



Screening of Popular Bivoltine Hybrid Silkworm Breeds of West Bengal on the Basis of Disease Susceptibility in Uttar Pradesh Climatic Conditions

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ABSTRACT

In tropical countries like India, Grasserie, Bacterial flacherie, and other diseases (DNP, CPV, IFV, Sotko disease) spreads by many parasitic microorganism in the blood cells of the silkworm. It is known to occur in all larval instars during all seasons causing 20-50% cocoon crop losses in India. In the present study, 20 promising bivoltine hybrids i.e. SF₁₉ x KA, NB₁₈ x KA, NB₇ x KPG-B, SH₆ x KA, NB₄D₂ x KA for monsoon KA x NB₄D₂, NB₇ x NB₁₈, NB₄D₂ x SH₆, KA x KB, NB₁₈ x NB₄D₂ for autumn P₅ x KB, P₅ x KPG-B, NB₄D₂ x NB₁₈, P₅ x NB₁₈, KPG-B x NB₇ for spring KPG-B x NB₁₈, NB₁₈ x P₅, NB₁₈ x NB₇, SH₆ x NB₁₈ and KA x NB₁₈ for summer season were selected for the experiment to check their disease susceptibility for four different rearing seasons, i.e. monsoon, autumn, spring and summer of Uttar Pradesh respectively. These breeds were screened for their susceptibility to BmNPV and BmIFV, Muscardine and other diseases and the susceptibility status has been compared in different season of Uttar Pradesh. This will help in selecting most promising race for all seasons which will be least susceptible to different silkworm diseases and farmer will face less difficulty during silkworm rearing and will have no fear of attack of diseases. It will lead to further adoption and spread of sericulture in other districts of Uttar Pradesh. Our result showed that the breeds SH₆ x KA, KA x NB₄D₂, P₅ x NB₁₈, KA x NB₁₈ showed less susceptible among other breeds in monsoon, autumn, spring and summer season respectively for Uttar Pradesh climatic conditions.

KEY WORDS: Grasserie, Flacherie, Mascardine, susceptibility, breeds, climatic condition.

INTRODUCTION

The silkworm *Bombyx mori* is a very delicate insect and is prone to many infectious diseases caused by various pathogenic microorganisms, these microorganisms are not only found in diseased caterpillars but also scattered in the rearing room and on appliances from the carcasses and feces of diseased caterpillars. These infectious microbes left over become an easy source of secondary contamination and spread of diseases [1-12]. Several workers have also reported that higher incidence of disease [13] with related to density of the silkworm larvae in the rearing bed plays vital role in influencing the growth of the larvae [14,15]. The population density of larvae reared in a unit area had a direct effect on the incidence of grasserie caused by the polyhedrosis virus (NPV) [15], it is also well-established fact that, the grasserie is most common disease in the tropics and temperate climate. In India it has been reported that extent of 32.9 - 55.3% among the total silkworm diseases grasserie was found, grasserie generally attacks the advance stage of worms i.e. the fourth moult and accounts for more than 15% of the loss of cocoon yield [16-20]. No race is immune completely to diseases [21] and different races of silkworm show variation in their susceptibility to different diseases [22]. Preliminary work has been done on rearing performance of different races of silkworm [23]. Different races of silkworm exhibit marked variation in their susceptibility to various diseases [24]. Some preliminary screening of multivoltine x bivoltine hybrids for their comparative rearing performance was conducted by [23,24] screened 21 races of silkworm including pure and hybrid races for 'their relative susceptibility to Nuclear polyhydrosis under natural and induced conditions. All the early workers in their studies have established superiority of bivoltine exotic races over those of local multivoltine races in rearing performance [19-21]. However, no serious attempts have been made to systematically screen different races for their relative susceptibility grasserie and flacherie, mascardine etc., which is one of the major causes of cocoon crop failure in India [25-27]. Keeping this in view in the present study the disease susceptibility to different bivoltine hybrid races were tested under different seasons i.e. spring, summer, monsoon and autumn of Uttar Pradesh.

MATERIALS AND METHODS

The present study has been conducted at Babasaheb Bhimrao Ambedkar University, Lucknow. Twenty bivoltine silkworm hybrid breeds *i.e.* SF₁₉ x KA, NB₁₈ x KA, NB₇ x KPG-B, SH₆ x KA, NB₄D₂ x KA for monsoon KA x NB₄D₂, NB₇ x NB₁₈, NB₄D₂ x SH₆, KA x KB, NB₁₈ x NB₄D₂ for autumn P₅ x KB, P₅ x KPG-B, NB₄D₂ x NB₁₈, P₅ x NB₁₈, KPG-B x NB₇ for spring KPG-B x NB₁₈, NB₁₈ x P₅, NB₁₈ x NB₇, SH₆ x NB₁₈ and KA x NB₁₈ for summer season were selected for the experiment to check their disease susceptibility for four different rearing seasons, *i.e.* monsoon, autumn, spring and summer of Uttar Pradesh respectively. The standard rearing method adopted as recommended by Krishnaswami and other scientists [28-34] were followed. Three replicas with 400 larvae of selected breeds were maintained for control and field conditions separately. Data were collected for Grasserie and Flacherie and other diseases every day onset of spinning. In all seasons average temperature and humidity recorded in natural conditions as shown in table (1 & 2). Data were subjected to statistical method for deriving the results. Experiment was conducted in different rearing seasons of years *i.e.* 2002 and 2003.

RESULT

To check the variability in disease tolerance in twenty bivoltine silkworm hybrid breeds *i.e.* SF₁₉ x KA, NB₁₈ x KA, NB₇ x KPG-B, SH₆ x KA, NB₄D₂ x KA for monsoon KA x NB₄D₂, NB₇ x NB₁₈, NB₄D₂ x SH₆, KA x KB, NB₁₈ x NB₄D₂ for autumn P₅ x KB, P₅ x KPG-B, NB₄D₂ x NB₁₈, P₅ x NB₁₈, KPG-B x NB₇ for spring KPG-B x NB₁₈, NB₁₈ x P₅, NB₁₈ x NB₇, SH₆ x NB₁₈ and KA x NB₁₈ for monsoon were selected across different seasons of the year is presented in Table-1 and Table-2.

MONSOON SEASON

Grasserie

On the basis of results obtained during monsoon season the lowest mean percentage of grasserie disease under controlled conditions was 5.75 in SH₆ x KA followed by 6.00 in NB₇ x KPG-B & NB₄D₂ x KA, 10.50 in SF₁₉ x KA and 12.00 in NB₁₈ x KA. In first year under field condition observed lowest mean % of grasserie disease was 23.00 in SH₆ x KA followed by 23.50 in NB₄D₂ x KA, 24.00 in NB₁₈ x KA, 26.00 in SF₁₉ x KA and 27.00 NB₇ x KPG-B. In second year under field condition lowest mean percentage of grasserie disease recorded was 17.75 in SH₆ x KA followed by 18.00 in NB₄D₂ x KA & SF₁₉ x KA, 20.00 in NB₁₈ x KA and 22.50 NB₇ x KPG-B for different breeds as shown in table-1 and graph 1-5 as shown in table-1 and table-2.

