INCIDENCE OF 'TUKRA' AND BACTERIAL BLIGHT ON MULBERRY PLANTS IN GERM PLASM BANK

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ABSTRACT

The percentage incidence of 'Tukra' and bacterial blight on 20 indigenous and 23 exotic mulberry varieties in the University Germ Plasm Bank was recorded at monthly intervals from August 1985 to February 1986 (seven months). Most of the exotic varieties (18) were free from 'Tukra'-while many of the indigenous varieties (16) were affected. In general, infection was severe during the month of February. All the indigenous varieties were significantly free from bacterial blight while only 5 of the 23 exotic varieties were found to be severelly affected. About 13 exotic varieties were totally free from both 'Tukra' and bacterial blight infection.

INTRODUCTION

In tropical countries like India, the most common and widespread disease of mulberry plants is leaf curling at growing shoot tips[1,2]. The disease is commonly known as 'Tukra' in West Bengal[3]. As early as in 1899, Mukerji[3] ascertained that 'Tukra' is caused by a minute insect. Later Roy[4], Paul[5] and Rai Choudhury[6] observed that the mealybug *Phenococcus hirsutus* Gr. was associated with affected portions of the mulberry plants. The mealybugs were found in various stages of development in the folds and knots of the leaves and apical shoots. The early investigators reported that the disease was caused by the coccids. Sriharan *et al*[7], released definite number of adult mealybugs (*Maconellicoccus hirsutus* Gr., order Homoptera) on the growing parts of healthy mulberry plants and observed 'Tukra' symptoms after 15 days. The symptoms were a direct result of the colonization and infestation of the plants by these coccids. Tukra-affected plants show retarted growth in apical portions, and distorted stem and leaves. Hence growth and leaf yield are severely affected. The mealybugs feed on the sap by sucking on tender leaves and shoots[8]. It is not known whether, by such feeding, the insects (mealybugs) introduce a virus which is responsible for the observed disease[9]. Mealybugs are known to be the vectors for several viral diseases[10,11]. Ullal and Narasimhanna[12] have mentioned that the cause of 'Tukra' disease is a virus for which the common mealybug is the vector. Although the work of Sriharan *et al*[7] establishes that mealybugs are the causal agents of 'Tukra' disease, it remains to be shown that it is not due to virus/mycoplasma which might be transmitted through the mealybugs[2].

Young silkworms must be fed with tender mulberry leaves. In 'Tukra', the tender leaves at the shoot tips are the parts attacked by the insect. The leaves are deformed as a result of the insect bite. Affected leaves also show various biochemical changes compared to healthy leaves[13-15]. As a result of these, 'chawki', rearing of silkworms (rearing of young silkworms) is affected. In a preliminary survey of mulberry gardens situated in and around Bangalore, the incidence of 'Tukra' was noticed to be very common; it was severe during the pre-monsoon and summer months[2]. An attempt was therefore made to note the incidence of 'Tukra' on mulberry plants maintained at the University Germ Plasm Bank.

In the case of bacterial leaf blight of mulberry, caused by a bacterium, *Pseudomonas mori*, small, water-soaked, irregular spots appear on the lower surface of leaves and later on the upper surface also. The spots turn brown, grow in size and become slightly angular with a yellow halo. When younger leaves are affected, they are crinkled, distorted and curled outwards. They fall off prematurely. Vein and vein-let infection is also common. Sometimes lesions appear on the stem as dark black slits, irregular, lengthy and sunken. Bacterial ooze is seen from these sunken lesions during the later stages of infection. The diseased leaves cannot be utilized for rearing silkworms[16]. While recording the number of 'Tukra'-affected mulberry plants in the University Germ Plasm Bank, attention was also paid to noting the incidence of bacterial blight disease.

MATERIALS AND METHOD

About twenty indigenous mulberry varieties, viz. Berhampore, Berhampore Local, Channapatna

Local, Coonoor series – C–6, C–10, C–11, C–14, C–15, C–18, CRR, Hakkikalu, Jakkur Local, Kajali, Kanva–2 (M5), MR2, Mysore Local, S–36, S–41, S–54 and Yenneranganakaddi (YRK), and twenty-three exotic plants, viz. Farmer's field, Goshoerami, Haraban, Italian, Kairyo-nezumigaeshi, Kosen, Kurangi, Okinawa–1 and –2, Philippine, Popua, Tai-Song No.2 (*Morus formosensis*), Tai-Song No.3, Thailand, Tsukasaguwa, Viet-nam, *Morus alba*, *M. australis*, *M. cathayana*, *M. lembang*, *M. macroura*, *M. multicaulis*, and *M. nigra*, growing at the Germ Plasm Bank, Jnana Bharathi Campus, Bangalore University, Bangalore, were chosen for the study. All the plants had acclimatized well and many of the varieties chosen for the study were in a similar state of maturity. There were two rows of six plants for each of the varieties mentioned. On a particular day of the month (29th), the number of infected plants was noted simultaneously for both 'Tukra' and bacterial blight diseases, at monthly intervals from August 1985 to February 1986 (seven months). Percentage incidence was calculated from the above data.

