J. Sher-e-Bangla Agric. Univ., 3(1): 1-8, January 2009 ISSN 1997-6038

DISTRIBUTION OF WHITEFLY, *Bemisia tabaci* Gennadius ON MUNGBEAN IN MAJOR MUNGBEAN GROWING REGIONS OF BANGLADESH[1]

M. R. Ali[2] and M. M. Rahman[3]

ABSTRACT

The study was conducted in the three mungbean growing locations/regions of Bangladesh viz., Barisal, Jessore and Gazipur during March 2005 to March 2006 to explore the distribution of whitefly, *Bamisia tabaci* Genn. and the incidence of *Mungbean yellow mosaic virus* (MYMV) disease infection in mungbean (*Vigna radiata*) as well to study the climatic factor(s) as the basis for regulating them. The incidence of whitefly and MYMV infection were the maximum in Barisal (253.7 adults and 82.90 nymphs/20 plants, and 37.33% leaves and 57.20% plants infection, respectively) and the lowest in Jessore (39.0 adults and 10.19 nymphs/20 plants, and 18.20% leaves & 16.50% plants infection, respectively). The rate of MYMV infection in leaves and plants were positively correlated with the incidence of both whitefly adult and nymph. The climatic factors were attributed to the variations of whitefly incidence as well as performance of mungbean in locations. Among three locations, macroclimatic temperature (31.5°C), RH (84.44%) and rainfall (1.47 mm) as well as microclimatic temperature (25.6°C) and RH (77.8%) within crop canopy of mungbean were the highest in Jessore, which were detrimental to the incidence of whitefly. Conversely, macroclimatic temperature (28.4°C) and RH (76.44%); microclimatic temperature (21.53°C) and RH (73.73%) were the lowest in Barisal, which played as the favorable factors for whitefly population. Both macro and microclimatic temperature, RH and rainfall were negatively correlated to the incidence of whitefly. Accordingly, the incidence of whitefly and MYMV infection were the maximum in Barisal and minimum in Jessore and intermediate in Gazipur. Thus yield attributes were better and higher yield (1160.6 kg/ha) was obtained in Jessore, which was followed by Barisal (866.7 kg/ha), while the yield was minimum (414.7 kg/ha) in Gazipur.

Key words: Whitefly, *Bemisia tabaci*, distribution, mungbean, growing regions, Bangladesh.

INTRODUCTION

Mungbean, *Vigna radiata* (L.) Wilczek, belonging to the family Leguminosae, is the most promising pulse crop in tropical and sub-tropical regions including Bangladesh (Gowda and Kaul, 1982). It is an excellent source of protein and minerals and contains 51% carbohydrate, 26% protein, 4% minerals, 3% vitamins (Yadav *et al.*, 1994). According to Afzal *et al.* (2004), mungbean occupies about 12% of the total pulse area of which nearly 70% mungbean is grown in the southern districts of Bangladesh including Barisal in late Rabi season. Recently another window opened to expand mungbean in north-western part of the country through the intervention of Lentil, Blackgram and Mungbean Development Pilot Project (LBMDPP) of the Ministry of Agriculture, Bangladesh. This project created a tremendous impact on the rural economy and farmers' livelihood. Munagbean is already popularized in Rajshahi and Natore regions, while in the northern region it can be grown as an additional crop in between wheat and aman rice. These opportunities facilitated to increase the area and production of mungbean against the decreasing trend of area and production of other pulses. However, there are some major constraints to mungbean production of which whitefly (*Bemisia tabaci* Genn.) is the most serious one as it acts as the vector of *Mungbean yellow mosaic*

[1]Part of Ph.D. Dissertation of first author; [2]Associate Professor and [3]Professor, Department of Entomology, Sher-e-Bangla Agricultural University, Dhaka-1207 and Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh.

virus (MYMV) (Chhabra and Kooner, 1980; Mahmud, 2004). The principal economic loss in mungbean from whitefly infestation is due to the injury from whitefly transmitted MYMV rather than loss from whitefly feeding directly. As mungbean is grown in different regions of the country in different ecological conditions, it is assumed that there might be variability in distribution of whitefly in major mungbean growing areas of Bangladesh. Information relating distribution of whitefly in mungbean growing regions and their bio-ecological effects on the mungbean crop is inadequately. Thus the study was undertaken to generate the geographical distribution of whitefly in major mungbean growing regions of Bangladesh and to identify the macro and microclimatic factors, which determine the distribution of whitefly.

