EFFECT OF DIFFERENT DATES OF PLANTING TIME ON PREVALENCE OF *TOMATO YELLOW LEAF CURL VIRUS* AND WHITEFLY OF TOMATO

M. H. RASHID[1], I. HOSSAIN[2], A. HANNAN[3], S. A. UDDIN[4] AND M. A. HOSSAIN[5]

[1]Principal Scientific Officer, Pulses Research Centre, BARI, Ishurdi, Pabna, [2]Professor, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh, [3]Scientific Officer (Farm), RARS, BARI, Ishurdi, Pabna, [4]Lecturer (Agriculture), Shyamnagar Mohsin College, Shyamnagar, Satkhira, [5]Principal Scientific Officer, RARS, BARI, Hathazari, Chittagong, Bangladesh

Accepted for publication: December 26, 2007

ABSTRACT

Rashid M. H., Hossain I., Hannan A., Uddin S. A. and Hossain M. A. 2008. *Effect of Different Dates of Planting Time on Prevalence of Tomato Yellow Leaf Curl Virus and Whitefly of Tomato.* **J .Soil .Nature. 2(1)**: **01-06**

An experiment was conducted to detect effect of different dates of planting time on prevalence of *Tomato Yellow Leaf Curl Virus* (TYLCV) and whitefly in tomato fields in Bangladesh. The percentage of TYLCV incidence in different date of planting time (one year from mid October, 2000 to mid September, 2001) of tomato cv. BARI Tomato 4 was evaluated. The highest TYLCV incidence (%) was observed at 75 DAP during the period of March and April, 2001 planting followed by May, 2001 planting, but the lowest TYLCV incidence (%) was found in November, 2000 planting followed by December, 2000 planting. A strong correlation was obtained between the incidence of TYLCV and number of whitefly in tomato plants.

Key word: Planting time, prevalence, TYLCV, whitefly, tomato

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is a good source of vitamins (A and C) and minerals. It is one of the most widely grown vegetable crops, highly popular due to its high nutritive value, taste and versatile use in various food items as salad as well as processed products like tomato sauce, pickle, ketchup, puree, dehydrated and of whole peeled tomatoes. In Bangladesh, it is widely grown in winter and to some extent in summer season. About 15014.17 ha of land were under tomato cultivation, producing 100485 ton fresh fruits in the year 2001 (BBS, 2004). Although the total cultivated area and production of tomato in our country have increased gradually over the last few years but the productivity is still very low (6.46t ha^{-1}) compared to the average of the world yield (26.29 t ha^{-1}) as per FAO (2003). Among the factors responsible for low yield of tomato, diseases are considered to be the most serious ones. Globally tomato is susceptible to more than 200 diseases, out of which 40 are caused by viruses (Martelli and Quacquarelli, 1982; Lukyanenko, 1991). So far, 16 different viruses have been recorded on tomato in Bangladesh (Akanda, *et al*., 1991; Akanda, 1994). Among these viral diseases, *Tomato Yellow Leaf Curl Virus* (TYLCV) is considered as the most devastating one (Kalloo, 1991). TYLCV was appeared in early 1960 s as a threat to tomato cultivation due to its high prevalence resulting tremendous yield loss in different countries (Polston and Anderson, 1997). In Bangladesh, Akanda *et al*. (1991) first noted the prevalence of TYLCV. Few bench mark research on this virus have been carried out in the country (Akanada and Rahman, 1993; Alam 1995; Shih *et. al.*, 1998; Maruthi *et. al.*, 2005).

During last two decades the virus has emerged as devastating one causing economic loss of up to 100% in many tropical and subtropical regions including Bangladesh (Lukyanenko, 1991; Akanda 1994; Peterschmit *et al*. 1999, Moriones and Castillo 2000; Varma and Malathi, 2003). In many cases TYLCV epidemics lead to abandonment of the crop, particularly in seasons/periods favoring whitefly population buildup (Pico *et al.* 1996). However, thorough study on prevalence and damage of tomato due to the virus has not yet been studied in Bangladesh. Recently, TYLCV has become the prime limiting factor in tomato production in Bangladesh (Anon., 2004). For the last few years it appeared in epidemic form. As the disease caused heavy toll to tomato in many countries, development of suitable management practices is of utmost importance. Considering the importance of the above background, the present research programme was designed to know the effect of different planting times on prevalence of TYLCV and whitefly in tomato.