Flacherie

On the basis of results obtained during monsoon season the lowest mean % of flacherie disease under controlled conditions was 1.50 in SH₆ x KA & NB₄D₂ x KA followed by 2.50 in SF₁₉ x KA, 2.00 in NB₇ x KPG-B and 5.50 % in NB₁₈ x KA. In first year under field condition lowest mean percentage of flacherie disease recorded was 8.00 in SH₆ x KA & NB₄D₂ x KA followed by 10.00 in NB₁₈ x KA, 11.00 in SF₁₉ x KA & NB₇ x KPG-B. In second year under field condition lowest mean percentage of flacherie disease recorded was 8.00 in NB₇ x KPG-B followed by 10.25 in SF₁₉ x KA, 10.75 in NB₁₈ x KA 12.00 in SH₆ x KA & NB₄D₂ x KA for different breeds as shown in table-1 and graph 1-5.

Other Diseases

In monsoon season it was observed that under controlled conditions SH₆ x KA, NB₇ x KPG-B, NB₁₈ x KA and NB₄D₂ x KA have shown better tolerance for other diseases. However, In SF₁₉ x KA 1.00 % aspergillosis disease was recorded. During the first year under field conditions SH₆ x KA, NB₇ x KPG-B, NB₁₈ x KA and NB₄D₂ x KA have shown better tolerance to other diseases, however SF₁₉ x KA have shown 1% susceptibility to other diseases. During the second year under field conditions it was observed SH₆ x KA and NB₄D₂ x KA are more tolerant to other diseases, however, 1.75%, 1.00%, 0.50% susceptibility to other diseases was observed in SF₁₉ x KA, NB₁₈ x KA and NB₇ x KPG-B for different breeds respectively as shown in table-1 and graph 1-5.

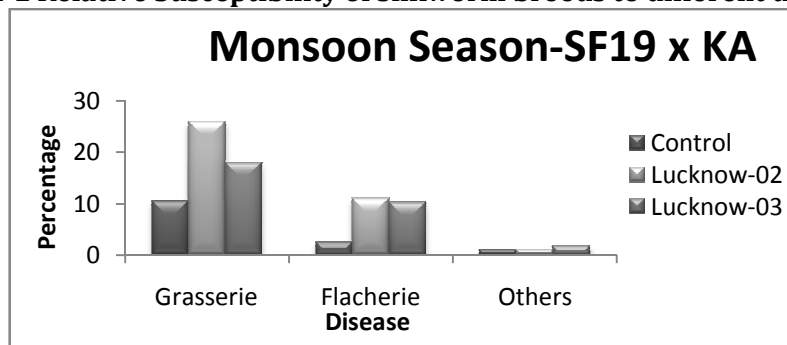
AUTUMN SEASON

Grasserie

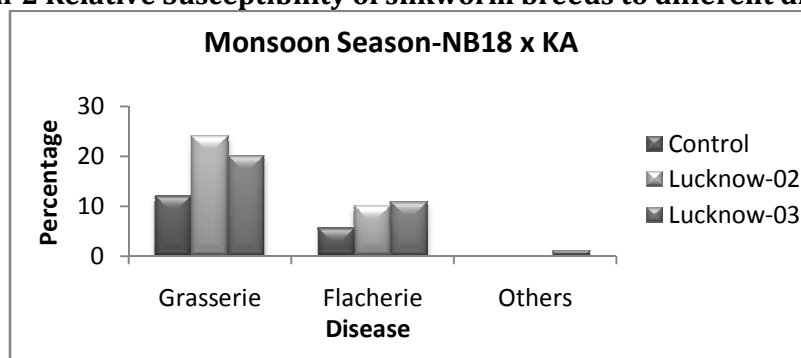
On the basis of results obtained during autumn season the lowest mean % of grasserie disease recorded under controlled conditions was 8.50 in KA x NB₄D₂ followed by 11.75 in NB₇ x NB₁₈, 12.50 in NB₄D₂ x SH₆, 13.25 in KA x KB and 13.50 in NB₁₈ x NB₄D₂. In first year lowest mean percentage of grasserie disease

recorded under field conditions was 20.00 in KA x NB₄D₂ & NB₄D₂ x SH₆ followed by 21.75 in NB₇ x NB₁₈, 21.25 in KA x KB and 21.50 in NB₁₈ x NB₄D₂. In second year it was observed that lowest mean % of grasserie disease under field conditions was 19.00 in KA x NB₄D₂ followed by 20.00 in NB₄D₂ x SH₆, 22.75 in NB₇ x NB₁₈, 24.50 in KA x KB and 25.00 in NB₁₈ x NB₄D₂ for different breeds as shown in table-1 and graph 6-10.

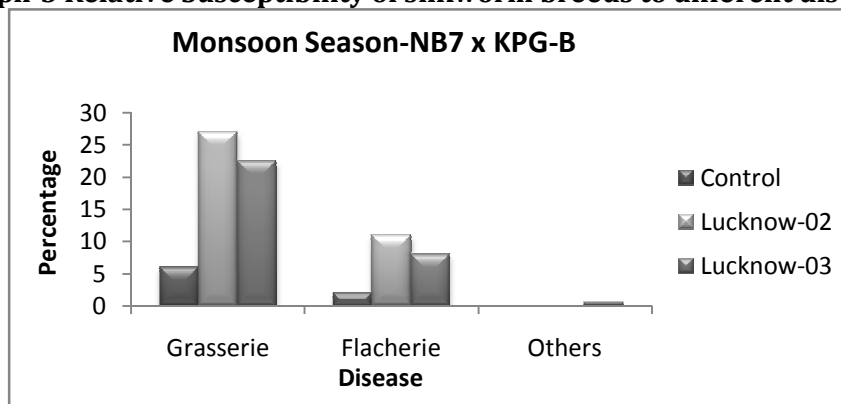
Graph-1 Relative Susceptibility of silkworm breeds to different diseases



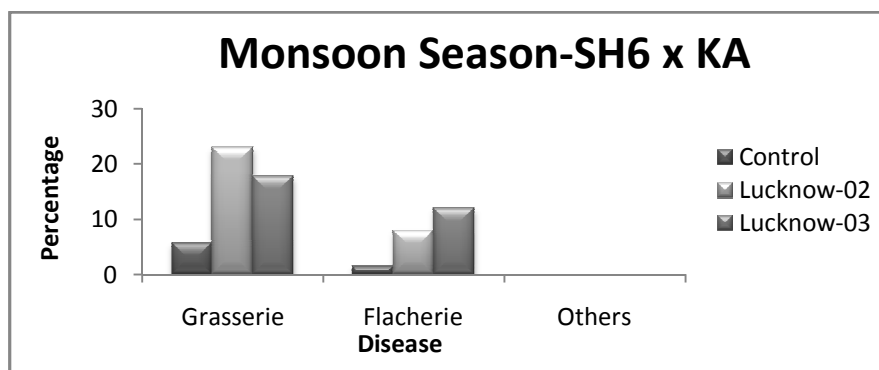
Graph-2 Relative Susceptibility of silkworm breeds to different diseases