MATERIALS AND METHODS

The study was conducted in the field of three mungbean locations named Gazipur in kharif I season 2005, Jessore in kharif I 2005 and Barisal in late rabi season 2006. The experimental fields were selected at Bangabandhu Sheikh Mujibur Rahaman Agricultural University in Gazipur, Regional Agricultural Research Station (RARS) of Bangladesh Agricultural Research Institute (BARI) in Jessore and Barisal, respectively. The soils of respective fields were well prepared and good tilth ensured for commercial mungbean production. Fertilizers were applied at the rate recommended for commercial cultivation of mungbean during land preparation (Anonymous, 1997). At each location, the experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Barisal local variety of mungban seeds were directly sown in the experimental field of each location. One day after sowing, a light irrigation was applied. Subsequent irrigations, thinning, mulching and weeding were done properly. For data collection, twenty plants per plot @ two plants per row were randomly selected and tagged. The data were recorded on the incidence of whitefly, *Mungbean yellow mosaic virus* (MYMV) infection, micro and macroclimatic factors viz. temperature (^{o}C), relative humidity (%) and rainfall (mm). The microclimatic temperature and relative humidity were recorded within the crop canopy by using the hygrothermometer. Adult whitefly numbers on the selected plants of each plot were counted once in a week by Bell Jar method, which is slightly modified from that of Rangaraju and Chenulu (1980). In this case, instead of Bell Jar, white transparent bottomless plastic jar (20 cm dia. x 30 cm height) was used, where the randomly selected plant was trapped inside the jar and the plant was slightly shaken. The whitefly then left the plant and moved to the inner wall of jar and crawled upwards and counted directly. The counting was done very early in the morning (before sun-rise), when the adults were least mobile. The nymphs were also counted by direct visual observation through leaf turn method. Counting of whitefly was started 10 days after germination of the mungbean seeds and continued up to fruit set. Number of MYMV infected plants and leaves were counted in each replication to calculate the percent MYMV infected plants and leaves, respectively using the following formula:

$$\text{Percent MYMV infected leaves} = \frac{\text{Number of infected leaves}}{\text{Total Number of leaves}} \times 100$$

Data were statistically analyzed for RCBD using MSTAT-C software (Anonymous, 1989) and Least Significant Different (LSD) test was performed for mean separation to determine the level of significant difference. The correlation analysis and regression line were made to correlate between different parameters.

RESULTS AND DISCUSSION

The results of the present study regarding the distribution of whitefly in Barisal, Jessore and Gazipur of Bangladesh and their bio-ecological effects on mungbean production have been discussed with interpretations and furnished under the following sub-headings:

1. Incidence of whitefly and MYMV infection on mungbean in different regions

Different mungbean growing regions showed statistically significant (p=0.01) variations in the incidence of whitefly adults and nymphs by number as well as percent MYMV infection on leaves and plants in the present study (Table 1).

1.1. Incidence of whitefly

The highest incidence whitefly (253.7 adults/20 plants) was recorded in the mungbean field of Barisal, which was significantly differed from that of all other locations followed by Gazipur (141.7 adults/20 plants) and Jessore (39.0 adults/20 plants) (Table 1). Similar trend was also observed in relation to incidence of whitefly nymphs, where the highest incidence (82.90 nymphs/20 plants) of whitefly nymphs by number was recorded in Barisal, which was statistically different from all other locations followed by Gazipur (28.90 nymphs/20 plants) and Jessore (10.19 nymphs/20 plants).

1.2. Incidence of MYMV infection

The highest rate of MYMV infected leaves (37.33%) was recorded the munbean of Barisal, which was statistically similar with Gazipur (33.07%) followed Jessore (18.20%) (Table 1). Similar trend was also observed in relation to the incidence of MYMV infected plants, which was the highest (57.20%) in Barisal and being statistically different from all other locations followed by Gazipur (46.80%), but the lowest in Jessore (16.50%).