MATERIALS AND METHODS

An investigation was carried out at Horticulture Research Centre, Bangladesh Agricultural Research Institute (BARI), Gazipur during October 2000 to March 2001. The soil of the experimental field was sandy loam in texture having pH 6.5. The seeds were collected from Olericulture Division, HRC, BARI, Gazipur. To minimize the primary seed-borne viral pathogen of tomato, tobamoviruses (TMV, ToMV) seeds were soaked in a 10% (w/v) solution of Trisodium Phosphate (TPS) for 30 minutes and transferred them to a fresh solution of 10% TPS for two hrs and then rinsed in running tap water for 45 minutes. The variety “BARI tomato 4” was used in this experiment. Tomato seedlings were raised in a seedbed (3.0 m X 1.0 m) in the vegetable field on 16 October, 2000. Weeding, mulching and irrigation were done as and when needed. The selected land was first opened by tractor one month before planting. Several ploughings and cross ploughings followed by ladderings were done until the desired tilth

was achieved. Before final land preparation, weeds and stubbles were collected and removed from the field. Finally the plots were made ready by using spade. Urea, TSP, MP and cow dung were applied in the field @ of 450 kg, 250 kg, 150 kg and 10 ton ha^{-1}, respectively. Half of the cow dung and the entire amount of TSP were applied during the final land preparation. The remaining cow dung and one third of MP were applied during pit preparation one week before transplanting. The entire urea and rest two third of MP were applied as top dressing in 3 equal installments at 10, 25 and 40 days after transplanting. Thirty day old seedlings were transplanted in six (3.2 m X 2.65 m) plots. Plant to plant and row to row distances were maintained as 45 cm and 60 cm, respectively. Six seedlings were planted in four rows running breadth wise to get a total plant population of 24 in each plot. TYLCV symptoms were diagnosed according to the description of "Leaf curl and yellowing viruses of pepper and tomato: an overview" by Green and Kalloo (1994). When the seedling was established, the soil around the base of each seedling was pulverized. Staking was done to each growing plant by bamboo stick to keep them erect. Weeding, pruning and watering were done in the plots as and when necessary. No insecticide was applied to any of these plots under this experiment to give maximum opportunity for the increase of the whitefly population and also the disease incidence. The experimental plots were inspected to look for the appearance of leaf curl disease symptom at 15 days interval.

Five healthy as well as five diseased plants were selected randomly from each unit plot. Data on TYLCV incidence (%) was recorded at 15 days interval commencing from 30 days after planting (DAP) up to 75 DAP. TYLCV incidence (%) and gradation were done where HR (Highly Resistant) = no leaf curl symptom, R (Resistant) = 1-25% plants infected, MR (Moderately Resistant) = 26-50% plants infected, MS (Moderately Susceptible) = 51-75% plants infected, S (Susceptible) = 76-100% plants infected and ( ) = mild to moderate symptoms (Begum and Khan, 1996). Moreover, data on incidence of whitefly population, plant height (cm), fruits $plant^{-1}$, single fruit weight (g) and yield $plant^{-1}$ (kg) were recorded. Yield of fruit was recorded once in every week.

RESULTS AND DISCUSSION

TYLCV incidence (%)

The percentage of TYLCV incidence in different dates of planting time (from mid October 2000 to mid September 2001) of tomato cv. BARI Tomato 4 is presented in Table 1. The TYLCV incidence at 30 DAP ranged from 2.08 to 43.68%. The highest TYLCV incidence (%) was observed in May, 2001 planting followed by June, 2001 planting (27.04) and the lowest TYLCV incidence (%) was found in November, 2000 and September, 2001 planting (2.08) followed by August, 2001 (4.17). In case of 45 DAP, the TYLCV incidence ranged from 6.24 to 56.16%. The highest TYLCV incidence (%) was observed in February, 2001 planting followed by June, 2001 planting (47.84) and the lowest TYLCV incidence (%) was found in November, 2000 planting followed by August, 2001 planting (12.48). But in case of 60 DAP, the TYLCV incidence ranged from 25.00 to 77.00% where the highest TYLCV incidence (%) was observed in April, 2001 planting followed by March, 2001 planting (72.80) and the lowest TYLCV incidence (%) was found in October, 2000, November, 2000 and September, 2001 planting followed by December, 2000 planting 27.04. In case of 75 DAP, the TYLCV incidence ranged from 29.12 to 89.44%. The highest TYLCV incidence (%) was observed in March, and April, 2001 planting (89.44) followed by May, 2001 planting, but the lowest TYLCV incidence (%) was found in November, 2000 planting followed by December, 2000 planting (33.28).