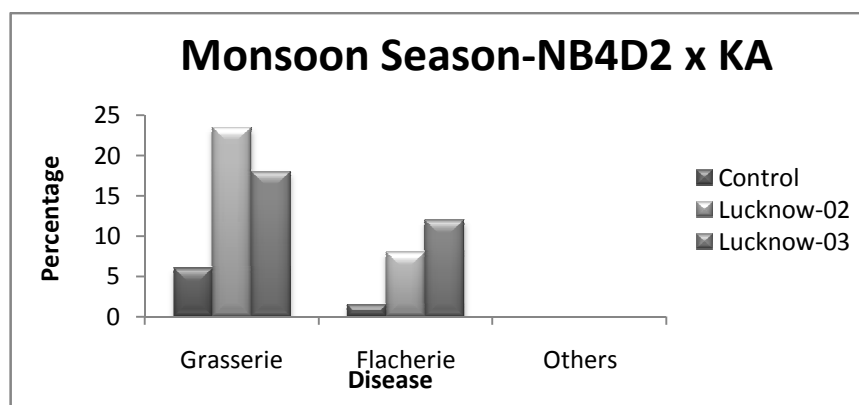
Graph-3 Relative Susceptibility of silkworm breeds to different diseases



Graph-4 Relative Susceptibility of silkworm breeds to different diseases



Graph-5 Relative Susceptibility of silkworm breeds to different diseases

**AUTUMN SEASON****Grasserie**

On the basis of results obtained during autumn season the lowest mean % of grasserie disease recorded under controlled conditions was 8.50 in KA x NB₄D₂ followed by 11.75 in NB₇ x NB₁₈, 12.50 in NB₄D₂ x SH₆, 13.25 in KA x KB and 13.50 in NB₁₈ x NB₄D₂. In first year lowest mean percentage of grasserie disease recorded under field conditions was 20.00 in KA x NB₄D₂ & NB₄D₂ x SH₆ followed by 21.75 in NB₇ x NB₁₈, 21.25 in KA x KB and 21.50 in NB₁₈ x NB₄D₂. In second year it was observed that lowest mean % of grasserie disease under field conditions was 19.00 in KA x NB₄D₂ followed by 20.00 in NB₄D₂ x SH₆, 22.75 in NB₇ x NB₁₈, 24.50 in KA x KB and 25.00 in NB₁₈ x NB₄D₂ for different breeds as shown in table-1 and graph 6-10.

Flacherie

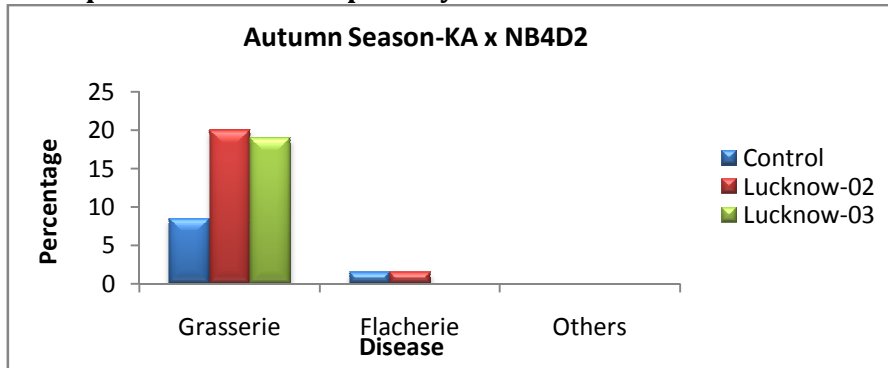
On the basis of results obtained during autumn season the lowest mean percentage of flacherie disease under controlled conditions recorded was 1.50 in KA x NB₄D₂ followed by 5.00 in NB₄D₂ x SH₆ & NB₁₈ x NB₄D₂, 7.00 in KA x KB and 8.00 in NB₇ x NB₁₈. In first year lowest mean % of flacherie disease recorded in field conditions was 1.00 in KA x KB followed by 1.50 in KA x NB₄D₂ 2.00 in NB₇ x NB₁₈ & NB₁₈ x NB₄D₂ and 3.00 in NB₄D₂ x SH₆. During second year under field conditions the breed KA x NB₄D₂ & NB₁₈ x NB₄D₂ which showed disease tolerance against flacherie disease, other breed NB₇ x NB₁₈, NB₄D₂ x SH₆ and KA x KB showed disease susceptibility to flacherie 8.00, 7.00 and 0.50 respectively for different breeds as shown in table-1 and graph 6-10.

Other Diseases

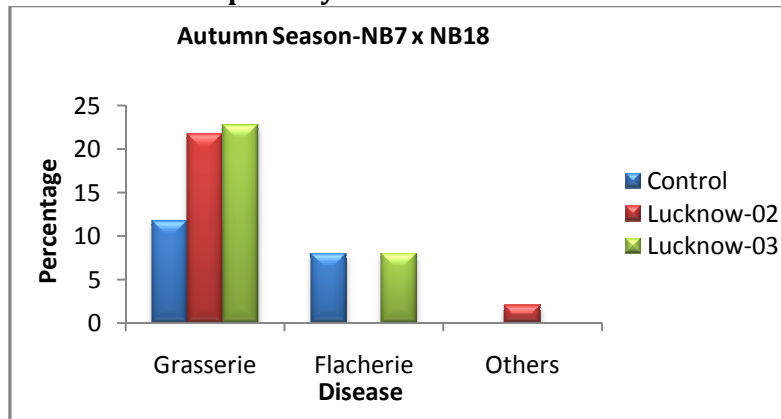
On the basis of results obtained during autumn season the other diseases under controlled conditions were KA x NB₄D₂, NB₇ x NB₁₈ and NB₁₈ x NB₄D₂ which showed tolerance against the other diseases,

Percentage of gattine disease recorded was 2.00 in NB₄D₂ x SH₆ and 0.50 in KA x KB. In first year mean percentage of other diseases under field conditions KA x NB₄D₂, NB₇ x NB₁₈, NB₄D₂ x SH₆ and NB₁₈ x NB₄D₂ showed tolerance against other diseases, only 0.09 in KA x KB recorded disease susceptible to gattine. During second year under field conditions KA x NB₄D₂, NB₇ x NB₁₈, KA x KB and NB₁₈ x NB₄D₂ showed tolerance against other diseases, only 1.00 in NB₄D₂ x SH₆ recorded disease susceptible for different breeds to other diseases as shown in table-1 and graph 6-10.