Table 1. Incidence of whitefly and MYMV infection on mungbean grown in Gazipur and Jessore during Kharif I, 2005 and Barisal during to late Rabi, 2006

Locations/ regions	Mean whitefly incidence (number/20 plants)		MYMV infection (%)	
	Adult whitefly	Whitefly nymph	MYMV infected leaf	MYMV infected plant
Barisal	253.70 a	82.90 a	37.33 a	57.20 a
Gazipur	141.70 b	28.90 b	33.07 a	**46.80 b**
Jessore	39.00 c	10.80 c	18.20 b	16.50 c
$LSD_{(0.01)}$	20.46	10.19	7.76	5.55
CV (%)	3.76	6.64	6.99	3.68

In a column, means followed by same letter(s) are not significantly different at 1% level of significance by LSD

1.3. Relationship between incidence of adult whitefly and MYMV infection

From the correlation studies it can be concluded that the number of whitefly adults had significant (p=0.01) and strong positive influence on the MYMV infection on leaves (r=0.89) and plants (r=0.84) (Fig. 1).

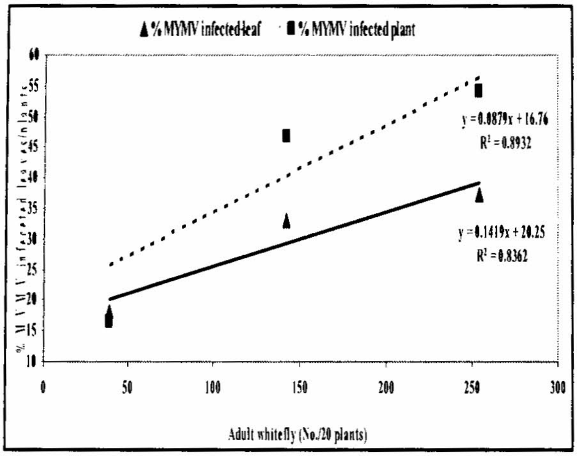

Fig. 1. Correlations between the incidence of adult whitefly and MYMV infection on mungbean in three major mungbean growing locations of Bangladesh

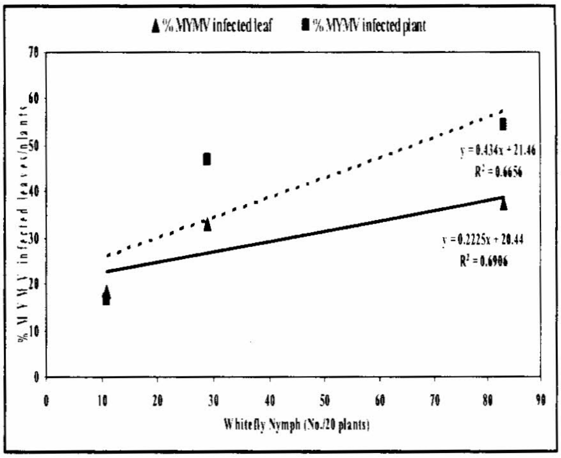

Fig. 2. Correlations between the incidence of whitefly nymph and MYMV infection on mungbean in three major mungbean growing locations of Bangladesh

1.4. Relationship between incidence of whitefly nymph and MYMV infection

Irrespective of regions, the number of whitefly nymphs had also highly significant (p=0.01) and positively correlated with the percent MYMV infected leaves (r= 0.69) and plants (r=0.67) (Fig. 2).

From the above findings, it is inferred that due to the geographical variations, the incidence of whitefly as well as MYMV infection on mungbean significantly varied, and the incidence of whitefly adults and nymphs as well as MYMV infected leaves and plants were the highest in Barisal followed by Gazipur and Jessore regions.