Table 1. Effect of planting time on the incidence (%) of TYLCV of BARI tomato 4

Sl.No.	Planting time	30 DAP*	45 DAP	60 DAP	75 DAP
1.	15 October 2000	8.33	12.48	25.00	39.52
2.	15 November 2000	2.08	6.24	25.00	29.12
3.	15 December 2000	10.40	14.64	27.04	33.28
4.	15 January 2001	8.32	18.72	35.36	56.16
5.	15 February 2001	25.00	56.16	62.40	81.12
6.	15 March 2001	12.48	39.52	72.80	89.44
7.	15 April 2001	18.72	27.05	77.00	89.44
8.	15 May 2001	43.68	43.68	52.00	85.28
9.	15 June 2001	27.04	47.84	64.48	76.96
10.	15 July 2001	14.57	31.20	43.68	54.08
11.	15 August 2001	4.17	12.48	29.12	41.68
12.	15 September 2001	2.08	14.56	25.00	35.36
	LSD ($P \geq 0.05$)	10.08	9.29	12.02	5.21

*DAP = Days after planting.

Incidence of whitefly

Whitefly population was recorded from 10 randomly selected leaves at every week throughout the experimental period (Table 2). The highest incidence of whitefly population was observed in April, 2001 planting (59) followed by May (54) and June, 2001 planting (51), but the lowest incidence of whitefly population was recorded in November, 2000 planting (32) followed by October (34) and December, 2000 planting (35).

Plant height (cm)

The plant height differed significantly from one to another planting time in respect of growth and yield contributing performance under field condition (Table 2). The plant height ranged from 46.67 to 104.00 cm, while the tallest plant was found in June, 2001 planting followed by July, 2001 planting (93.67 cm). The lowest plant height (46.67 cm) was recorded in October, 2000 and September, 2001 planting followed by August, 2001 planting (50.67 cm).

Number of fruits/plant

The number of fruits plant^{-1} varied greatly among the planting time (Table 2). The range of fruit number per plant varied from 28.67 to 46.33. The highest number of fruits per plant was observed in January, 2001 planting followed by June, 2001 planting (39.00). The lowest number of fruits plant^{-1} was found in April, 2001 planting followed by March, 2001 planting (31.00).

Single fruit weight (g)

Single fruit weight differed significantly among the planting time and ranged from 27.33 to 43.33 g (Table 2). The highest single fruit weight was recorded in February, 2001 planting followed by November, 2000 planting. The lowest single fruit weight (27.33 g) was observed in October, 2000 planting followed by June, 2001 planting (29.00).

Yield (kg/plant)

The yield results are presented in Table 2. The yield varied from 2.40 to 4.23 kg plant^{-1}. The highest yield was observed in November, 2000 planting followed by December, 2000 planting (4.00 kg plant^{-1}). The lowest yield was recorded from the April, 2001 planting followed by March, 2001 (2.61 kg plant^{-1}).

Table 2. Effect of planting time on the incidence of whitefly, yield and yield contributing characters of BARI tomato 4

Sl. No.	Planting time	Average incidence of whitefly	Plant height (cm)	No. of fruits plant $^{-1}$	Single fruit wt. (g)	Yield (kg plant^{-1})
1.	15 October 2000	34	46.67	31.33	27.33	3.05
2.	15 November 2000	32	73.00	38.67	40.67	4.23
3.	15 December 2000	35	64.67	37.78	31.67	4.00
4.	15 January 2001	36	63.44	46.33	31.14	3.69
5.	15 February 2001	41	55.67	32.00	43.33	3.23
6.	15 March 2001	50	57.89	31.00	31.33	2.61
7.	15 April 2001	59	75.33	28.67	31.00	2.40
8.	15 May 2001	54	89.33	32.33	35.67	3.01
9.	15 June 2001	51	104.00	39.00	29.00	3.15
10.	15 July 2001	49	93.67	35.00	35.00	3.38
11.	15 August 2001	43	50.67	36.33	31.00	3.51
12.	15 September 2001	40	46.67	38.67	32.33	3.55
	LSD ($P \geq 0.05$)	9.56	7.89	7.015	4.965	0.23