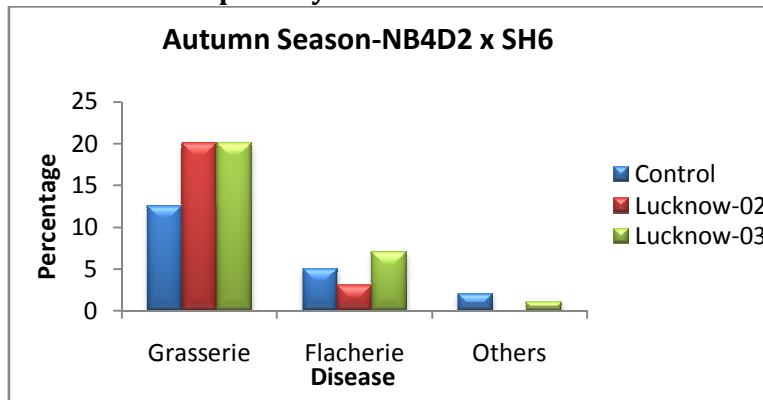
Table-1: - Graph-6 Relative Susceptibility of silkworm breeds to different diseases



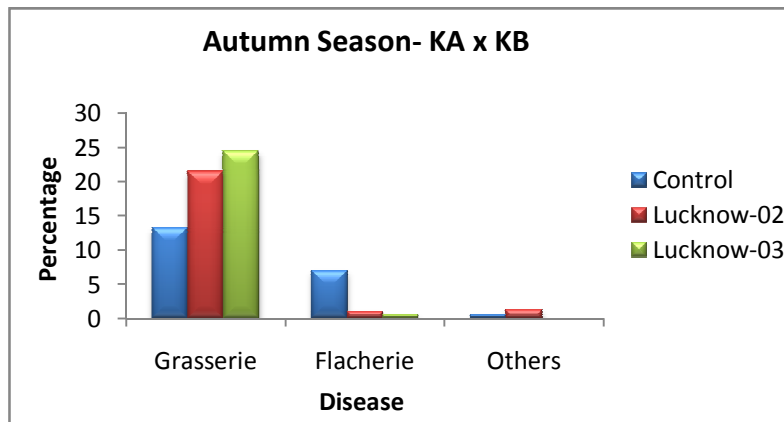
Graph-7 Relative Susceptibility of silkworm breeds to different diseases



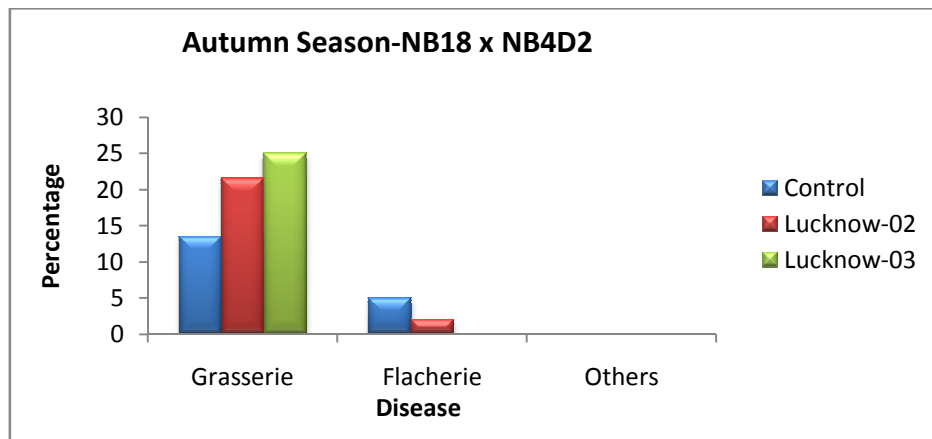
Graph-8 Relative Susceptibility of silkworm breeds to different diseases



Graph-9 Relative Susceptibility of silkworm breeds to different diseases



Graph-10 Relative Susceptibility of silkworm breeds to different diseases



SPRING SEASON

Grasserie

On the basis of results obtained during spring season the lowest mean % of grasserie disease under controlled conditions was 9.56 in $P_5 \times KPG-B$ followed by 12.00 in $P_5 \times NB_{18}$, 12.25 in $NB_{4D_2} \times NB_{18}$, 15.45 in $KPG-B \times NB_7$ & $P_5 \times KB$. In first year lowest mean percentage of grasserie disease recorded under field conditions 20.75 in $P_5 \times NB_{18}$ followed by 22.00 in $P_5 \times KB$ & $KPG-B \times NB_7$, 23.75 in $P_5 \times KPG-B$ and 25.00 in $NB_{4D_2} \times NB_{18}$. During second year under field conditions lowest mean percentage of grasserie disease recorded 14.98 in $P_5 \times NB_{18}$ followed by 17.85 in $NB_{4D_2} \times NB_{18}$, 18.50 in $P_5 \times KB$, 20.12 in $P_5 \times KPG-B$, and 20.50 in $KPG-B \times NB_7$ for different breeds as shown in table-2 and graph 1-5.

Flacherie

On the basis of results obtained during spring season the lowest mean percentage of flacherie disease under controlled conditions was 4.94 in $P_5 \times NB_{18}$ followed by 5.00 in $P_5 \times KB$, 6.18 in $NB_{4D_2} \times NB_{18}$, 6.25 in $KPG-B \times NB_7$ and 6.82 in $P_5 \times KPG-B$. In second year under field conditions lowest mean % of flacherie disease recorded 5.96 in $NB_{4D_2} \times NB_{18}$ followed by 7.25 in $P_5 \times KB$, 7.50 in $P_5 \times NB_{18}$, 7.56 in $P_5 \times KPG-B$, and 8.50 in $KPG-B \times NB_7$. In first year lowest mean percentage of flacherie disease recorded under field conditions was 9.25 in $P_5 \times KPG-B$ followed by 10.25 in $NB_{4D_2} \times NB_{18}$ & 10.50 in $KPG-B \times NB_7$ and 12.50 in $P_5 \times KB$ for different breeds as shown in table-2 and graph 1-5

Other diseases

On the basis of results obtained during spring season the breed $P_5 \times NB_{18}$ under controlled conditions showed disease tolerance against other diseases, The breeds 1.50 in $P_5 \times KB$, 2.38 in $P_5 \times KPG-B$, 1.00 in $NB_{4D_2} \times NB_{18}$ and 3.50 in $KPG-B \times NB_7$ showed disease susceptibility to other diseases. In first year mean percentage of other diseases under field condition $P_5 \times NB_{18}$ & $KPG-B \times NB_7$ were showed tolerance against other disease. Other breeds showed disease susceptibility 3.00 in $P_5 \times KB$, 1.75 in $P_5 \times KPG-B$ and 1.50 in

NB₄D₂ x NB₁₈. During second year under field conditions P₅ x NB₁₈ & KPG-B x NB₇ showed tolerance against other diseases. The breeds P₅ x KB, P₅ x KPG-B and NB₄D₂ x NB₁₈ 1.52, 1.45 and 1.56 respectively showed disease susceptibility against other diseases for different breeds as shown in table-2 and graph 1-5.