2. Yield and yield attributes of mungbean

Different mungbean growing regions/locations showed statistically significant (p=0.01) variations in yield and yield attributes of mungbean (Table 2). In respect of yield and yield attributes of mungbean, more or less similar trends of results were observed. The number of leaf (216.0/20 plants), branch (4.33/plant), pod (24.60/plant), 1000's seed weight (33.77 gm) and yield (1160.00 kg/ha) of munbean were maximum in Jessore followed by Barisal (214.0 leaves/20 plants, 3.07 branch/plant, 18.67 pod/plant, 31.0 gm/1000's grain and 866.7 kg/ha yield, respectively) and that was minimum in Gazipur (140.00 leaves/20 plants, 2.80 branch/plant, 15.80 pod/plant, 27.50 gm/1000's grain and 414.70 kg/ha yield, respectively).Such variation in geographical distribution of whitefly as well as correlation between the whitefly incidence and MYMV infection, and yield and yield attributes is logical, and has been reported by several researchers although no such study has been reported from Bangladesh. Greathead (1986) reported that the host range of the whitefly often has regional characteristics and the same plant species subjected to severe infestations in one area, may be relatively free from the whitefly in another. Rajnish *et al.* (2004) reported a significant positive correlation between MYMV disease incidence and whitefly population attacking mung [*V. mungo*] and urd bean *[V. radiata]*. Aftab *et al.* (1992) and Nath (1994) also reported MYMV disease spread rapidly with increase in the whitefly population. In Bangladesh, Mahmud (2004) also observed the positive correlation between whitefly population (adult and nymphs) and MYMV infection on mungbean. Babu *et al.* (1984) reported that infection of *V. radiata* plants by MYMV caused significantly reduction in number of pods/plants, seed yield and thousand seed weight. Jain *et al.*

(1995) reported that the reduction in grain yield ranged from 39.9% to 51.5% due to MYMV infection on blackgram and the reduction in plant height, pods/plant, 1000's seed weight and crop growth rate contributed in decreasing grain yield.

Table 2. Yield and yield attributes of mungbean grown in Gazipur and Jessore during Kharif I, 2005 and Barisal during late Rabi, 2006

Locations/ regions	Yield and yield attributes of mungbean				
	Leaf (No./20 plants)	Branch (No./plant)	Pod (No./plant)	1000's seed weight (gm)	Yield (kg/ha)
Barisal	214.0 a	3.07 b	18.67 b	31.00 a	866.70 b
Gazipur	140.0 b	2.80 b	15.80 c	27.50 b	**414.70 c**
Jessore	216.0 a	4.33 a	24.60 a	33.77 a	1160.60 a
$LSD_{(0.01)}$	8.68	0.43	3.01	2.94	78.31
CV (%)	4.33	3.40	4.88	2.54	4.56

In a column, means followed by same letter(s) are not significantly different at 1% level of significance by LSD

Weather factors that varied due to the geographical/regional variations and their possible attributions to the variations in whitefly incidence, MYMV infection and yield attributes of mungbean are presented below.

3. Climatic variations in three major mungbean growing locations

Table 3 shows sharp variations in macro and microclimatic factors viz. temperature, relative humidity and rainfall in three mungbean growing locations.

3.1. Variations in the level (maximum and minimum) of macroclimatic factors in three mungbean growing locations

The maximum mean temperature throughout the cropping season (31.5°C) was recorded in Jessore followed by Gazipur (29.07°C) and it was minimum (28.4°C) in Barisal (Table 3). In case of mean macroclimatic relative humidity (RH), the maximum RH (84.44%) was recorded in Jessore followed by Gazipur (77.96%) that was more closer to Barisal (76.44%). The maximum mean rainfall (1.47 mm) was also recorded in Jessore followed by Barisal (0.856 mm) and minimum (0.216 mm) in Gazipur.

Table 3. Climatic variations in three major mungbean growing locations of Bangladesh

Locations/ regions	*Macroclimatic factors			**Microclimatic factors	
	Mean temperature (°C)	Mean relative humidity (%)	Mean rainfall (mm)	Temperature within crop canopy (°C)	Relative humidity within canopy (%)
Barisal (late Rabi '06)	28.40	76.44	0.856	21.53 c	73.73 c
Gazipur (kharif I '05)	29.07	77.96	0.216	24.22 b	75.80 b
Jessore (kharif I '05)	31.50	84.44	1.470	25.60 a	77.80 a
$LSD_{(0.01)}$				0.77	0.58
CV (%)				0.87	0.95

*Statistical analysis was not done; **Means followed by same letter(s) are not significantly different at 1% level of significance by LSD

3.2. Effect of macroclimatic factors on the incidence of whitefly in mungbean

Significant correlations were observed between macroclimatic factors and the number of adult whitefly on mungbean (Fig. 3 to Fig. 5).