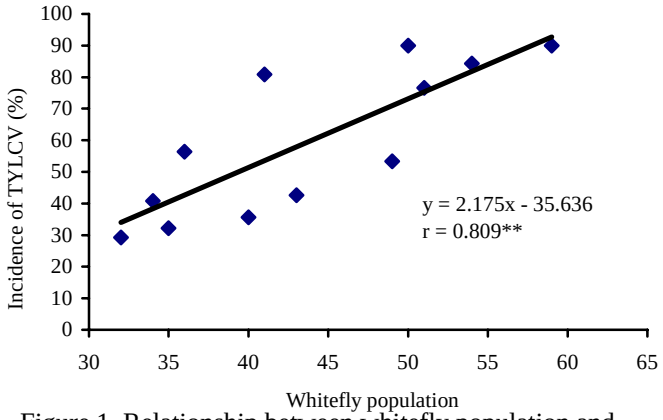

Figure 1. Relationship between whitefly population and incidence of TYLCV of BARI tomato 4

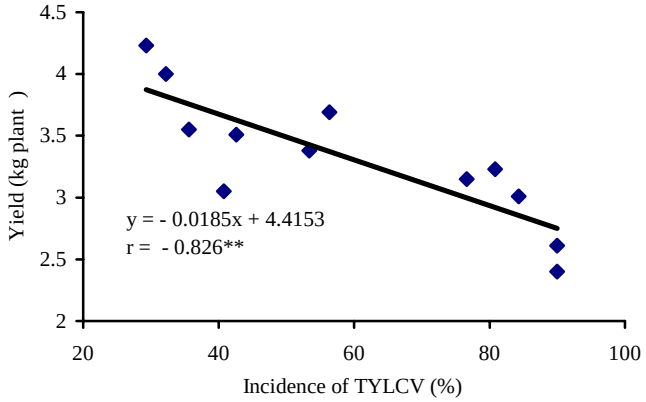

Figure 2. Relationship between incidence of TYLCV (%) and yield (kg plant^{-1}) of BARI tomato 4

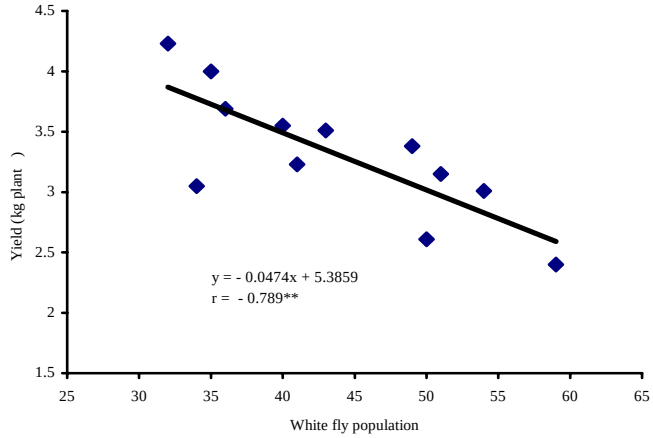

Figure 3. Relationship between white fly population and yield (kg plant^{-1}) of BARI Tomato 4

Relationship between the whitefly populations build up and % incidence of TYLCV in the tomato field

Relationship between whitefly population and % incidence of TYLCV in the field is shown in Figure 1. A strong positive correlation exists between the incidence (%) of TYLCV infection and whitefly population. It means that with the increase of whitefly population, TYLCV infection increases. A regression line was fitted between whitefly population and % incidence of TYLCV. The correlation coefficient (r) was 0.809** and the contribution of the regression (R^2 = 0.6548) indicated that 65.48% TYLCV infection increased by whitefly.

Relationship between incidence of TYLCV (%) and yield in the tomato field

A negative correlation was found between the incidence of TYLCV (%) and yield of tomato (Figure 2). It means that with the increase of incidence of TYLCV (%), yield of tomato decreased. A regression line was fitted between % incidence of TYLCV and yield of tomato. The correlation coefficient (r) was – 0.826** and the contribution of the regression (R^2 = 0.6822) indicate that 68.22% yield in tomato would be affected by TYLCV infection.

