Spring was the best among

the three seasons and the hybrids , particularly the KPGB x P5 was the best breed so far as absolute silk content was concerned.

4.3.2.6. Effective Rate of Rearing in weight (ERR wt.)

Breed -Season interaction : Pure breeds during the spring performed significantly better than in other seasons . In case of the hybrids there was no significant difference between the ERR wt. value of spring and autumn crops. On the whole , the KPGB x P5 during spring (18.79kg) and P5 during summer (9.24kg) performed the best and the worst respectively (Table -76).

Breed -Fertilizer interaction : Significantly different effects of fertilizer levels on the breeds regarding ERR wt. were recorded. The highest yield was found when the leaves were raised under F4 level and were fed to the larvae of P5x KPGB (18.72kg) followed by KPGB x P5 (18.19kg) . The leaves of F3 fertilizer level when fed to any of the two hybrids give better result than by the breeds even better than the values obtained from the F4 level of fertilizer(Table 77).

Season -Fertilizer interaction : The highly significant differences in the values of ERR wt. were found among different seasons and fertilizer levels. The best performance was obtained in case of F4 level and during spring (20.49kg) placing far behind the yield values of all the breeds during autumn (18.64kg) or summer (13.32kg) (Table -78) .

Table 75. Effect of breed , season and leaves raised under different fertility status on absolute silk content (g.)

Silkwormbreed	Fertilizer	Season		
		Spring	Autumm	Summer
P5	F0	2033.33	1501.00	1006.00
	F1	2407.33	1930.67	1151.33
	F2	3645.33	2725.33	1662.00
	F3	3962.00	3094.00	1951.67
	F4	4106.33	3466.67	2230.67
KPGB	F0	2337.67	1578.33	1100.00
	F1	2520.00	2147.33	1390.00
	F2	4010.67	2901.32	1729.33
	F3	4109.33	3293.33	2242.33
	F4	4236.00	3610.67	2595.67
KPGB x P5	F0	2417.67	2129.00	1095.00
	F1	2965.33	2370.00	1482.00
	F2	3828.00	3693.33	1832.67
	F3	2410.00	4008.00	2422.00
	F4	4521.00	4178.00	2776.67
P5 x KPGB	F0	2510.67	2140.00	1057.67
	F1	2985.67	2670.00	1438.67
	F2	3900.33	3770.67	1895.00
	F3	4275.33	4120.00	2468.00
	F4	4422.00	4367.67	2904.00

SEM (±) 70.25
CD at 5% 196.72

Table 76. Effect of breed and season on ERR in weight (kg.)

Season \ Breed	P5	KPGB	KPGB x P5	P5 x KPGB
Spring	16.62	17.76	18.79	18.70
Autumn	13.35	13.87	17.18	17.85
Summer	9.24	10.11	10.43	10.62

SEM (±) 0.94
CD at 5 % 2.63

Table 77. Effect of silkworm breed and leaves raised under different fertility status on ERR in weight (kg.)

Fertilizer \ Breed	P5	KPGB	KPGB x P5	P5 x KPGB
F0	9.82	10.63	11.94	12.06
F1	10.96	11.77	13.70	13.60
F2	13.60	14.41	16.15	16.47
F3	14.86	15.26	17.37	17.78
F4	16.10	16.91	18.19	18.72

SEM (±) 0.12
CD at 5 % 0.34

Table 78. Effect of season and leaves raised under different fertility status on ERR in weight (kg.)

Fertilizer \ Season	Spring	Autumn	Summer
F0	14.41	11.77	7.16
F1	15.43	13.64	8.45
F2	19.44	16.31	9.72
F3	20.09	17.44	11.87
F4	20.49	18.64	13.32

SEM (±) 0.10
CD at 5 % 0.29

Breed -Season -Fertilizer interaction : During spring when leaves raised under F4 level was fed to the larvae of KPGB x P5 was found to produced highest significant ERR wt. (21.32kg) followed by P5 x KPGB (21.02kg). P5 breed reared on leaves at F0 level during summer (6.88kg) produced very poor (Table -79) .

From overall observations it can be said that BV hybrids in general and KPGB x P5 in particular showed better performance when larvae were reared on leaves raised under highest level of fertilizer during spring so far as ERR in weight is concrned , autumn was also found quite favourable , while summer was un favourable even when larve were fed on the leaves raised under highest level of fertilizer .

4.3.2.7. Effective Rate of Rearing in number (ERR no.)

Breed-Season interaction : Hybrids during spring performed significantly better than in other seasons . In case of hybrids there was no significant differences during any seasons. On the whole , P5 x KPGB during spring (9626.67) and P5 during summer (5860.00) performed the best and the worst respectively (Table -80).

Breed -Fertilizer interaction : Fertilizer enrichment had significantly better effect on different breeds , with greater effect on the hybrids. Fertilizer increment gradually increased the survivability rate . Larvae of P5 x KPGB when fed with the leaves of F4 level of fertilizer , proved best (9177.78) followed non-significantly by KPGB x P5 at F4 level (9133.33) and followed by significantly lower values in others (Table -81) .

Season -Fertilizer interaction : The differences at different fertilization levels were significant. F3 and F4 levels of fertilizer improved the ERR significantly especially during summer, even the value was significantly higher at F2 level that F0 level of fertilization. During spring larvae reared on the leaves of F4 fertilization level improved the survivability rate up to 98% while during autumn the value was about 91% (Table -82) .

Breed -Season -Fertilizer interaction : The ERR no was higher in the hybrids during spring when the larvae were reared on F4 leaves (9900.00) , followed by F3 level (9866.67) . However, the difference between the results obtained from these two fertilizer levels was non-significant during summer (Table -83).

Table 79. Effect of breed , season and leaves raised under different fertility status on ERR in weight (kg.)