Table-2: - Graph-1 Relative Susceptibility of silkworm breeds to different diseases

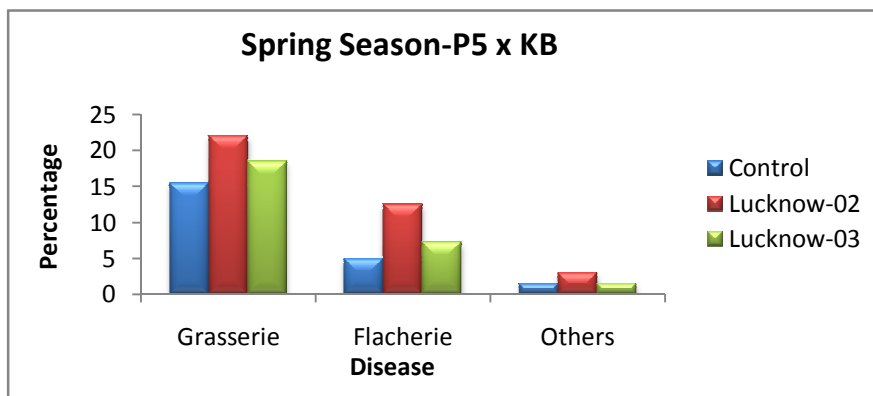


Table-2: - Graph-2 Relative Susceptibility of silkworm breeds to different diseases

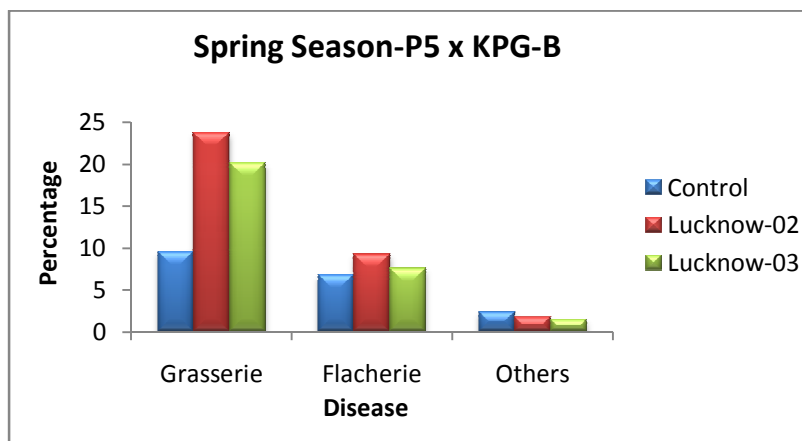


Table-2: - Graph-3 Relative Susceptibility of silkworm breeds to different diseases

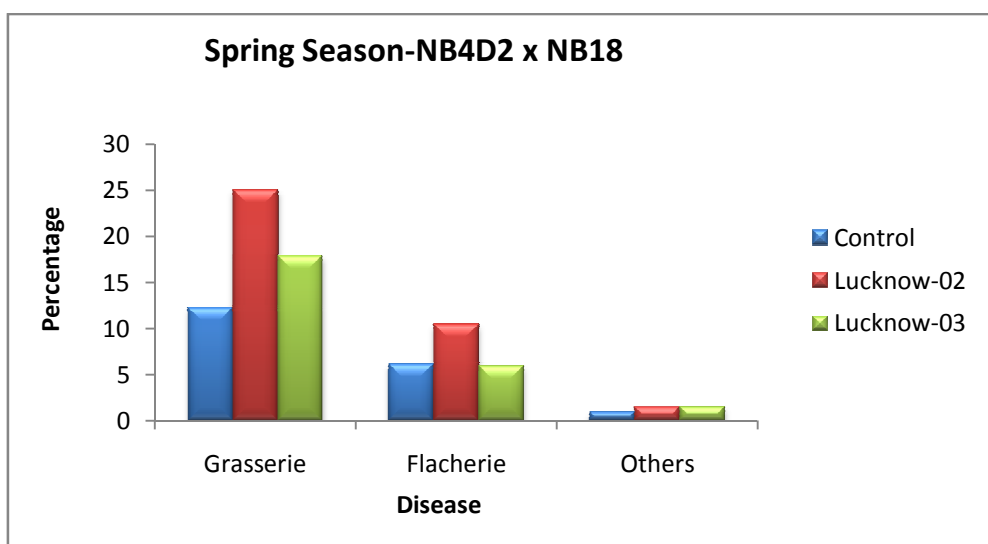


Table-2: - Graph-4 Relative Susceptibility of silkworm breeds to different diseases

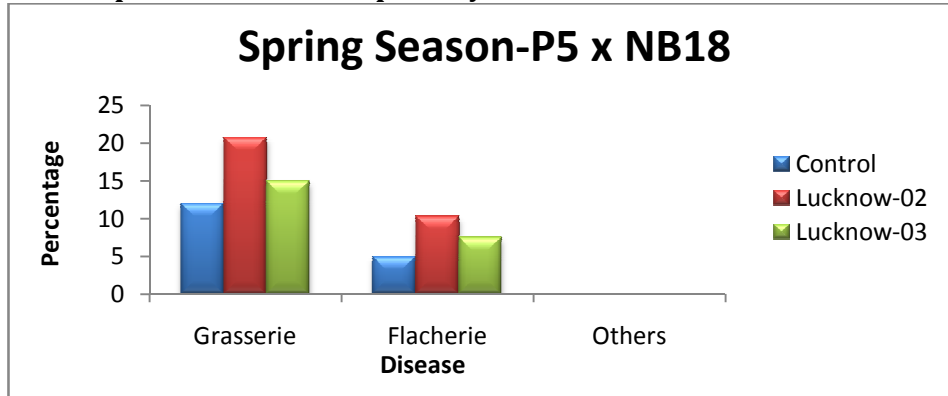
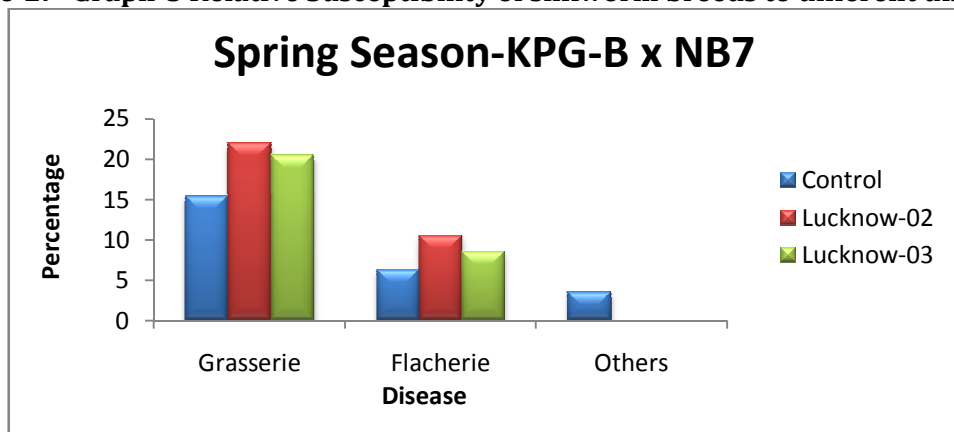