Relationship between the whitefly population and yield in the tomato field

A negative correlation was found between the whitefly population and yield of tomato (Figure 3). It means that with the increase of whitefly population, yield of tomato decreased. A regression line was fitted between whitefly population and yield of tomato. The correlation coefficient (r) was – 0.789** and the contribution of the regression (R^2 = – 0.619) indicate that 61.90% yield in tomato would be affected by whitefly.

Under the present studies, date of planting time and the season on the intensity of TYLCV disease and its relation to its vector were investigated. From June onwards the whitefly population started to decrease gradually reaching lowest population during November 2000, when there was a regular and less number of rainy days. Verma *et al.* (1989) reported that the incidence of *tomato leaf curl virus* on tomato was directly related to the population density of the vector, *B. tabaci*. The vector population developed during January when incidence of the disease also began to increase. Maximum

number of whitefly population was recorded in March to June 2001 planting though the number of whiteflies was almost minimum in October, 2000 to January, 2001 planting.

There was a difference in time of appearance of the vectors. In November, 2000 planting the whitefly population accumulated at the end of the crop growth, which resulted in the escape of the disease and low percentage of disease incidence was found. In the March to May, 2001 planting the vector population was more in the beginning of the crop itself and the percentage of disease incidence was more. The percentage of disease incidence attained its peak 89.44% in the plots planted during March and April 2001 and the lowest disease incidence (29.12%) in plots of November, 2000 planting. This indicates that if the whitefly population was more in the beginning of the crop or within a month after transplanting, the higher percentage of disease incidence and spread of the disease were noticed. Saikia and Muniyappa (1989) investigated the epidemiology and control of tomato leaf curl virus in Southern India. The incidence of TYLCV from July to November ranged from 17 to 53% and from February to May up to 100% of the crops. In sequential sowings 90-100% of plants were infected in plots sown between the end of January and the end of May. These results point out that tomato crop planted during August 2001 to September 2001 and October 2000 to December 2000 showed the lowest leaf curl disease incidence due to the lesser population of the whitefly and less infection of the disease. Higher incidence of leaf curl disease (76.96 – 89.44%) was found in the planting of February 2001 to June 2001 where the high population was also noticed. This finding is also supported by Saikia and Muniyappa (1989).

The relationship between whitefly population and incidence of TYLCV was investigated. A positive correlation between the incidence of TYLCV and whitefly population (r = 0.809**) was recorded which was supported by Saikia and Muniyappa (1989), Polizzi and Asero (1994) and Aboul *et al.* (2000). The present study also revealed the relationship between whitefly population and yield of tomato. A negative correlation (r = - 0.789**) between the whitefly population and yield of tomato was recorded which is an accordance with the findings of Gupta (2000). A negative correlation (r = - 0.826**) between the incidence of TYLCV and yield was also obtained that has also been supported by Gupta (2000).

REFERENCES

Aboul, Ata., Awad, A.E., Aziz, M.A.E., Abdel, S., Peters, D., Megahed, H. and Sabik, A. 2000. Epidemiology of tomato yellow leaf curl begomovirus in the Fayium area, Egypt. Diseases of cucurbitaceous and solanaceous vegetable crops in the Mediterranean region, Kerkyra, Greece, 11–14 October 1999. *Bulletin OEPP*. 30 (2) : 297–300

Akanda, A. M., Tsuno, K. and Wakimoto, S. 1991. Serological detection of four plant viruses in cucurbitaceous crops from Bangladesh. *Ann. Phytopath. Sco. Japan*. 57: 499–505

Akanda, A.M. 1994. Virus diseases of tomato and eggplant and their control. Lecture note for the trainers training programmes on grafting technology of tomato and eggplant. IPSA–JICA publication. IPSA. Salna, Gazipur. pp. 28–33

Akanda, A.M. and Rahman, M.L. 1993. Problems and prospects of vegetable disease management. Workshop on research and development crops. Published by IPSA–JICA–USAID. IPSA, Salna, Gazipur, pp. 76–84

Alam, N. 1995. Studies on the virus disease of tomato in Bangladesh. An M. Phil thesis submitted to the Department of Botany, Jahangirnagar University, Saver, Dhaka, pp. 54-77

Anonymous. 2004. Status of whitefly incidence and infestation in vegetable crops. IPM CRSP Annual Highlights. Year 11. 2003–2004. Office of International Research, Education and Development. 1060 Litton Reaves Hall. Virginia Tech, Blacksburg, VA 24061–0334. pp 31–32

