Agricultural Sciences, 1 (1996) 13-16

Evaluation of Insecticides and Agril Polyester Cover against Whitefly (*Bemisia Tabaci* Gennadius) in Tomato Crops

K.M. Azam*, A. Zouba, S.A. Razvi and A.A. Al-Raeesi

Department Plant Sciences, College of Agriculture, Sultan Qaboos University, P.O.Box 34, Al-Khod 123, Sultanate of Oman.

خلاصة : أجريت دراسات حقلية لمدة عامين على محصول الطماطم لتقييم فعالية ست مبيدات حشرية وهي: ترايزوفس، فوسفاميدون، دايميثويت، ببروفيزين وأفلكس (إندوسلفان + دايميثويت) كل بتركيز ٠,٠٥٪ والربلين (مبيد ناتج نباتي) بتركيز ١٪ مع معامل فلاحي بتغطية النباتات بالأقريل (مادة من البوليستر) لمكافحة الذبابة البيضاء(بيمسيا تباسي). استعملت المبيدات ثمان مرات على فترات أسبوعية بعد نقل الغرس مباشرة. وتم تسجيل أعداد بيض الذبابة البيضاء وأعداد العذارى، ونسبة الإصابة بعدوى فيروس تجعد الأوراق أسبوعيا على مدى الأسابيع الثمانية في كل المعاملات بما فيها التجربة الحاكمة غير المعاملة. وكانت معدلات الذبابة البيضاء أكبر في السنة الثانية (٩٢/ ١٩٩٣) عند مقارنتها بالسنة الأولى وبين كل المعاملات سجلت التغطية بالأقريل، وهي نظام فلاحي حديث أقل معدلات للذبابة البيضاء والإصابة بفيروس تجعد الأوراق. وكان متوسط أعداد البيض ٠,٠ و ٥,٤٧ والعذارى ٠,٥٤ و ٠,٥٨ بكل ١٠ وريقات، بينما بلغت الإصابة بفيروس تجعد الأوراق ٤,٣٢ و ٤,٧٦ في معاملة التغطية بالأقريل خلال السنوات الأولى والثانية على التوالي. ومن بين المبيدات الحشرية المختبرة سجل مبيد الأفلكس فقط أقل الإصابات بالآفة حيث بلغت ٣,٤٦ و ٣٠,٤ بيضة لكل ١٠ وريقات و٠,٩٤ و ٥,٣٤ عذراء لكل ١٠ وريقات خلال عامي الدراسة على التوالي. وبقية المبيدات الحشرية كانت أقل فاعلية في تقليل الإصابة بالآفة والمرض. ولقد سجل المحصول تحت غطاء الأقريل أكبر إنتاجية حيث بلغت ٣٤,٥٧ و ٢٦,١٥ طن/هكتار طماطم مقارنة مع ١٦,٤٨ و ١٠,٨٢ طن/هكتار للتجربة الحاكمة في السنوات الأولى والثانية على التوالي.

ABSTRACT: Field experiments were conducted on tomato crops over a two year period to evaluate the efficacy of six insecticides, viz., triazophos, phosphamidon, dimethoate, buprofezin and Aflix (endosulfan + dimethoate) each at 0.05% and Repelin (plant product insecticide) at 1% concentration along with a cultural treatment by covering the plants with Agril (a polyester material) for the control of whitefly, *Bemisia tabaci*. The insecticides were applied eight times at weekly interval immediately after transplantation. The whitefly eggs, nymphal population counts and the per cent incidence of tomato leaf curl virus (TLCV) were recorded every week for eight weeks in all the treatments including untreated control. The incidence of whitefly was more severe in the second year (i.e.1992-93) as compared to the previous season. Among the various treatments, the Agril cover, a newly introduced cultural practice, recorded the least incidence of whitefly and of TLCV. The average counts of eggs were 0.0 and 5.47 and of nymphs 0.54 and 0.58 per 10 leaflets and TLCV were 4.32 % and 4.76 % in Agril cover treatment during the first and second year, respectively. Among the insecticides tested only Aflix recorded less incidence of the pest, being 3.46 and 30.4 eggs per 10 leaflets and 0.94 and 5.34 nymphs per 10 leaflets during the two years of study, respectively. The other treatments were less effective in reducing pest and disease incidence. The crop under Agril- cover recorded the maximum yield of 34.57 and 26.15 t/ha of tomatoes as compared to 16.48 and 10.82 t/ha in control during the first and second year, respectively.