3.2a. Relationship between macroclimatic temperature and incidence of whitefly adult

The macroclimatic temperature (°C) had moderately negative correlation (r=0.53) with the incidence of adult whitefly (Fig. 3).

3.2b. Relationship between macroclimatic relative humidity and adult whitefly

A highly significant (p=0.01) and negative correlation (r=0.87) was observed between macroclimatic relative humidity and incidence of adult whitefly on mungbean (Fig. 4).

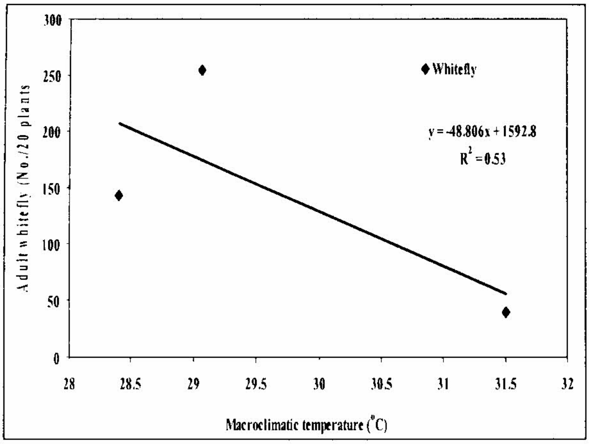

Fig. 3. Correlation between macroclimatic temperature and incidence of adult whitefly on mungbean in three major mungbean growing regions of Bangladesh

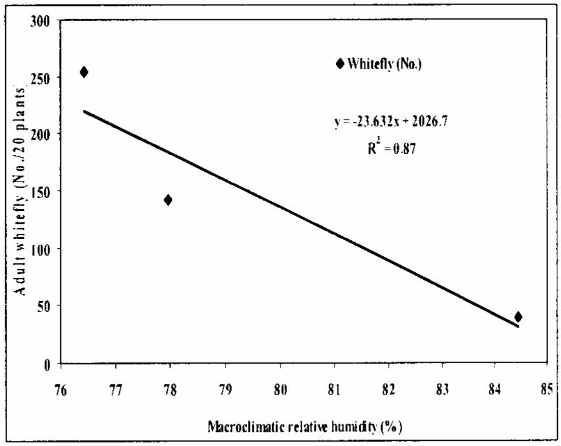

Fig. 4. Correlation between macroclimatic relative humidity and incidence of adult whitefly on mungbean in three major mungbean growing regions of Bangladesh

3.2c. Relationship between rainfall and the incidence of adult whitefly on mungbean field

From the correlation studies it was revealed that a highly significant (p=0.01) and negative correlation (r=0.22) was observed between rainfall and adult whitefly incidence in three mungbean growing locations (Fig. 5). Here the incidence of adult whitefly was weakly correlated with the rainfall that is adult white incidence decreased slowly with the increase of the rainfall.

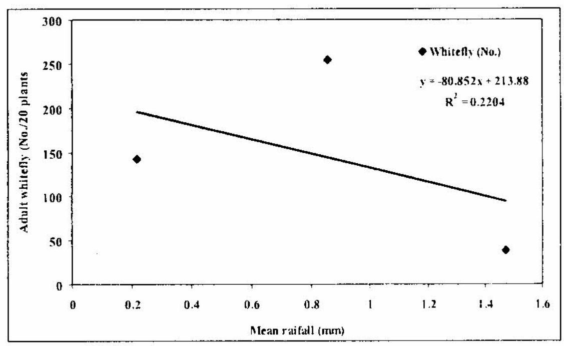

Fig. 5. Correlation between mean rainfall and incidence of adult whitefly on mungbean in three major mungbean growing regions of Bangladesh

3.3. Effect of microclimatic factors on the incidence of whitefly on mungbean

Significant (p=0.01) correlations were observed between components of microclimatic factor (temperature and RH) within the crop canopy and the incidence of whitefly adult on mungbean (Fig. 6 and Fig. 7

3.3a. Relationship between microclimatic temperature and incidence of whitefly adult

The microclimatic temperature (°C) within crop canopy had strong negative correlation (r=0.98) with the incidence of whitefly adult on mungbean (Fig. 6).