Silkwormbreed	Fertilizer	Season		
		Spring	Autumm	Summer
P5	F0	12.93	9.66	6.88
	F1	14.38	10.37	7.64
	F2	17.73	13.77	9.31
	F3	18.71	15.29	10.60
	F4	19.37	17.16	11.77
KPGB	F0	14.38	10.09	7.43
	F1	15.24	11.44	8.64
	F2	19.05	14.75	9.43
	F3	19.91	15.87	11.79
	F4	20.24	17.21	13.28
KPGB x P5	F0	15.15	13.53	7.13
	F1	16.06	16.14	8.89
	F2	20.46	18.07	9.91
	F3	20.98	18.81	12.30
	F4	21.32	19.33	13.94
P5 x KPGB	F0	15.18	13.78	7.20
	F1	16.04	16.14	8.62
	F2	20.52	18.67	10.33
	F3	20.75	19.81	12.79
	F4	21.02	20.88	14.47

SEM (±) 0.21
CD at 5% 0.59

Table 80. Effect of breed and season on ERR in number.

Season \ Breed	P5	KPGB	KPGB x P5	P5 x KPGB
Spring	9053.33	9300.00	9593.33	9626.67
Autumn	7373.33	7586.67	9200.00	9226.67
Summer	5860.00	6426.67	6426.67	6426.67

SEM (±) 45.87
CD at 5 % 128.43

Table 81. Effect of breed and leaves raised under different fertility status on ERR in number.

Fertilizer \ Breed	P5	KPGB	KPGB x P5	P5 x KPGB
F0	6888.89	6722.22	7500.00	7633.33
F1	6888.89	7211.11	8022.22	7922.22
F2	7522.22	7688.89	8511.11	8522.22
F3	7922.22	8244.44	8866.67	8877.78
F4	8422.22	8688.89	9133.33	9177.78

SEM (±) 59.21
CD at 5 % 165.80

Table 82. Effect of season and leaves raised under different fertility status onERR in number.

Fertilizer \ Season	Spring	Autumn	Summer
F0	8808.33	7500.00	4875.00
F1	9050.00	7958.33	5525.00
F2	9600.00	8391.67	6191.67
F3	9708.33	8733.33	6991.67
F4	9800.00	9150.00	7616.67

SEM (±) 51.28
CD at 5 % 143.59

Table 83. Effect of breed , season and leaves raised under different fertility status on ERR in number.

Silkwormbreed	Fertilizer	Season		
		Spring	Autumm	Summer
P5	F0	8133.33	6166.67	4866.67
	F1	8700.00	6733.33	5233.33
	F2	9266.67	7433.33	5866.67
	F3	9466.67	7866.67	6433.33
	F4	9700.00	8666.67	6900.00
KPGB	F0	8766.67	6400.00	5000.00
	F1	9000.00	7000.00	5633.33
	F2	9400.00	7633.33	6033.33
	F3	9633.33	8166.67	6933.33
	F4	9700.00	8733.33	7633.33
KPGB x P5	F0	9033.33	8633.33	4833.33
	F1	9266.67	9100.00	5700.00
	F2	9900.00	9233.33	6400.00
	F3	9866.67	9466.67	7266.67
	F4	9900.00	9566.67	7933.33
P5 x KPGB	F0	9300.00	8800.00	4800.00
	F1	9233.33	9000.00	5533.33
	F2	9833.33	9266.67	6466.67
	F3	9866.67	9433.33	7333.33
	F4	9900.00	9633.33	8000.00

SEM (±) 102.56
CD at 5% 287.18

On the whole , better ERR no. was obtained during spring reared on the leaves raised under higher fertility levels of F4 and F3 and particularly in hybrids. The ERR no. was always lower in summer .

4.3.2.8. Fecundity

Breed -Season interaction : Higher rate of fecundity was obtained in the hybrids in all the seasons. Both the hybrids during spring (604.00) , KPGB x P5 during autumn (595.80) and during summer (596.87) were significantly better for fecundity than the others, having the pure breeds during summer at the lowest position (Table -84).

Breed -Fertilizer interaction : Fertilizer increased the fecundity in all the breeds , However , nutrient augmentation in the leaves by way of higher input of fertilizer have no breed specific impact. The fecundity values of different breeds at all the levels of fertilizer was non significant (Table-85).

Season -Fertilizer interaction : Significant differences were observed. Larvae reared on the leaves of F4 level of fertilization during spring and autumn (648.17 and 678.33 respectively) were significantly better than during summer (670.83) and than the other. Gradual increment of fertilizer dose significantly increased the fecundity of the moth (Table -86).

Breed -Season -Fertilizer interaction : The combined effect of season , fertility level and breed had no significant influence on fecundity. However, the highest fecundity was obtained from KPGB x P5 hybrid than reared on the leaves raised under the F4 fertilizer level during spring (696.67) (Table-87) .

4.3.3. Effect of Fertilizer Supplementation on Cocoon Quality

4.3.3.1. Filament length (Table -88)

Impact of Breed : Significant difference were observed among the breeds , the highest was in KPGB x P5 (805.03m) followed by P5 x KPGB (786.205m) . The hybrids had longer filaments . But the pure breeds produced shorter silk filaments, 755.28m in case of P5 and 745.63m in case of KPGB.

Table 84. Effect of breed and season and leaves raised under different fertility status on fecundity (no.)

Season / Fertilizer	P5	KPGB	KPGB x P5	P5 x KPGB
Spring	595.80	575.60	602.87	604.00
Autumn	588.00	576.67	595.80	583.00
Summer	562.33	551.87	596.87	585.67

SEM (±) 3.65
CD at 5 % 10.23

Table 85. Effect of silkworm breed and leaves raised under different fertility status on fecundity (no.)