BBS (Bangladesh Bureau of Statistics). 2004. Yearbook of Agricultural Statistics of Bangladesh. 2001. p. 107

Begum, S. N. and Khan, M. A. 1996. Tomato leaf curl virus in Bangladesh. Proceedings of the phase I final workshop of the South Asian Vegetable Research Network, Kathmandu, Nepal. pp. 210–215

FAO. 2003. FAO, Production Yearbook. Vol. 57. p. 140–141

Green, S.K. and Kalloo, G. 1994. Leaf curl and yellowing viruses of pepper and tomato: an overview. Technical Bulletin No. 21, Asian Vegetable Research and Development Center. p. 51

Gupta, N.D. 2000. Occurrence of tomato yellow leaf curl virus and tomato purple vein virus (TPVV) and their effect on growth and yield of tomato. MS thesis, Department of Plant Pathology, BSMRAU, Salna, Gazipur.p140

Kalloo, G. 1991. *Genetic improvement of tomato*. Springer verlag, Berlin Heidelberg, Germany. p. 358.

Lukyanenko, A. N. 1991. *Disease Resistance in Tomato*. In: Kalloo, G. (ed.) 1991. Genetic improvement of tomato. Springer verlag, Berlin Heidelberg, Germany. pp. 99–119

Martelli, G. P. and Quacquarelli, A. 1982. The present status of tomato and pepper viruses. *Acta Horti.* 127: 39–64

Maruthi , M. N., Alam , S. N., Kader, K. A., Rekha , A. R., Cork , A. and Colvin Molecular J. 2005. Diversity of Begomoviruses Causing Tomato Leaf Curl Disease in Bangladesh. 2nd Joint Conference of the International Working Groups on Legume (IWGLV) and Vegetable Viruses (IWGVV). April 10–14, 2005, Fort Lauderdale, Florida USA. p.24

Moriones, E. and Castillo, J.W. 2000. Tomato yellow leaf curl virus, an emerging virus complex causing epidemics worldwide. Special Issue: Plant Virus Epidemiology: challenges for the twenty–first century, Almeria, Spain, 11–16 April 1999. *Virus Res.* 71 (1–2): 123–134

Peterschmit, M., Granier, M., Mekdoud, R., Dalmon, A., Gambin, O., Vayssieres, J.F. and Reynaud, B. 1999. First report of tomato yellow leaf curl virus in Reunion Island. *Plant Dis.* 83 (3): 303

Pico, B., Diez, M.J. and Nuez, F. 1996. Viral diseases causing the greatest economic losses to the tomato crop. II. The tomato yellow leaf curl virus – a review. *Scientia Horticulturae*. 67 (3–4): 151–196

Polizzi, G. and Asero, C. 1994. Epidemiology and incidence of tomato yellow leaf curl virus (TYLCV) in greenhouse protected by screens in Italy. Second symposium on protected cultivation of Solanacea in mild winter climates, Adana, Turkey, 13–16 April 1993 [edited by Cockshull, K. E.; Tuzel, Y.; Gul, A.]. *Acta Horticulturae.* 366: 345–352

Polston, J.E. and Anderson, P.K. 1997. The emergence of whitefly, transmitted geminiviruses in tomato in Western Hemisphere. *Plant Dis*. 12: 1358–1369

Saikia, A.K. and Muniyappa, V. 1989. Epidemiology and control of tomato leaf curl virus in Southern India. Trop. Agric. (United Kingdom). 66(4): 350–354

Shih, S.L., Tsai, W.S., Nakhla, M.K., Maxwell, D.P., Rashid, M.H. and Green, S.K. 1998. Molecular comparison of two tomato yellow leaf curl viruses from Bangladesh. *Plant Prot. Bull.* (Taiwan, ROC). 40(4): 436–437

Varma, A. and Malathi, V.G. 2003. Emerging geminivirus problem: A serious threat to crop production. *Ann. Appl. Biol.* 142 (2): 145-164

Verma, A. K., Basu, D., Nath, P. S., Das, S., Ghatak, S. S. and Mukhopadhyay, S. 1989. Relationship between the populations of whitefly, *Bemisia tabaci* Genn. (Homoptera: Aleyrodidae) and the incidence of tomato leaf–curl virus disease. *Indian J. Mycological Res*. 27 (1): 49–52