RESULTS AND DISCUSSION

Screening was done simultaneously for both 'Tukra' and bacterial blight diseases (i.e., the same varieties at the same time). A few varieties were affected with one disease and not with the other. However, the percentage of plants with 'Tukra' or bacterial blight infection varied depending on the mulberry variety and also the month of study.

Depending on the severity of infection (per cent incidence, table 1), the varieties were broadly classified into the following three categories:–

1 (a) Free from 'Tukra' attack (throughout the period of study): Farmer's field, Haraban, Kairyo-nezumigaeshi, Kurangi, *Morus alba*, *M. australis*, *M. cathayana*, *M. lembang*, *M. macroura*, *M. multicaulis*, *M. nigra*, Okinawa–1 and –2, Philippine, Tai-Song No.2 and No.3, Thailand and Viet-nam.

The above varieties may be "resistant" to the insect and/or the organism (virus/mycoplasma?) responsible for the 'Tukra' disease.

(b) Free from bacterial blight infection (throughout the period of study): Berhampore, Berhampore Local, Channapatna Local, Coonoor series—C–6, C–10, C–11, C–14, C–15, C–18, CRR, Hakkikalu, Jakkur Local, Kajali, M5, MR2, Mysore Local, S–36, S–41, S–54, YRK, Farmer's field, Goshoerami, Haraban, Italian, Kairyo-nezumigaeshi, Kosen, Kurangi, *Morus australis*, *M. cathayana*, *M. lembang*, *M. multicaulis*, Okinawa 1 and 2, Philippine, Popua, Tai-Song 2 and 3, and Tsukasaguwa.

2 10–25% 'Tukra' incidence: Channapatna Local, CRR, S-36 and YRK. These were moderately resistant to the 'Turka' attack.

3 (a) 25–50% 'Tukra' incidence: Berhampore, Coonoor series – C–10, C–6, C–11, C–14, C–18, Hakkikalu, Italian, Jakkur Local, Kajali, Kosen, M–5, MR–2, Popua, S–41, S–54 and Tsukasaguwa.

(b) 50–75% 'Tukra' incidence: Berhampore Local, C–15, Goshoerami and Mysore Local.

These were highly 'susceptible' to 'Tukra' attack.

(c) 75–80% bacterial blight incidence: Thailand, *Morus alba*, *M. macroura*, *M. nigra* and Viet-nam.

These varieties were highly 'susceptible' to bacterial blight attack. Symptoms on the stem were more pronounced compared to those on foliage. These varieties were also prone to fungal diseases (leaf spot caused by *Cercospora moricola* and leaf rust caused by *Aecidium mori*)[17].

During the period from August 1985 to February 1986, the highest incidence of 'Tukra' was in August, September, December and February (table 1). From October to January, the following varieties were free from Tukra: Berhampore, C–6, C–10, C–11, C–14, C–15, C–18, Hakkikalu, Italian, Jakkur Local and Tsukasaguwa. The highest incidence of 'Tukra' was recorded during the month of February. This is probably due to the poor egg-laying ability and hatchability of the insect (*Maconellicoccus hirsutus*) in the colder months, viz. December and January, while the same is high during the warm months of February, July and August[7]. From February to June, the insects multiply so rapidly that 'Tukra' spreads all over the field during this period[7]. However, heavy rains are found to wash away the pest and thus relieve the plants which recover completely from the attack[3,7].

Of the 23 exotic varieties, 18 were found to be 'resistant' to 'Tukra' attack under natural conditions. On the contrary, all the 20 indigenous varieties were 'resistant' to the bacterial blight disease. Nearly 13 exotic varieties, namely Farmer's field, Haraban, Kairyo-nezumigaeshi, Kurangi, Okinawa–1 and –2, Philippine, Taisong No. 2 and No. 3, *Morus australis*, *M. cathayana*, *M. lembang*, and *M. multicaulis*, were significantly 'resistant' to both 'Tukra' and bacterial blight disease. The

Table 1 *Percentage incidence of Tukra (T) and bacterial blight (Bb) on mulberry varieties from August 1985 to February, 1986*