Season / Fertilizer	P5	KPGB	KPGB x P5	P5 x KPGB
F0	478.33	465.00	490.00	485.56
F1	523.89	507.78	534.44	531.67
F2	600.22	587.44	617.56	609.44
F3	631.11	624.44	657.22	642.22
F4	676.67	655.56	693.33	685.56

SEM (±) 4.72
CD at 5 % Non-significant

Table 86. Effect of season and leaves raised under different fertility status on fecundity (no.)

Season / Fertilizer	Spring	Autumn	Summer
F0	494.17	484.17	460.83
F1	552.92	523.33	497.08
F2	596.58	608.08	606.33
F3	645.00	635.42	635.83
F4	684.17	678.33	670.83

SEM (±) 4.085
CD at 5 % 11.44

Table 87. Effect of breed , season and leaves raised under different fertility status on fecundity (no.)

Silkwormbreed	Fertilizer	Season		
		Spring	Autumm	Summer
P5	F_0	493.33	490.00	451.67
	F_1	553.33	553.33	485.00
	F_2	605.67	603.33	591.67
	F_3	640.00	636.67	616.67
	F_4	686.67	676.67	666.67
KPGB	F_0	480.00	470.00	445.00
	F_1	530.00	513.33	480.00
	F_2	574.67	603.33	584.33
	F_3	633.33	630.00	610.00
	F_4	660.66	666.67	640.00
KPGB x P5	F_0	500.00	490.00	480.00
	F_1	553.33	533.33	516.67
	F_2	607.67	614.00	631.00
	F_3	656.67	651.67	663.33
	F_4	696.67	690.00	693.33
P5 x KPGB	F_0	503.33	486.67	466.67
	F_1	575.00	513.33	506.67
	F_2	598.33	611.67	618.33
	F_3	650.00	623.33	653.33
	F_4	693.33	680.00	683.33

SEM (±) 8.17

CD at 5% Non-significant

Impact of Fertilizer : A higher significant impact of fertilizer was observed , larvae fed on leaves of F4 giving the highest . The highest filament length (875.21m) was obtained from the leaves raised from F4 level of fertilizer. This was followed by that of F3 level (833.69m). From the F2 level (776.60m) of fertilizer , the filament length shortened considerably.

Breed-Fertilizer intaction : Leaves raised from F4 level of fertilizer when fed to the larvae of KPGB x P_5 resulted in significantly the highest filament length (918.98m),followed by P_5xKPGB (897.69m) .The pure breeds produced shorter filament at all the fertilizer levels. Even the hybrid larvae reared on the leaves grown on F3 level yielding to significantly longer filaments that the pure breeds reared on the leaves grown on F4 level of fertilizer.

4.3.3.2. **Reelability** (Table -89)

Impact of Breed : The P_5 breed proved best for reelability , the mean value was 91.33. The reelability of the other three breeds was lower and did not differ significantly.

Impact of Fertilizer : The effect of fertilizer on reelability differed significantly in all the fertilizer levels from F0. Though the highest value was recorded at F4 level, its difference with the value obtained from F3 was nonsignificant. Similarly the values obtained from F1 and F2 levels also did not differ significantly.

Breed-Fertilizer interaction : Reelability was significantly the highest when the leaves were raised on F4 level and fed to the larvae of P_5 (92.67%). This value was followed by P_5 x KPGB (92%) and by P_5 reared on the leaves raised on F3 level (92%). In general the reelability was higher due to fertilizer .

4.3.3.3. **Denier** (Table -90)

Impact of Breed : The denier differed among the breeds . The best mean value was obtained in P_5 (3.49) followed by in KPGB x P_5 (3.35). The differences among the breeds , particularly between KPGB and P_5 x KPGB were not so wide .

Table 88. Effect of breed and leaves raised under different fertility status on Filament length (mt.)

Season / Fertilizer	P5	KPGB	KPGB x P5	P5 x KPGB	Mean
F0	632.67	623.00	705.08	672.08	658.21
F1	717.92	706.25	734.92	726.83	721.48
F2	764.67	755.25	807.25	779.25	776.60
F3	815.67	805.00	858.92	855.17	833.69
F4	845.50	838.67	918.98	897.69	875.21
Mean	755.28	745.63	805.03	786.05	

	SEM (±)	CD at 5%
Season	1.39	2.81
Fertilizer	2.79	5.64
Season x Fertilizer	1.24	2.51

Table 89. Effect of breed and leaves raised under different fertility status on reelability(%)

Season / Fertilizer	P5	KPGB	KPGB x P5	P5 x KPGB	Mean
F0	90.00	83.00	86.33	85.33	86.17
F1	92.00	90.00	88.67	88.00	89.67
F2	90.00	90.00	90.00	89.33	89.33
F3	92.00	91.00	90.33	90.33	91.00
F4	92.67	91.67	91.00	92.00	91.83
Mean	91.33	89.20	89.28	89.00	

	SEM (±)	CD at 5%
Season	0.19	0.38
Fertilizer	0.21	0.42
Season x Fertilizer	0.43	0.87

Table 90. Effect of breed and leaves raised under different fertility status on denier

Season / Fertilizer	P5	KPGB	KPGB x P5	P5 x KPGB	Mean
F0	3.48	3.38	3.29	3.30	3.36
F1	3.45	3.26	3.37	3.29	3.34
F2	3.49	3.27	3.29	3.35	3.35
F3	3.48	3.29	3.42	3.25	3.36
F4	3.52	3.36	3.37	3.23	3.37
Mean	3.49	3.31	3.35	3.28	

	SEM (±)	CD at 5%
Season	0.01	0.02
Fertilizer	0.01	0.02
Season x Fertilizer	0.02	0.04

Impact of Fertilizer : The impact of different levels of fertilizer on the denier was very irregular. The mean values did not differ significantly between F3 and F4.