Table-2: - Graph-5 Relative Susceptibility of silkworm breeds to different diseases



SUMMER SEASON

Grasserie

On the basis of results obtained during summer season the lowest mean percentage of grasserie disease under controlled conditions was 10.00 in KPG-B x NB₁₈ followed by 12.00 in NB₁₈ x NB₇, 12.50 in NB₁₈ x P₅, SH₆ x NB₁₈ and 13.50 in KA x NB₁₈. In first year under field conditions the lowest mean percentage of grasserie recorded was 22.00 in KPG-B x NB₁₈ followed by 23.00 in NB₁₈ x P₅ & SH₆ x NB₁₈, 23.50 in KA x NB₁₈ and 24.00 in NB₁₈ x NB₇. During second year under field conditions lowest mean percentage of grasserie recorded was 17.00 in KA x NB₁₈ followed by 17.85 in NB₁₈ x P₅, 18.00 in NB₁₈ x NB₇, 18.50 in KPG-B x NB₁₈ and 18.75 in SH₆ x NB₁₈ for different breeds as shown in table-2 and graph 6-10.

Flacherie

On the basis of results obtained during summer season under controlled conditions KA x NB₁₈ showed tolerance against flacherie, the breed susceptible percent recorded was 2.00 in SH₆ x NB₁₈ followed by 4.00 in NB₁₈ x P₅, 6.00 in NB₁₈ x NB₇ and 6.50 in KPG-B x NB₁₈. In first year under field conditions lowest mean percentage of flacherie recorded was 2.00 in SH₆ x NB₁₈ followed by 3.00 in NB₁₈ x NB₇, 4.50 in NB₁₈ x P₅ and 5.00 in KPG-B x NB₁₈. KA x NB₁₈ showed tolerance against flacherie. During second year under field conditions the lowest mean percentage of flacherie disease recorded was 3.00 in NB₁₈ x P₅ & KA x NB₁₈ followed by 4.00 in KPG-B x NB₁₈ & NB₁₈ x NB₇ for different breeds as shown in table-2 and graph 6-10.

Other diseases

On the basis of results obtained during summer season in controlled conditions the breeds KA x NB₁₈, SH₆ x NB₁₈, and KPG-B x NB₁₈ showed tolerance against other diseases. The disease susceptibility to other disease recorded percent was 1.00 NB₁₈ x P₅ in and 0.75 in NB₁₈ x NB₇. During second year under field conditions KA x NB₁₈, SH₆ x NB₁₈, and NB₁₈ x P₅ were shown disease tolerance to other diseases. The

disease susceptibility recorded was 1.75 in KPG-B x NB₁₈ & NB₁₈ x NB₇ to other diseases. In first year only KA x NB₁₈ showed disease tolerance against other diseases. The disease susceptibility to other breeds recorded percent was 1.00 in KPG-B x NB₁₈, 1.50 in NB₁₈ x P₅, 1.00 in NB₁₈ x NB₇ and 0.25 in SH₆ x NB₁₈ for different breeds as shown in table-2 and graph 6-10.

Table-2: - Graph-6 Relative Susceptibility of silkworm breeds to different diseases

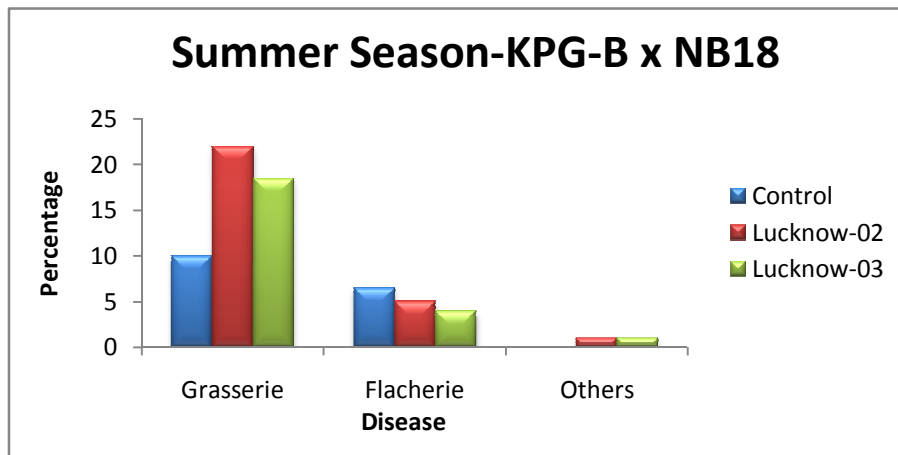


Table-2: - Graph-7 Relative Susceptibility of silkworm breeds to different diseases

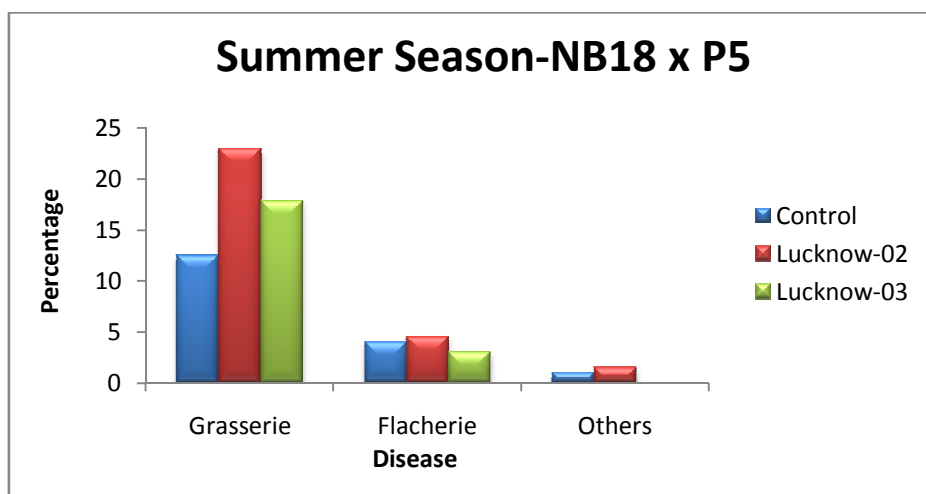


Table-2: - Graph-8 Relative Susceptibility of silkworm breeds to different diseases