Varietal Name	Disease	Month						
		August	September	October	November	December	January	February
Berhampore	T	29 0	29.0	—	—	—	—	38.0
	Bb	—	—	—	—	—	—	—
Berhampore Local	T	51.7	55 0	58.9	59 0	60 0	65.0	72.3
	Bb	—	—	—	—	—	—	—
Channapatna Local	T	12.2	15.0	16.1	16.3	17.0	17.8	18.9
	Bb	—	—	—	—	—	—	—
Coonoor series:- C–6	T	28.0	30.7	—	—	—	—	38.9
	Bb	—	—	—	—	—	—	—
C–10	T	29.1	29 1	—	—	—	—	38.9
	Bb	—	—	—	—	—	—	—
C–11	T	32.5	32.8	—	—	—	—	36.8
	Bb	—	—	—	—	—	—	—
C–14	T	39.0	39.0	—	—	—	—	39.0
	Bb	—	—	—	—	—	—	—
C–15	T	52.5	52.5	—	—	—	—	70.0
	Bb	—	—	—	—	—	—	—
C–18	T	48.9	48.9	—	—	—	—	50.0
	Bb	—	—	—	—	—	—	—
CRR	T	15.0	15.6	15.8	16.8	17.0	20.8	24.0
	Bb	—	—	—	—	—	—	—
Hakkikalu	T	29.0	29 0	—	—	—	—	50.0
	Bb	—	—	—	—	—	—	—
Jakkur Local	T	31.9	31.9	—	—	—	—	50.0
	Bb	—	—	—	—	—	—	—
Kajali	T	38.8	38.9	—	—	—	—	50.0
	Bb	—	—	—	—	—	—	—
Kanva-2	T	41.0	41.7	43.0	45.8	46.7	49.1	50.0
	Bb	—	—	—	—	—	—	—
MR2	T	42.0	43.7	43.7	43.8	48.0	48.0	50.0
	Bb	—	—	—	—	—	—	—
Mysore Local	T	69.8	71.0	72.6	72.8	72.9	72.9	75.0
	Bb	—	—	—	—	—	—	—
S–36	T	13.5	13.9	15.0	16.2	18.2	20.1	23.4
	Bb	—	—	—	—	—	—	—
S–41	T	43.0	43.5	43.9	44.8	45.9	49.0	50.0
	Bb	—	—	—	—	—	—	—
S–54	T	48.0	48.0	49.9	49.9	49.9	49.0	50.0
	Bb	—	—	—	—	—	—	—
Yenneranganakaddi	T	21.7	21.7	21.9	22.3	23.7	24.0	24.9
	Bb	—	—	—	—	—	—	—
Farmer's field	T	—	—	—	—	—	—	—
	Bb	—	—	—	—	—	—	—
Goshoerami	T	66.1	67.8	69.8	73.0	73.1	74.9	75.0
	Bb	—	—	—	—	—	—	—
Haraban	T	—	—	—	—	—	—	—
	Bb	—	—	—	—	—	—	—
Italian	T	29.1	29.7	—	—	—	—	50.0
	Bb	—	—	—	—	—	—	—
Kairyo-nezumigaeshi	T	—	—	—	—	—	—	—
	Bb	—	—	—	—	—	—	—

(*Contd. . . . next page*)

(*Table 1 contd. . . .*)

Varietal Name	Disease	Month						
		August	September	October	November	December	January	February
Kosen	T	39.9	39.9	43.0	48.0	48.1	49.6	50.0
	Bb	—	—	—	—	—	—	—
Kurangi	T	—	—	—	—	—	—	—
	Bb	—	—	—	—	—	—	—
Okinawa-1 and	T	—	—	—	—	—	—	—
Okinawa-2	Bb	—	—	—	—	—	—	—
Philippine	T	—	—	—	—	—	—	—
	Bb	—	—	—	—	—	—	—
Popua	T	28.1	28.1	29.0	29.1	29.1	30.8	49.5
	Bb	—	—	—	—	—	—	—
Tai-Song No. 2 and	T	—	—	—	—	—	—	—
Tai-Song No. 3	Bb	—	—	—	—	—	—	—
Thailand	T	—	—	—	—	—	—	—
	Bb	78.0	78.0	78.1	79.0	80.9	82.1	85.0
Tsukasaguwa	T	28.0	28.2	—	—	—	—	48.0
	Bb	—	—	—	—	—	—	—
Viet-nam	T	—	—	—	—	—	—	—
	Bb	80.1	80.3	81.0	84.1	84.5	84.8	85.0
Morus alba	T	—	—	—	—	—	—	—
	Bb	82.5	83.0	83.9	84.8	85.0	85.0	85.0
M. australis	T	—	—	—	—	—	—	—
	Bb	—	—	—	—	—	—	—
M. cathayana	T	—	—	—	—	—	—	—
	Bb	—	—	—	—	—	—	—
M. lembang	T	—	—	—	—	—	—	—
	Bb	—	—	—	—	—	—	—
M. macroura	T	—	—	—	—	—	—	—
	Bb	80.0	82.0	82.0	82.0	82.0	83.9	85.0
M. multicaulis	T	—	—	—	—	—	—	—
	Bb	—	—	—	—	—	—	—
M. nigra	T	—	—	—	—	—	—	—
	Bb	75.0	75.0	75.0	78.2	79.0	81.0	84.5

Indonesian species *Morus lembang* and *M. cathayana*, although known to be susceptible to diseases[18], remained significantly free from both 'Tukra' and bacterial attack. Whether the exotic and indigenous varieties described as 'resistant' in the present study have true resistance or have just escaped disease is not clear and more studies are needed to prove resistance.

The results also indicate a possible antagonistic effect of one disease on the other. All the 20 indigenous varieties and only a few exotic varieties were affected by 'Tukra' but not by the bacterial blight. Similarly, very few exotic varieties (*Morus alba*, Thailand, Viet-nam *M. macroura*, and *M. nigra*) were affected by the bacterial blight but not by the 'Tukra'. A thorough study of this aspect may help us to develop some means of biological control for either one or both of these diseases.

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