Breed-Fertilizer interaction : The significantly highest denier was observed when the larvae of P5 breed was fed on the leaves raised under F4 level (3.52) , followed significantly by F2 (3.49) and F3 (3.48) where the difference was non-significant. The lowest denier was found from KPGB when larvae were fed on leaves raised under F1 level (3.26).

From the overall result it was revealed that though KPGB x P5 could produce higher filament length and denier was found higher in P5. Reelability was found higher both in P5 and KPGB x P5. The leaves raised from F4 level of fertilizer was the most suitable so far as cocoon quality (namely ,filament length , reelability and denier) was concerned.

4.3.4. Effect of Fertilizer Supplementation on Consumption and Utilization of Food in different breeds over seasons

4.3.4.1. Consumption Indices (fifth instar larva)

Larval duration : Larval duration was the lowest (5.50 days) during summer when the larvae of the hybrids were fed on the leaves raised at F3 and F4 level of fertilization while the duration of larvae after feeding leaves raised under F0 to F2 level was 5.75 days. During spring , the larvae of both the pure breeds took longer duration , it was 6.50 days when reared on leaves raised under F0 and F1 level and 6.25 days when reared on the leaves raised at F2 to F4 levels. In case of the hybrids the values were 6.25 days for F0 and F1 levels and 6.00 days for F2 to F4 levels of fertilizer . During autumn irrespective of fertilizer level the durations of pure breeds and hybrids were 6.00 days and 5.75 days respectively (Table-91) .

Food ingestion : Starting with the F0 level , food consumption was decreased with the rise of fertilizer level in all the breeds and in all the seasons . During spring , larvae of P5 and P5 x KPGB fed on leaves raised without fertilizer supplementation (F0) consumed the highest quantity of food (10.42g) . The lowest quantity of food was consumed by both the hybrids during summer at F4

Table 91. Effect of breed , season and leaves raised under different fertility status on duration of fifth instar larva (days)

Silkwormbreed	Fertilizer	Season		
		Spring	Autumn	Summer
P_5	F_0	6.50	6.00	6.00
	F_1	6.50	6.00	6.00
	F_2	6.25	6.00	6.00
	F_3	6.25	6.00	5.75
	F_4	6.25	6.00	5.75
KPGB	F_0	6.50	6.00	6.00
	F_1	6.50	6.00	6.00
	F_2	6.25	6.00	6.00
	F_3	6.25	6.00	5.75
	F_4	6.25	6.00	5.75
KPGB x P_5	F_0	6.25	5.75	5.75
	F_1	6.25	5.75	5.75
	F_2	6.00	5.75	5.75
	F_3	6.00	5.75	5.50
	F_4	6.00	5.75	5.50
P_5 x KPGB	F_0	6.25	5.75	5.75
	F_1	6.25	5.75	5.75
	F_2	6.00	5.75	5.75
	F_3	6.00	5.75	5.50
	F_4	6.00	5.75	5.50

fertilizer level (5.00g) . Among the seasons alone in all the breeds the highest quantity of leaves was ingested during spring . The consumption during summer was either the lowest or at par with the quantity during autumn (Table -92) .

Food balance : Likewise in consumption , the food balance was reduced in all the breeds with the rise of fertilizer level. Food balance showed positive correlation (+0.93) with food ingestion(Table -100) . The highest value of food balance was found case of KPGB when the larvae were fed with the leaves raised under F0 during autumn (5.26g) followed by spring (5.14g) . However, food balance in KPGB during autumn and spring from leaves raised under F2 was 4.18g and 4.02g respectively and 3.32g and 3.25g respectively at F4 level. The lowest food balance (2.17g) was recorded during summer in case of both the hybrids when reared on leaves raised under F4 level . In general the food balance was higher during spring with some exceptions (Table - 93).

Weight gained by the larva : The gain in larval weight was higher in all the breeds and during all the seasons with the rise of fertilizer level. Again ,in almost all the cases the highest gain was during spring and the lowest gain was during autumn. The larvae of P_5 and P_5 xKPGB when fed with the leaves raised at F3 and F4 levels gained maximum weight during spring (0.92g) . The lowest value of gain in weight was recorded from the larvae of KPGB reared on the leaves raised under F0 level during summer (0.60g) (Table-94) .

Morever, the weight gained by the larvae had negative correlation with food ingestion (- 0.83) and food balance (- 0.77) which indicated that higher ingestion or balance of food did not help to gain in weight (Table -100) .

In brief the shorter larval duration was accompanied lower food intake and food balance which ultimately reflected in lower gain in weight by larvae during summer as compared with those of spring and autumn where higher gain in weight by the larvae was accompanied with higher duration , higher food ingestion and higher food balance during spring and autumn . Leaves raised under higher fertilizer level resulted in lower duration and food ingestion . Though food balance was low due to low ingestion , the gain in weight by the larvae was higher when they were reared on the leaves raised with higher levels of fertilizer. Larvae of P_5xKPGB and KPGB x P_5 showed better gain in weight though food balance was low.

Table 92. Effect of breed , season and leaves raised under different fertility status on Food Ingestion (g.) by a fifth instar larvae

Silkwormbreed	Fertilizer	Season		
		Spring	Autumm	Summer
P5	F0	10.42	10.00	9.76
	F1	8.77	9.23	8.57
	F2	8.08	8.22	7.82
	F3	6.59	6.56	6.51
	F4	6.41	6.24	6.32
KPGB	F0	10.00	9.88	9.62
	F1	9.23	8.22	8.37
	F2	8.08	7.77	7.56
	F3	6.66	7.21	6.32
	F4	6.50	6.78	6.28
KPGB x P5	F0	10.28	10.04	9.98
	F1	8.68	8.64	8.43
	F2	8.00	7.89	7.56
	F3	6.59	6.20	6.00
	F4	5.89	5.66	5.00
P5 x KPGB	F0	10.42	10.00	10.00
	F1	8.77	8.66	8.62
	F2	8.08	8.23	7.96
	F3	6.59	6.24	6.12
	F4	6.01	6.00	5.00

Table 94. Effect of breed , season and leaves raised under different fertility status on Weight Gain(g.)