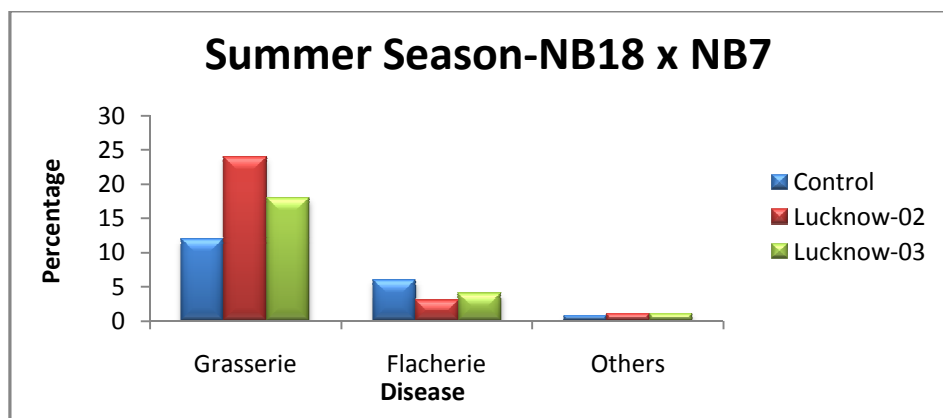


Table-2: - Graph-9 Relative Susceptibility of silkworm breeds to different diseases

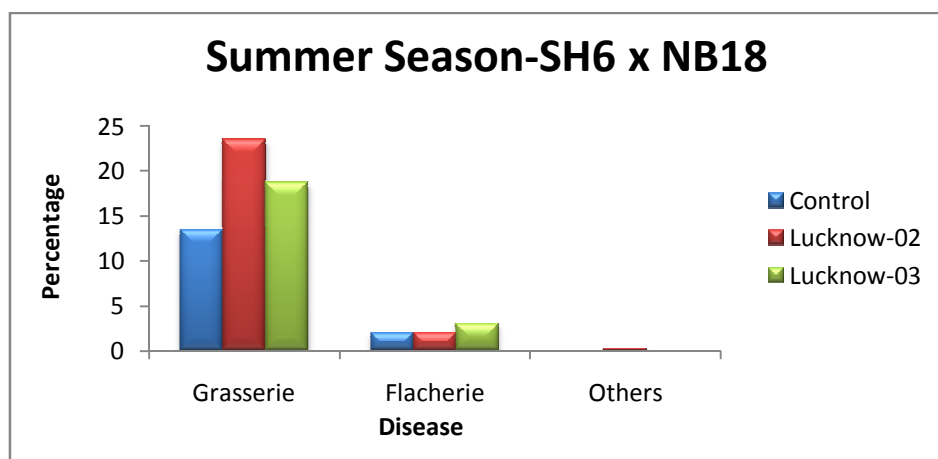
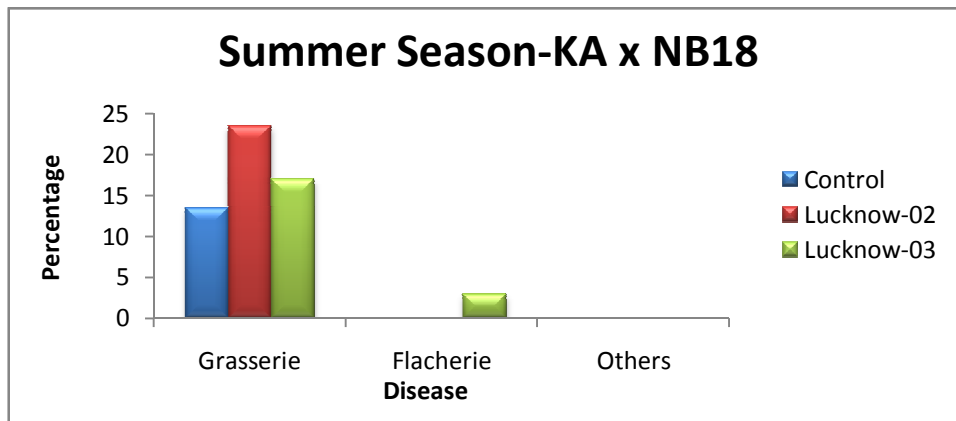


Table-2: - Graph-10 Relative Susceptibility of silkworm breeds to different diseases



DISCUSSION

Seasonal performance of breeds under laboratory and field conditions with regard to grasserie, flacherie and other disease resistance are presented in table (1&2). The study reveals that those breeds which showed least disease Susceptibility, 17.75% grasserie, 12.00% flacherie in SH₆ x KA in monsoon season. In autumn season KA x NB₄D₂ shows least disease susceptibility 19.00% against grasserie. 14.98.00% grasserie, 7.50% flacherie recorded in P₅ x NB₁₈ during spring season and in summer season KA x NB₁₈ recorded 17% grasserie and 3% flacherie [22, 35- 38]. I were observed during his study that breed of silkworm shows variations in their susceptibility to different seasons, similarly on present finding also showed variation in different season, breeds have shown their susceptibility to different disease as shown (Table 1&2). In present study higher incidence of grasserie was recorded 27% in NB₇ x KPG-B and higher flacherie % in P₅ x KB as compared to other diseases. The trend was almost similar to observation made by [39-44] who have proved that bivoltine breeds exhibited highest disease occurrence. Unfavorable seasonal fluctuations during most of the seasons appear to influence the high incidence of viral and flacherie disease [45-52]. Our observations are also similar to that studies. Many scientists [53-55] have reported that temperature and humidity have great influence on the occurrence of disease viz. grasserie and aspergillosis, also in the observation, it has found that the temperature and humidity in total have got a significant correlation in incidence of diseases. Further, it has been found that in dry conditions higher susceptibility of disease was observed (table 1-2). It is worthy to mention that the bivoltine hybrids tested in this experiment were screened under both laboratory and field condition, therefore bivoltine hybrid breeds

SH₆ x KA for monsoon KA x NB₄D₂ for autumn, P₅ x NB₁₈ for spring and KA x NB₁₈ for summer have exhibited better performance under Uttar Pradesh climatic conditions.