Tomato (*Lycopersicum esculentum)* is one of the most important vegetable crops. It is widely attacked by whitefly, *Bemisia tabaci* Genn. (Homoptera: Aleyrodidae). This polyphagous insect, having at least 500 host plants (Greathead, 1986) is one of the most noxious insects attacking the vegetables in field and green houses.

Whiteflies are minute, usually inconspicuous but extremely injurious. In Oman it caused extensive damage to vegetable crops resulting in heavy losses in yield. Larval instars as well as adults feed voraciously on the plant sap and when present in sufficient numbers cause leaf drop and prohibit the maturing of fruits (Pollard, 1955) . Whiteflies produce sticky honey dew (excreta) which serves as a substrate for the development of black fungus, which prohibits normal respiration of leaves and renders plants and fruits unsightly (Perkins, 1983). In addition to their pest status, whiteflies play a major role in transmission and dissemination of tomato leaf curl virus (TLVC) which causes severe leaf curl, shortening of leaves and stunting of plant growth (Muniyappa, 1980; Dhanju and Verma, 1986).

In the Sultanate of Oman, where the whitefly *B. tabaci* is prevalent all along the year, a survey made by the Ministry of Agriculture revealed that more than 25 different hosts are suspected to be infected by whitefly transmitted gemini viruses (Moghal *et. al.*, 1993).

No strategy for control of whitefly transmitted viruses was proved effective in practice. Whiteflies are difficult to control with insecticides and often become resistant to them. Indiscriminate use of pesticides by the

* Corresponding Author.

TABLE 1

Whitefly population (eggs and nymphs), virus incidence and fruit yield in different insecticidal and cultural treatments.

Treatment	Dosage %	Eggs per 10 leaflets		Nymphs per 10 leaflets		TLCV %		Yield (t/ha)	
		1991-92	1992-93	1991-92	1992-93	1991-92	1992-93	1991-92	1992-93
Hostathion 40 EC (triazophos)	0.05	4.66	83.20	7.60	10.14	74.83 (62.91)	68.98 (61.55)	22.89	12.25
Applaud 25 WP (buprofezin)	0.05	5.46	61.33	5.20	10.94	62.96 (52.69)	79.37 (67.48)	20.94	10.54
Dimecron 50 EC (phosphamidon)	0.05	6.94	59.49	8.66	23.06	90.42 (75.82)	76.55 (62.09)	13.49	14.85
Aflix 50 EC (endosulfan + dimethoate)	0.05	3.46	30.40	0.94	5.34	28.88 (32.30)	58.33 (50.00)	32.95	18.66
Rogor 40 EC (dimethoate)	0.05	7.06	66.00	7.60	12.00	60.00 (51.57)	73.34 (60.44)	25.08	9.86
Repelin 100 EC (botanical insecticide)	1.00	4.26	86.40	6.66	13.34	86.16 (71.99)	90.47 (73.93)	18.24	14.10
Agril (polyster cover)	---	0.00	5.47	0.54	0.58	4.32 (11.96)	4.76 (7.41)	34.57	26.15
Control	---	9.74	115.07	7.46	22.94	77.53 (66.49)	88.48 (75.26)	16.48	10.82
	$CD_{.05}$	3.70	38.08	4.60	8.06	(26.46)	(31.28)	11.99	3.19

Figures in the parentheses are angular transformed values

farmers to control this pest is leading to more resurgence of the pest. Even when it is possible to achieve acceptable control of the whitefly as a pest, this is not enough to prevent large dissemination of the virus. Keeping this in view , the objective of this study was to evaluate usefulness of insecticides and Agril cover in the control of whitefly and TLCV, specifically on tomato crops in the Sultanate of Oman.