BREED	Fertilizer	Season		
		Spring	Autumn	Summer
P5	F0	0.68	0.67	0.62
	F1	0.72	0.72	0.66
	F2	0.85	0.82	0.71
	F3	0.92	0.89	0.82
	F4	0.92	0.91	0.81
KPGB	F0	0.68	0.64	0.60
	F1	0.72	0.69	0.64
	F2	0.79	0.76	0.70
	F3	0.83	0.81	0.78
	F4	0.88	0.86	0.80
KPGB x P5	F0	0.70	0.64	0.62
	F1	0.74	0.68	0.66
	F2	0.81	0.81	0.76
	F3	0.88	0.89	0.82
	F4	0.90	0.90	0.84
P5 x KPGB	F0	0.72	0.66	0.64
	F1	0.76	0.70	0.68
	F2	0.85	0.83	0.78
	F3	0.92	0.90	0.82
	F4	0.92	0.91	0.85

Table 93. Effect of breed , season and leaves raised under different fertility status on Food Balance (g.) of a fifth instar larva

Silkwormbreed	Fertilizer	Season		
		Spring	Autumm	Summer
P5	F_0	4.00	4.87	4.73
	F_1	4.15	4.44	4.30
	F_2	4.04	4.06	3.76
	F_3	3.58	2.68	3.29
	F_4	3.68	2.61	3.27
KPGB	F_0	5.14	5.26	4.59
	F_1	4.63	4.19	4.31
	F_2	4.02	4.18	3.58
	F_3	3.43	3.59	3.27
	F_4	3.25	3.32	3.28
KPGB x P5	F_0	5.05	4.84	4.98
	F_1	4.12	4.24	4.05
	F_2	4.00	3.89	3.90
	F_3	3.59	3.20	3.00
	F_4	2.93	2.78	2.17
P5 x KPGB	F_0	5.00	4.77	4.87
	F_1	4.15	4.14	3.93
	F_2	4.04	4.11	4.20
	F_3	3.58	3.17	3.06
	F_4	3.28	3.02	2.17

Table 94. Effect of breed , season and leaves raised under different fertility status on Weight Gain(g.)

BREED	Fertilizer	Season		
		Spring	Autumn	Summer
P5	F0	0.68	0.67	0.62
	F1	0.72	0.72	0.66
	F2	0.85	0.82	0.71
	F3	0.92	0.89	0.82
	F4	0.92	0.91	0.81
KPGB	F0	0.68	0.64	0.60
	F1	0.72	0.69	0.64
	F2	0.79	0.76	0.70
	F3	0.83	0.81	0.78
	F4	0.88	0.86	0.80
KPGB x P5	F0	0.70	0.64	0.62
	F1	0.74	0.68	0.66
	F2	0.81	0.81	0.76
	F3	0.88	0.89	0.82
	F4	0.90	0.90	0.84
P5 x KPGB	F0	0.72	0.66	0.64
	F1	0.76	0.70	0.68
	F2	0.85	0.83	0.78
	F3	0.92	0.90	0.82
	F4	0.92	0.91	0.85

Moreover , leaves raised under higher fertility levels lowered the larval duration by one feeding . Again , the food ingestion was 50% and 100% higher than in cases of conventional dose F2 and without application of fertilizer F0 respectively . This was also reflected in higher food balance by the larvae fed on leaves of lower fertility status . However, the gain in weight of the larvae was more in case of higher fertility level (F4) than in F2 and F0 levels.

4.3.4.2. Nutritional Efficiencies (fifth instar larva)

Consumption index (C.I.) : Higher consumption index was recorded during summer with the leaves raised from F0 level and fed to KPGB x P5 (2.48) followed by during autumn season (2.43) and the lowest value (0.81) was during spring on the leaves raised under F4 level and fed to the larvae of P5 x KPGB indicating higher C.I. at lower fertility level (Table -95) . The result can be further confirmed by co-relation study (Table -100) where C.I. was positively correlated with food ingestion (+0.93) and food balance (+0.87) while weight gain by larvae was negatively correlated with the C.I. (-0.93).

Growth Rate (G.R.) : The larvae of KPGB x P5 when fed with the leaves raised under F3 and F4 levels during summer showed the highest growth rate (0.17). However, the lowest G.R. of larvae was recorded (0.14) during spring from the pure breeds irrespective of fertilizer level. On the whole , the G.R. was better when larval duration , food ingestion and food balance were lower (Table-96) .

Approximate Digestibility (A.D.) : The A.D. was recorded highest during spring when the leaves raised under F4 level were fed to the larvae of P5 (57.41%) followed by P5xKPGB (54.58%) and the lowest value was in P5 (38.39%) during summer and on the leaves raised from F0 fertilizer level (Table - 97). The A.D. maintained a positive linearity with food balance and weight gained by the larvae (Table.-100).

Efficiency of Conversion of Ingested food (E.C.I.) : The E.C.I. in all the breeds and at all the seasons increased with the increase of fertility level. During summer , leaves raised under F4 level when fed to the larvae of KPGB x P5 showed the highest E.C.I. (17.00) followed by its reciprocal P5xKPGB (16.80) (Table -98) . The E.C.I. had higher positive correlation with weight gain (+0.91)

Table 95. Effect of breed , season and leaves raised under different fertility status on Consumption Index (C.I.)