3.3b. Relationship between microclimatic relative humidity and incidence of whitefly

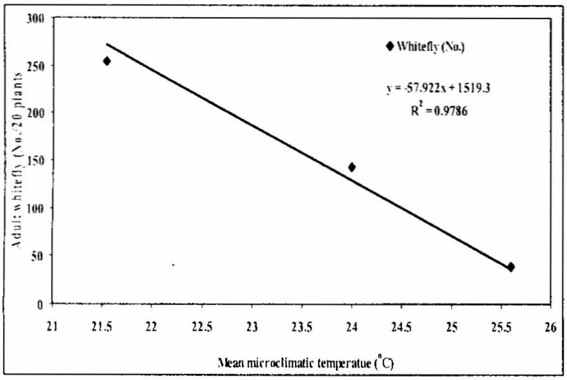

Fig. 6. Correlation between microclimatic temperature and incidence of adult whitefly in three major mungbean growing regions of Bangladesh

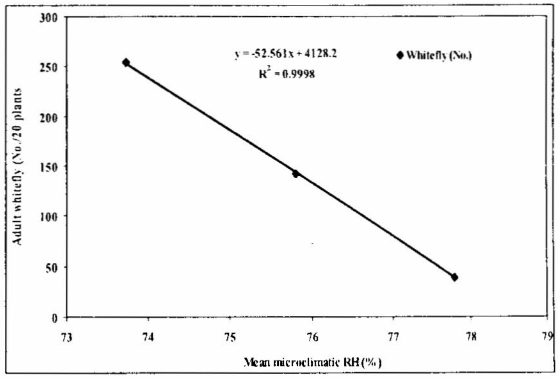

Fig. 7. Correlation between microclimatic relative humidity and incidence of adult whitefly in three major mungbean growing regions of Bangladesh

The relative humidity (%) within crop canopy had strong negative correlation (r=0.99) with the incidence of adult whitefly (Fig. 7).

The above findings provided the basis of logical explanation of the factors that are integral to the geographical variations, and are consequently attributive to the performance of mungbean and whitefly incidence in the three mungbean growing locations/regions of Bangladesh. The factors are macro and micro climatic temperature, relative humidity and seasonal rainfall. Although these factors were more or less significantly important in influencing the whitefly incidence, MYMV infection and crop performance, but the degree of their influence was different. Among the three mungbean growing locations, the maximum mean macroclimatic temperature, relative humidity and rainfall (31.5°C, 84.44% and 1.47 mm, respectively) prevailed in Jessore, whereas the minimum mean macroclimatic temperature and relative humidity prevailed in Barisal (28.4°C and 76.44%, respectively) followed by Gazipur (29.07°C and 77.96%), while the rainfall was minimum in Gazipur (0.216 mm). The macroclimatic temperature (°C), relative humidity (%) and the rainfall (mm) were negatively correlated with the incidence of whitefly adult in mungbean crop, i.e., the incidence of adult whitefly was minimum (39.0 adult/20 plants) in Jessore and maximum (253.7 adults/20 plants) in Barisal. On the other hand, the microclimatic factors such as the maximum temperature and relative humidity (25.6°C and 77.8%, respectively) within crop canopy prevailed in Jessore and these were minimum in Barisal (21.53°C and 73.73%) followed by Gazipur (24.22°C and 75.8%, respectively). Both of the microclimatic temperature and relative humidity within crop canopy had strong negative correlations with the incidence of adult whitefly in mungbean, and thus the incidence of adult whitefly was minimum in Jessore and maximum in Barisal. Since the whitefly population and MYMV infection had strong positive correlations, the MYMV infection both in leaves and plants was the maximum in Barisal and minimum in Jessore.

Several workers reported the more or less similar relationship between climatic parameters and incidence of whitefly, *Bemicia tabaci* Genn. Rajnish *et al.* (2004) reported that kharif season crop of mung and urd bean were more vulnerable to the attack of whitefly, where temperature and sunshine hours were favorable for whitefly as positive correlation. In Bangladesh, Mahmud (2004) observed the positive correlation between whitefly population (adults and nymphs) with increasing temperature and relative humidity. Eichelkraut and Cardona (1989) reported that dry conditions were more favorable for whitefly, *B. tabaci*, than those of high precipitation. Gerling *et al.* (1986) found that the lower and upper developmental thresholds of temperature are 11 and 33°C, respectively. Rates of development are maximal at 28°C, whereas extreme relative humidities, both high and low, were unfavorable for the survival of whitefly. Horowitz (1986) reported that heavy rain was usually followed by a drop in population levels of whitefly.