Materials and Methods

Tomato seedlings (variety Ace 55) were grown in a greenhouse and covered with Agril, a polyester material (a non-woven sheet made of continuous heat sealed fibres without the use of chemical binder) manufactured by M/S Gromax, Battisford, U.K., to prevent whitefly infestation. One month old seedlings were transplanted into the main field in 9 x 3 m^2 plots by maintaining a spacing of 150 cm between rows and 50 cm between plants. The crop was grown following recommended agronomic practices. The experiments were conducted in a randomized block design (R.B.D.), with eight treatments, replicated thrice. The study was conducted at the Agricultural Experiment Station, Sultan Qaboos University, Sultanate of Oman, for two successive years during 1991-92 and 1992-93.

The treatments comprised six insecticides, viz., triazophos (Hoechst Co., Germany), phosphamidon (Ciba - Geigy, Switzerland), dimethoate (American Cyanamid, USA), buprofezin (Nichon Nohyaku, Japan) and Aflix (Hoechst, Germany) each applied at 0.05% and Repelin a plant product insecticide containing Neem *Azadriachta indica*, Karanjia *Pongamia glabra* and Mahua *Madhuca indica* (Indian Tobacco Co. Ltd., India) at 1.0% concentration; one cultural method where the plants were covered with Agril and one untreated control. The insecticides were applied, at the recommended dosages, for eight times at weekly intervals starting immediately after transplantation. The Agril cover was removed 60 days of transplantation, as further covering would lead to more vegetative growth and may reduce the yield.

Whitefly eggs and nymphal population counts were recorded by observing ten grown up terminal leaflets selected at random from the middle stratum of ten plants at the rate of one leaflet per plant. The observations were recorded at weekly intervals for a period of eight weeks starting one week after transplantation. The average number of eggs and nymphal population per 10 leaflets were calculated. The number of plants with typical symptoms of TLCV were also counted at weekly intervals and expressed on percentage basis. These values were transformed into angular transformation for statistical analysis. Tomato yield was recorded at each picking and the total yield of all pickings for each treatment was determined and

expressed in tons per hectare. The data were subjected to analysis of variance.

Results and Discussion

Among the various treatments, the use of Agril to cover the plants gave the maximum protection from whitefly. During the first year the average egg count number was nil while the nymphal count was 0.54 per 10 leaflets (Table 1) when compared to insecticidal treatments viz., Aflix (3.46 eggs and 0.94 nymphs), Repelin (4.26 eggs and 6.66 nymphs), triazophos (4.66 eggs and 7.60 nymphs), dimethoate (7.06 eggs and 7.60 nymphs), phosphamidon (6.94 eggs and 8.66 nymphs) and buprofezin (5.46 eggs and 5.20 nymphs). The counts in the control plot were 9.74 eggs and 7.46 nymphs / 10 leaflets.

During the second year (i.e. 1992-93) the incidence of whitefly was higher than the previous year. The egg and nymph counts in the control were 115.07 and 22.94 per 10 leaflets, respectively (Table 1). The incidence in Agril was lowest, being 5.47 eggs and 0.58 nymphs per 10 leaflets, respectively, but was at par with Aflix where the egg and nymph counts were 30.4 and 5.34, respectively. In buprofezin, phosphamidon and dimethoate the egg counts were 61.33, 59.47 and 66.00 per 10 leaflets, respectively and were significantly superior over control. However, in triazophos and Repelin the egg counts were high being 83.2 and 86.40 per 10 leaflets, respectively and were at par with the control, suggesting that they are not effective against adult whitefly. With regard to the nymphal counts, all the treatments except phosphamidon (23.06 nymphs/10 leaflets) were significantly superior over control. The nymphal counts in triazophos, buprofezin, dimethoate and Repelin were 10.14, 10.94, 12.00 and 13.34 per 10 leaflets, respectively .

The results of the two years study clearly indicate (Figure 1) that Agril acts as a physical barrier against the whitefly and gives maximum protection to the crop. Effective control of whitefly has also been reported by using a spun bonded polyethylene cover (Weeb and Linda, 1992) and a non-agricultural nylon net and Agronet-S™ (Rivas Platero,1994).