Silkwormbreed	Fertilizer	Season		
		Spring	Autumm	Summer
P5	F0	2.11	2.22	2.32
	F1	1.69	1.92	1.93
	F2	1.37	1.52	1.63
	F3	1.02	1.12	1.24
	F4	1.00	1.04	1.21
KPGB	F0	2.02	2.29	2.37
	F1	1.78	1.76	1.94
	F2	1.47	1.52	1.62
	F3	1.15	1.34	1.28
	F4	1.06	1.18	1.23
KPGB x P5	F0	2.11	2.43	2.48
	F1	1.70	1.98	1.98
	F2	1.48	1.52	1.57
	F3	1.12	1.10	1.21
	F4	0.98	0.98	0.99
P5 x KPGB	F0	2.08	2.35	2.42
	F1	1.67	1.93	1.97
	F2	1.16	1.56	1.61
	F3	1.07	1.09	1.26
	F4	0.81	1.03	0.97

Table 96. Effect of breed , season and leaves raised under different fertility status on Growth Rate (G.R.)

Silkwormbreed	Fertilizer	Season		
		Spring	Autumm	Summer
P5	F0	0.14	0.15	0.15
	F1	0.14	0.15	0.15
	F2	0.14	0.15	0.15
	F3	0.14	0.15	0.16
	F4	0.14	0.15	0.16
KPGB	F0	0.14	0.15	0.15
	F1	0.14	0.15	0.15
	F2	0.14	0.15	0.15
	F3	0.14	0.15	0.16
	F4	0.14	0.15	0.16
KPGB x P5	F0	0.14	0.16	0.15
	F1	0.14	0.16	0.16
	F2	0.15	0.16	0.16
	F3	0.15	0.16	0.17
	F4	0.15	0.16	0.17
P5 x KPGB	F0	0.14	0.15	0.15
	F1	0.14	0.16	0.15
	F2	0.12	0.16	0.16
	F3	0.15	0.16	0.16
	F4	0.15	0.16	0.16

Table 97. Effect of breed , season and leaves raised under different fertility status on Approximate Digestability (A.D.)

Silkwormbreed	Fertilizer	Season		
		Spring	Autumm	Summer
P5	F0	38.39	48.70	48.46
	F1	47.32	48.10	50.18
	F2	50.00	49.39	48.08
	F3	54.32	40.85	50.54
	F4	57.41	41.83	51.74
KPGB	F0	51.40	53.24	47.71
	F1	50.16	50.97	51.49
	F2	49.75	53.80	47.35
	F3	51.50	49.79	51.74
	F4	50.00	48.97	52.23
KPGB x P5	F0	49.12	48.21	49.90
	F1	47.47	49.07	48.04
	F2	50.00	49.30	51.59
	F3	54.48	51.61	50.00
	F4	49.75	49.12	43.40
P5 x KPGB	F0	47.98	47.70	48.70
	F1	47.32	47.81	45.59
	F2	50.00	49.94	52.76
	F3	54.32	50.80	50.00
	F4	54.58	50.33	43.40

Table 98. Effect of breed , season and leaves raised under different fertility status on Efficiency of conversion of ingested food (E.C.I.)

Silkwormbreed	Fertilizer	Season		
		Spring	Autumm	Summer
P5	F0	6.53	6.70	6.35
	F1	8.21	7.80	7.70
	F2	10.52	9.98	9.08
	F3	13.96	13.57	12.60
	F4	14.35	14.58	12.82
KPGB	F0	6.80	6.48	6.24
	F1	7.80	8.39	7.65
	F2	9.78	9.78	9.26
	F3	12.46	11.23	12.34
	F4	13.54	12.68	12.74
KPGB x P5	F0	6.81	6.37	6.21
	F1	8.53	7.87	7.83
	F2	10.13	10.27	10.05
	F3	13.35	14.35	13.67
	F4	15.28	15.90	16.80
P5 x KPGB	F0	6.91	6.60	6.40
	F1	8.67	8.08	7.89
	F2	10.52	10.09	9.80
	F3	13.96	14.42	13.40
	F4	15.31	15.17	17.00

while lower food ingestion (-0.96) and food balance (- 0.92) accelerated conversion efficiency of ingested food by the larvae (Table -100) .

Efficiency of Conversion of Digested food (E.C.D.) : The E.C.D. followed the trend similar to that of E.C.I. Here also the leaves raised from F4 level during summer and fed to P_5 xKPGB showed highest E.C.D. (39.17%) followed by KPGB x P_5 (38.71%) and the least was in the larvae of KPGB fed on the leaves raised under F0 during autumn (12.17%) (Table -99) .Again , the E.C.D. had higher positive correlation with E.C.I. (+0.96) indicating maximum conversion efficiencies in larvae having lower food ingestion (-0.91) and food balance (-0.95) (Table -100). In general, during summer that was higher value of consumption index, growth rate , E.C.I. and E.C.D. , but not the digestibility . The lower nutritional efficiencies were observed during spring and autumn . Lower consumption index was supplemented by higher digestibility and E.C.I. and E.C.D. by the larvae fed on leaves raised from the highest level of fertilizer (F4) . It was also observed that the hybrids recorded higher rate of growth and digestibility as well as conversion efficiencies though consumption index was low in comparison to that of pure breeds.

4.3.5. Total Leaf Yield of fertilizer enriched S1 mulberry variety

The total leaf yield obtained was the highest from F4 level in any season , especially during autumn (152.29 q/ha) followed by F3 level . Moreover leaf yield from F4 in any season was about 50% higher than from F2 (91.41 q/ha during autumn) in any season . The lowest yield was obtained from F0 during summer (24.08 q/ha) (Table .101).