REFERENCES

Aftab, M., Asad, S., Khokon, K. M., Ayub, M. A. and Butt. 1992. Effect of *Mungbean yellow mosaic virus* on yield and growth components of *Vigna radiata. Pak. J. Phytopathol.* 5 (1-2): 58-61.

Afzal, M. A., Bakr, M.A., Hamid, A., Haque, M. M. and Akter, M.S. 2004. Mungbean in Bangladesh. Lentil Blackgram and Mungbean Development Pilot Project. Pulse Research Centre, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh. Pub. No. 23, 60p.

Anonymous. 1989. *MSTAT-C, a microcomputer program for the design, management and analysis of agronomic research experiments.* Michigan State Univ., East Lansing, MI.

Anonymous. 1997. Determination of the combined effect of sowing date and insecticide applications against insect pests of mungbean. *Annual Report, 1996-1997*: Entomology Division, Bangladesh Agricultural Research Institute (BARI), Gazipur, pp. 104-105.

Babu, A.K., Rathinaswamy, R. and Srinivasan, P.S. 1984. Certain physiological changes in green gram plants infected by mungbean yellow mosaic virus. *Madras Agric. J.* 71(12): 795-798.

Chhabra, K. S. and Kooner, B. S. 1980. Sources of whitefly, *Bemisia tabaci* Genn., and yellow mosaic virus resistance in *Vigna radiata. Tropic. Grain Legume Bull.* 9:26-29

Eichelkraut, K. and Cardona, C. 1989. Biology, mass rearing and ecological aspects of the whitefly, *B. tabaci* Genn. (Homoptera: Aleyrodidae) as a pest of beans. *Turrialba.* 39(1): 55-62

Gerling, D., Horowitz, A.R. and Baumgaertner, J. 1986. Autecology of *Bemisia tabaci. Agric. Ecosys. Environ.* 17: 5-19

Gowda, C.L.L. and Kaul, A. K. 1982. Pulses in Bangladesh. Bangladesh Agricultural Research Institute, Joydebpur, Dhaka and Food & Agricultural Orgination of the United Nations. pp.154-167.

Greathead, A. H. 1986. Host plants. p. 17-25. In: M. J. W. Cock (ed.) *Bemisia tabaci* Literature Survey. C. A. B. International Institute of Biological Control, U.K.

Horowitz, A. R. 1986. Populations dynamics of *Bemisia tabaci* (Gennadius) with special emphasis on cotton fields. *Agric. Ecosys. Environ.* 17: 37-47

Jain, A. K., Yadava, H. S., and Gupta, J. C. 1995. Grain yield its components as affected by yellow mosaic virus in blackgram, *Vigna mingo* (L.) Hepper. *Tropic. Grain Legume Bull.* 16(3): 364-366

Mahmud, M. S. 2004. Performance of promising genotypes of mungbean against major insect pests. M.S. Thesis. Department of entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur. 83p.

Nath, P. D. 1994. Effect of time on the incidence of yellow mosaic virus disease and whitefly population on green gram. *Annals of Agricultural Research.* 15(2):174-177

Rajnish, K., Rizvi, S.M.A and Ali, S. 2004. Seasonal and varietal variation in the population of whitefly (*Bemisia tabaci* Genn.) and incidence of yellow mosaic virus in urd and mungbean. *Indian J. Entomol.* 66(2):155-158

Rangaraju, R. and Chenulu, V. V. 1980. A new method for counting whitefly (*Bemisia tabci* Genn.) population in mungbean *(Vigna radiata* L.). *Current Science,* 49:825-826.

Yadav, D.S., Panwar, K. S. and Singh, V.K. 1994. Management of pulse crops in sequential cropping. Indian Abstract. Proceedings of International Symposium on Pulse Research. 2-6 April, 1994, New Delhi, India. 27p.