Agril cover treatment had the lowest TLCV incidence at 4.32% and 4.76%, respectively in the two years of the study. During first year the TLCV incidence in Aflix treated tomatoes was the lowest (28.88 %) as compared to the other insecticidal treatments. Dimethoate, buprofezin, triazophos, Repelin and phosphamidon recorded high TLCV infection of 60.00, 62.96, 74.83, 86.16 and 90.42 per cent, respectively and were not significantly different from the control (77.53%). During second year, the

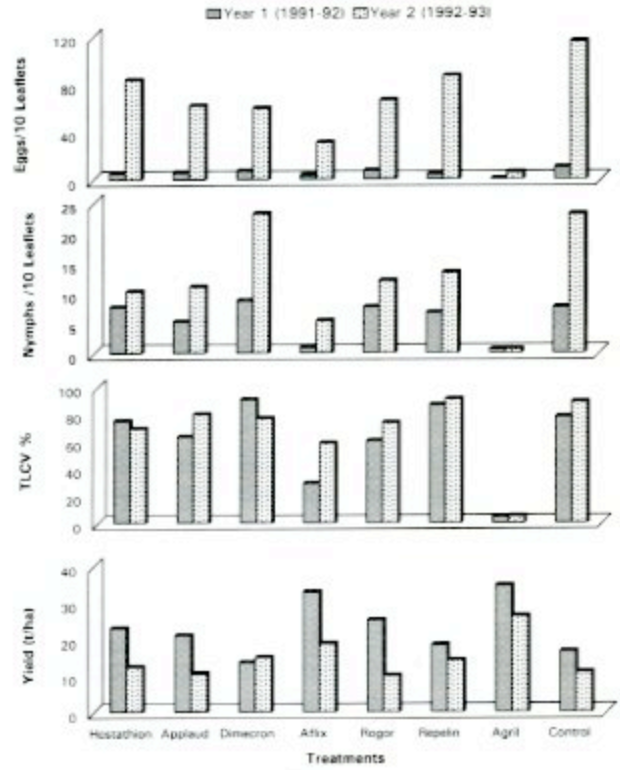

Figure 1. Whitefly population (eggs and nymphs) virus incidence (TLCV) and fruit yield in different insecticidal and cultural treatments.

disease in most of the insecticide treatments was high. The incidence in plots treated with Aflix, triazophos, dimethoate, phosphamidon, buprofezin and Repelin was 58.33, 68.98, 73.34, 76.55, 79.37, and 90.47 per cent, respectively and was at par with control (88.48%).

With regard to the yield it was found that among the various treatments during the first year, the highest yield (34.57 t/ha) was recorded from the plots covered with Agril (Table 1). Among the insecticides, Aflix recorded a significantly higher yield of 32.95 t/ha and was at par with Agril. The yields in plots treated with dimethoate, triazophos, buprofezin, Repelin and phosphamidon were 25.08, 22.89, 20.94, 18.24 and 13.49 t/ha, respectively and were not significantly different from control (16.48 t/ha).

During second year the incidence of whitefly was very severe and as a result the yields were low when compared to the previous year. The highest yield of 26.15 t/ha was recorded in Agril covered plots followed by Aflix (18.66 t/ha). The lowest yield of 9.86 t/ha was recorded in dimethoate treated plots followed by buprofezin (10.54 t/ha), triazophos (12.25 t/ha), Repelin (14.10 t/ha) and phosphamidon (14.85 t/ha) and were at par with the control where the yield was 10.82 t/ha .

Results using the different insecticides indicated that chemical control at its best can only provide partial control of TLCV. The possible reason for this is that

the pest might have developed resistance to these insecticides. There are a number of reports suggesting that insecticides like cypermethrin and monocrotophos failed to control whitefly, leading to an increase in numbers (Shelka *et. al.* 1987). The whitefly population increased in treatments where the cotton crop was treated with cypermethrin, monocrotophos, phorate and phosphamidon (Purohit and Deshpande, 1991). Similarly, Abdullah (1991) reported the presence of insecticide resistant strains of whitefly of cotton in Egypt. Natrajan and Sundaramurthy (1990) showed that monocrotophos 0.08% failed to control the whitefly population. Nair (1981) reported that dimethoate did not control the whitefly population in cassava and Ahmed *et. al.* (1987) found the presence of a whitefly resistant strain to dimethoate in Sudan. Dithrich *et. al.* (1990) also reported the presence of whitefly resistant strain in Sudan, Turkey, Gauthemala and Nicaragua against monocrotophos, cypermethrin and carbofuran. Results of these experiments showed that row cover using Agril to prevent whitefly from reaching the crop significantly, reduced the TLCV incidence and increased the fruit yield. However, the economic use of this practice needs to be investigated.