Table- (1) Relative Susceptibility (%) of silkworm races to different diseases in Monsoon and Autumn seasons

	Monsoon season				Autumn season			
	Breed	G	F	O	Breed	G	F	O
Control	SF ₁₉ x KA	10.50 ±	2.50 ±	1.00 ±	KA x NB ₄ D ₂	8.50 ±	1.50 ±	Nil ±
	NB ₁₈ x KA	0.90	0.95	0.24	NB ₇ x NB ₁₈	0.98	0.21	0.00
	NB ₇ x KPG-B	12.00 ±	5.50 ±	Nil ± 0.00	NB ₄ D ₂ x	11.75 ±	8.00 ±	Nil ±
	B SH ₆ x KA	1.23	0.84	Nil ± 0.00	SH ₆	1.45	0.42	0.00
	NB ₄ D ₂ x KA	6.00 ±	2.00 ±	Nil ± 0.00	KA x KB	12.50 ±	5.00 ±	2.00 ±
		0.98	0.66	Nil ± 0.00	NB ₁₈ x	1.12	0.52	0.21
		5.75 ±	1.50 ±		NB ₄ D ₂	13.25 ±	7.00 ±	0.50 ±
		0.12	0.23			1.23	0.84	0.11
		6.00 ±	1.50 ±			13.50 ±	5.00 ±	Nil ±
		0.52	0.50			1.58	0.63	0.00
Lucknow 2002	SF ₁₉ x KA	26.00 ±	11.00 ±	1.00 ±	KA x NB ₄ D ₂	20.00 ±	1.50 ±	Nil ±
	NB ₁₈ x KA	3.45	1.54	0.25	NB ₇ x NB ₁₈	1.32	0.66	0.00
	NB ₇ x KPG-B	24.00 ±	10.00 ±	Nil ± 0.00	NB ₄ D ₂ x	21.75 ±	2.00 ±	Nil ±
	B SH ₆ x KA	3.12	1.56	Nil ± 0.00	SH ₆	3.12	0.82	0.00
	NB ₄ D ₂ x KA	27.00 ±	11.00 ±	Nil ± 0.00	KA x KB	20.00 ±	3.00 ±	Nil ±
		3.24	1.45	Nil ± 0.00	NB ₁₈ x	2.15	0.93	0.00
		23.00 ±	8.00 ±		NB ₄ D ₂	21.50 ±	1.00 ±	1.25 ±
		2.45	1.25			2.07	0.77	0.09
		23.50 ±	8.00 ±			21.50 ±	2.00 ±	Nil ±
		3.26	1.46			2.23	0.82	0.00
Lucknow 2003	SF ₁₉ x KA	18.00 ±	10.25 ±	1.75 ±	KA x NB ₄ D ₂	19.00 ±	Nil ±	Nil ±
	NB ₁₈ x KA	1.32	1.92	0.75	NB ₇ x NB ₁₈	1.10	0.00	0.00
	NB ₇ x KPG-B	20.00 ±	10.75 ±	1.00 ±	NB ₄ D ₂ x	22.75 ±	8.00 ±	Nil ±
	B SH ₆ x KA	1.52	1.87	0.25	SH ₆	2.82	0.86	0.00
	NB ₄ D ₂ x KA	22.50 ±	8.00 ±	0.50 ±	KA x KB	20.00 ±	7.00 ±	1.00 ±
		2.78	1.54	0.12	NB ₁₈ x	2.56	0.26	0.25
		17.75 ±	12.00 ±	Nil ± 0.00	NB ₄ D ₂	24.50 ±	0.50 ±	Nil ±
		1.22	1.12	Nil ± 0.00		2.98	0.04	0.00
		18.00 ±	12.00 ±			25.00 ±	Nil ±	Nil ±
		2.06	1.82			3.09	0.00	0.00

G = Grasserie
F = Flacherie
O = Other disease

Table- (2) Relative Susceptibility (%) of silkworm races to different diseases in Spring and Summer seasons

	Spring				Summer			
	Breed	G	F	O	Breed	G	F	O
Control	P ₅ x KB	15.45 ±	5.00 ±	1.50 ±	KPG-B x	10.00 ±	6.50 ±	Nil ±
	P ₅ x KPG-B	1.45	1.00	0.28	NB ₁₈	1.49	1.25	0.00
	NB ₄ D ₂ x N	9.56 ±	6.82 ±	2.38 ±	NB ₁₈ x P ₅	12.50 ±	4.00 ±	1.00 ±
	B ₁₈	1.78	1.12	0.84	NB ₁₈ x NB ₇	1.32	0.95	0.09

Lucknow 2002	P ₅ x NB ₁₈	12.25 ±	6.18 ±	1.00 ±	SH ₆ x NB ₁₈	12.00 ±	6.00 ±	0.75 ±
	KPG-B x	1.52	1.32	0.14	KA x NB ₁₈	1.21	0.87	0.04
	NB ₇	12.00 ±	4.94 ±	Nil ± 0.00		13.50 ±	2.00 ±	Nil ±
		1.09	0.90	3.50 ±		1.45	0.56	0.00
		15.45 ±	6.25 ±	0.92		13.50 ±	Nil ± 0.00	Nil ±
		1.87	1.14			0.92		0.00
	P ₅ x KB	22.00 ±	12.50 ±	3.00 ±	KPG-B x	22.00 ±	5.00 ±	1.00 ±
	P ₅ x KPG-B	3.65	2.14	0.95	NB ₁₈	3.14	0.98	0.11
	NB ₄ D ₂ x	23.75 ±	9.25 ±	1.75 ±	NB ₁₈ x P ₅	23.00 ±	4.50 ±	1.50 ±
	NB ₁₈ P ₅ x	3.26	2.04	0.81	NB ₁₈ x NB ₇	3.22	0.56	0.15
	NB ₁₈	25.00 ±	10.50 ±	1.50 ±	SH ₆ x NB ₁₈	24.00 ±	3.00 ±	1.00 ±
	KPG-B x	3.12	1.89	0.26	KA x NB ₁₈	3.12	0.81	0.12
	NB ₇	20.75 ±	10.25 ±	Nil ± 0.00		23.50 ±	2.00 ±	0.25 ±
		2.21	1.23	Nil ± 0.00		3.56	0.10	0.02
	22.00 ±	10.50 ±			23.50 ±	Nil ± 0.00	Nil ±	
	2.89	1.84			2.77		0.00	
Lucknow 2003	P ₅ x KB	18.50 ±	7.25 ±	1.52 ±	KPG-B x	18.50 ±	4.00 ±	1.00 ±
	P ₅ x KPG-B	2.56	1.25	0.32	NB ₁₈	2.12	0.24	0.06
	NB ₄ D ₂ x	20.12 ±	7.56 ±	1.45 ±	NB ₁₈ x P ₅	17.85 ±	3.00 ±	Nil ±
	NB ₁₈ P ₅ x	3.45	1.51	0.46	NB ₁₈ x NB ₇	2.35	0.21	0.00
	NB ₁₈	17.85 ±	5.96 ±	1.56 ±	SH ₆ x NB ₁₈	18.00 ±	4.00 ±	1.00 ±
	KPG-B x	2.78	1.28	0.58	KA x NB ₁₈	3.14	0.19	0.07
	NB ₇	14.98 ±	7.50 ±	Nil ± 0.00		18.75 ±	3.00 ±	Nil ±
		1.66	1.06	Nil ± 0.00		2.78	0.18	0.00
		20.50 ±	8.50 ±			17.00 ±	3.00 ±	Nil ±
		3.45	1.85			1.66	0.11	0.00

G = **Grasserie**
F = **Flacherie**
O = **Other disease**

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