4.4. Impact of Different Combinations of Two Mulberry Varieties as Food on Consumption and Utilization and Rearing Performance of Silkworm Larvae

4.4.1. Consumption and Utilization of Food

4.4.1.1. Consumption Indices (fifth instar larva)

The quantity of food consumption varied according to the combinations of the mulberry varieties (Table -102) . The highest consumption was on S_1 variety alone and the best consumption was on TR_{10} followed by

Table 99. Effect of breed , season and leaves raised under different fertility status on Efficiency of conversion of digested food (E.C.D.)

Silkwormbreed	Fertilizer	Season		
		Spring	Autumm	Summer
P5	F0	17.00	13.76	13.11
	F1	17.35	16.22	15.35
	F2	21.04	20.20	18.88
	F3	25.70	33.21	24.92
	F4	25.00	34.87	24.77
KPGB	F0	13.23	12.17	13.07
	F1	15.55	16.47	14.85
	F2	19.65	18.18	19.55
	F3	24.20	22.56	23.85
	F4	27.08	25.90	24.39
KPGB x P5	F0	13.86	13.22	12.45
	F1	17.96	16.04	16.30
	F2	20.25	20.82	19.49
	F3	24.51	27.81	27.33
	F4	30.72	32.37	38.71
P5 x KPGB	F0	14.40	13.84	13.14
	F1	18.31	16.91	17.30
	F2	21.04	20.19	18.57
	F3	25.70	28.39	26.80
	F4	28.05	30.13	39.17

Table 100. Correlation Matrix of Rearing performance , nutritional efficiencies and chemical contents of leaf of fertilizer enriched Si variety

	L.du	FI	FB	Wt.G	CI	GR	AD	ECI	ECD	L.Wt	ERRwt	CWt	Swt	SR%	ASC	ERRno.	FEC	PRO	CAR	MOIS
L.du	1.00000**																			
FI	.38825	1.00000**																		
FB	.38352	.92550**	1.00000**																	
Wt.G	-.08226	.53959*	.77127**	1.00000**																
CI	.113360	.93494**	.86655**	.03502	1.00000															
GR	-.83425	-.30010	-.39356	.76633	-.12656	1.00000														
AD	.01897	.38578	.156**	.21731	.22854	-.02512	1.00000													
ECI	-.21578	-.06552	-.02156	.91428**	-.92567	.30960	.14035	1.00000												
ECD	-.21951	.91545	.95044**	.85636**	.82237	.32151	.10432	.98411**	1.00000**											
L.Wt	-.04056	.74537	.67165	.93098**	.86214	-.01277	.21885	.93035**	.76931**	1.00000**										
ERR Wt	.21356	.47506	.4057*	.76273	.6756	.21063	.22161	.95226	.53581	.59108**	1.00000									
CWt	.0039	.63637	.54735	.87330**	.79385	.11573	.26912	.71401**	.94177**	.94725**	.93669**	1.00000**								
Swt	.35095	.12149	.17812	.15573	.15406	-.15645	.02525	.13553	.12294	.18727	.18787	.19582	1.00000							
SR%	.20812	.71143	.68995	.78706**	.74556	.15116	.10864	.74000**	.69975**	.73420**	.58877**	.70552**	.13341	1.00000						
ASC	.13969	.60014	.52812	.67434**	.78149	-.15052	.25616	.71007**	.63846**	.95069**	.97272**	.96998**	.19755	.68680**	1.00000					
ERR no.	.29554	.32878	.28515	.61955**	.55156	-.26223	.14923	.46100**	.41735**	.77893**	.96042**	.81754**	.14916	.46139**	.89304**	1.00000				
FEC	-.25129	.92128	.86708	.92927**	.64965	.25776	.18787	.94416**	.89625**	.83573**	.62840**	.74840**	.14197	.80246**	.74124**	.60923**	1.00000**			
PRO	-.31056	.93561	.84649	.82037**	.90112	.26004	.28054	.96192**	.82297**	.72506**	.48829**	.65418**	.20466	.73847**	.61959**	.32559**	.90170**	1.00000**		
CAR	-.25198	.91835	.84704	.85638**	.90170	.21763	.24536	.90608**	.83893**	.75478**	.51715**	.68923**	.22404	.77765**	.66285**	.37906**	.90771**	.98512**	1.00000**	
MOIS	-.59114	.79476	.74782	.57240**	.61752	.55023**	.15623	.68362**	.63338**	.51321**	-.03652	.22556	.09260	.49697**	.13140	-.22567	.63507**	.77601**	.73293**	1.00000**

*, ** Significant at 5 % and 1 % level of significance respectively

L.Du = Larval Duration , FI = Food Ingestion , FB = Food Balance , Wt.G. = Weight Gain , CI = Consumption Index , GR = Growth Rate, AD = Approximate Digestability , ECI = Efficiency of Conversion of Ingested food , ECD = Efficiency of Conversion of digested food, L.Wt. = Larval Weight, ERR wt. = Effective Rate of Rearing (in weight) , C wt. = Single Cocoon weight, S wt. = Single Shell weight , SR% = Shell Ratio, ASC= Absolute silk Content , ERR no. = Effective Rate of rearing (in number) , FEC = Fecundity , PRO = Protein Content of Leaf , CAR = Carbohydrate Content of leaf MOIS = Moisture Content of leaf.

Table 101 . Effect of season and leaves raised under different fertility status on Leaf yield (q/ha.)