Conclusions

The results of the experiments revealed that, among the various treatments, the use of a polyester sheet to cover the crop soon after transplantation for 60 days gave maximum protection against whitefly and TLCV. This form of protection recorded the highest yield. Among the insecticides evaluated, Aflix 0.05% sprayed at weekly intervals immediately after transplantation for eight weeks gave partial control of whitefly and TLCV and recorded significantly higher yield over the control. The other insecticides tested viz., triazophos, phosphamidon, dimethoate, buprofezin, and Repelin were found to be less effective.

References

Abdullah, M.D. 1991. A general view of the resistance problem of cotton pest in Egypt. Resistant Pest Management 3 (2) : 22-25.

Ahmed, A.H.M., E.A.Elhag and N.H.H.Bashir 1987. Insecticide resistance in the cotton resistance in the cotton whitefly (*Bemisia tabaci* Genn.) in the Sudan Gezira. Tropical Pest Management 33 (1) : 67-72.

Dhanju, K.S. and J.P. Verma 1986. Natural occurrence of mixed infection of tomato leaf curl virus and tomato mosaic virus in tomato. Indian Journal Virology 1 :108 - 110.

Dithrich, V., G.H. Ernst, O. Ruesch and, S, Uk. 1990. Resistance mechanisms in sweet potato whitefly (Homoptera:Aleyrodidae) populations from Sudan, Turkey, Guatemala and Nicaragua. Journal of Economic Entomology 83 (5) : 1665-1670.

Greathead, A.H., 1986. Host plants . P. 17-25. In : M.J.W. Cock ed. *Bemisia tabaci* - a literature survey on cotton whitefly with an annotated bibliography. C.A.B. Int. Inst. Bio. Control. London.

Moghal, S.M., P. Shivanthan , A. Mani, Abdullah Dawood Al-Zidgali, Talal Sumar Al-Zidgali and Yousuf Mohammed Al-Raeesi, 1993. Status of pests and diseases in Oman. Directorate General of Agricultural Research, Agricultural Research Centre, Rumais, Document No. 6/93/22, First Edition . 99-132.

Munnyappa, V. 1980. Whiteflies. In: Vectors of Plant Pathogens. K.F. Harris and K. Maramorasch (Editors). 39-85. Academic Press, New York.

Nair,N.G. 1981. Relationship between cassava mosaic disease spread and whitefly (*Bemisia tabaci* Gen.) population under different insecticide treatments. Journal of Root Crops 7 (1-2): 15-19.

Natrajan, K. and V.T. Sundarmurthy. 1990. Effect of neem oil on cotton whitefly *(Bemisia tabaci)*. Indian Journal of Agricultural Sciences 60 (40) : 290-291.

Perkins, H.H. 1983. Identifications of processing of honey dew-contaminated cottons. Textile Research Journal : 508-512.

Pollard, D.G. 1955. Feeding habits of the cotton whitefly, *Bemisia tabaci* Genn. (Homoptera : Aleyrodidae). Annals of Applied Biology 3 : 664-671.

Purohit, M.S. and A.D. Deshpande. 1991. Effect of inorganic fertilizers and insecticides on population density of cotton whitefly *(Bemisia tabaci)*. Indian Journal of Agricultural Sciences 61 (9) : 696-698.

Rivas Platero, G.G., R. Lastra and L. Hilje, 1994. A delay in the virus disease transmitted by *Bemisia tabaci* (Gennadius) in tomato by protection of seedbeds. Manego Integrado de plagas No. 31, 12-16.

Shelka, S.S., A.R. Mali and D.S. Ajri. 1987. Effect of different schules of insecticidal sprays on pest incidence, yield of seed cotton and quality of seed in Laxmi cotton. Current Research Reporter, Mahatma Phule Agricultural University 3 (2) : 39-45.

Weeb, S.E., and S.B. Linda, 1992. Evaluation of spunbound polyethylene row covers as a method of excluding insects and viruses affecting Fall- grown squash in Florida. Journal of Economic Entomology. 85 (6) : 2344-2352.

Published with the approval of the College of Agriculture, S.Q.U., as paper number 210695.