Season / Fertilizer	Spring	Autumn	Summer
F_0	33.09	35.56	24.08
F_1	60.59	65.53	43.39
F_2	88.89	91.41	59.38
F_3	119.22	131.26	85.34
F_4	132.21	152.29	98.88

SEM (±) 0.50
CD at 5 % 12.01

Table 102. Performance of the fifth instar larvae reared on different combinations of two mulberry varieties, one at early and the other at late larval stage

Mulberry Varieties		Consumption Indices			
Early Stage	Late Satge	Larval duration (days)	Food ingested (g.)	Food balance (g.)	Weight gain (g.)
S1	S1	7.08	12.25	7.52	0.86
TR10	TR10	6.92	9.32	5.42	0.87
Kosen	Kosen	6.83	8.89	4.74	0.86
S1	TR10	6.75	10.19	5.56	0.88
S1	Kosen	6.83	9.82	5.85	0.9
Kosen	S1	7.08	11.53	7.44	0.84
TR10	S1	7.00	11.38	7.4	0.88
Kosen	TR10	6.58	9.01	5.3	0.95
TR10	Kosen	6.50	8.83	5.27	0.96
SEM (±)		0.07	0.07	0.07	0.12
CD at 5%		0.28	0.28	0.28	Non-significant

Kosen . Relatively lower quantities of leaves were consumed in the TR10 and Kosen varieties alone or their different combinations were given as food. The consumption was higher in case of nutritionally poor leaves. This was also directly related to the food balance , at higher consumption the food balance was also higher. The quantity of digestion of food also differed among the varietal combinations.

4.4.1.2. Nutritional Efficiencies (fifth instar larva)

Consumption Index (C.I.) and Growth Rate (G.R.) : The consumption index (C.I.) varied in the same way following ingestion and food balance. Higher C.I. was found in the larvae reared on the leaves of S1 (1.87) . The lowest C.I. (1.33) was recorded for the combination of leaves TR10 and Kosen . The C.I. was always lower in cases of Kosen and TR10 alone and their different combinations (Table -103).

Irrespective of mulberry varieties and their combination the growth rate was more or less the same (Table -103).

Approximate digestibility (A.D.) : Approximate digestibility (A.D.) followed the same pattern like food ingestion , food balance and consumption index so far as individual variety concerned (61.39% for S1 , 58.15% for TR10 and 53.31% for Kosen). Varieties having higher nutritive value like , Kosen and TR10 when fed at early stage of larval development following feeding of S1 variety at late stage showed higher A.D. (64.53% and 65.03% respectively) (Table -103).

From the present studies it is became evident that increment of nutrient level at the later stage of larval development increase digestibility.

Efficiency of Conversion : The efficiency of conversion of ingested food larvae (E.C.I.) varied widely among the different varieties and their combinations as influences by variation in nutritional level of leaves . Among the three varieties studied in this present investigation , namely , S1 , TR10 and Kosen variety leaves when fed separately alone all through the larval development Kosen showed highest E.C.I. (9.67%) , followed by TR10 (9.33%) and least on S1 (7.02%) . However, maximum E.C.I. value was observed (10.87%) when Kosen leaf was supplied in late stage of larval growth after feeding on TR10 leaf at early stage (Table -103) .

Table 103. Food Utilization Efficiencies of the fifth instar larvae reared on different combinations of two mulberry varieties,one at early and the other at late larval stage

Mulberry Varieties		Food Utilization Efficiencies				
Early Stage	Late Satge	Consumption Index (C.I.)	Growth Rate (G.R.)	Approximate Digestability (A.D.) %	Efficiency of conversion of Ingested food (E.C.I.) %	Efficiency of conversion of Digested food (E.C.D.) %
S1	S1	1.87	0.13	61.39	7.02	11.44
TR10	TR10	1.45	0.13	58.15	9.33	16.05
Kosen	Kosen	1.38	0.14	53.31	9.67	18.14
S1	TR10	1.72	0.14	54.56	8.63	15.82
S1	Kosen	1.61	0.14	59.57	9.16	15.38
Kosen	S1	1.50	0.13	64.53	7.28	11.29
TR10	S1	1.56	0.13	65.03	7.73	11.89
Kosen	TR10	1.36	0.14	58.82	10.54	17.92
TR10	Kosen	1.33	0.14	59.68	10.87	18.22
SEM (±)		0.07	0.002	0.18	0.10	0.16
CD at 5 %		0.28	0.008	0.72	0.40	0.64

The efficiency of conversion of digested food (E.C.D.) into body substances varied remarkably among the different nutrient level of these varieties E.C.D. varied in the same way following E.C.I. (18.14% in Kosen , 16.05% TR_{10}, 11.44% in S_1) and highest in Kosen in late stage feeding following TR_{10} leaves in early stage (18.22%) though difference with E.C.D. of only Kosen was non - significant (Table-103) .

4.4.2. Rearing Performance

Maximum cocoon weight (2.31g) was observed when leaves of Kosen variety was fed in late stage following leaves of TR_{10} variety at early stage. Single shell weight was higher when leaves of Kosen variety was fed all throughout the larval development (0.42g). But the highest significant SR% was observed when leaves of Kosen variety was fed all through(19.57%) . Higher SR% were found in combinations with S_1 at late stage and TR_{10} or Kosen at early stage (18.69% and 18.66% respectively) (Table -104) .

Table 104. Impact of different combinations of two mulberry varieties, one at early and the other at late larval stage, on some key parameters of rearing performance.

Mulberry Varieties		Key Rearing Parameters		
Early Stage	Late Satge	Single Cocoon Weight (g.)	Single Shell Weight (g.)	Shell Ratio (%)
S1	S1	1.88	0.33	17.76
TR10	TR10	2.19	0.40	17.78
Kosen	Kosen	2.15	0.42	19.57
S1	TR10	1.94	0.35	18.18
S1	Kosen	2.04	0.36	17.78
Kosen	S1	2.04	0.38	18.66
TR10	S1	1.99	0.37	18.69
Kosen	TR10	2.26	0.41	18.31
TR10	Kosen	2.31	0.41	17.89
SEM (±)		0.01	0.05	0.14
CD at 5%		0.04	0.02	0.57