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Effect of Caraway, Coriander and Aniseed on the Level of Tomato Yellow Leaf Curl Virus Disease and Tomato Yield

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Abstract: *Some medicinal plants i.e. caraway, coriander and aniseed were inter – cropped with the tomato varieties (Omdurman and Peto86) to reduce the whitefly population and the consequent pathogen infection. The experiments were conducted in the field of University of Gezira, during winter and summer of 2000.*
The results indicated that during both seasons, highly significant differences ($p < 0.01$) were found in the percentage level of TYLC infection between treatments, between the two tomato varieties and between the three sampling dates. Results also showed that the variety Omdurman was significantly exhibiting low incidences of TYLC infection within all treatments at the different dates of count throughout both growing seasons, compared to peto86.The intensity of the disease once appeared, progressively increased with the advent of the growing season.
Significantly higher yields were obtained by the variety Omdurman in the coriander and aniseed treatments (4361.660 and 4266.670 kg/ha, respectively). Although the lowest yield of both varieties were obtained from control treatment (200 kg/ha), but that was not significantly different from the yield obtained from the caraway treatment (128.6 kg/ha). Caraway appeared to be more competitive than the others.

INTRODUCTION

Tomato, *lycopersicon esculentum* Miller, is ranked as the most important vegetable crop in the Sudan (Yassin,1994 a,b; Ahmed, 1995). More than a hundred different pest species have been recorded on tomato crops (Talekar *et al*, 1983) . The whitefly, *Bemisia tabaci* and the disease, tomato yellow leaf curl virus (TYLCV) are major limiting factors in tomato production and losses are paramount. TYLCV may result in more quantitative yield reduction (Yassin, 1994a, b and Ahmed, 1995).

Tomato growers resort to extensive use of pesticides, mainly insecticides, to control *B. tabaci* and hence TYLCV in the absence of other control measures. ElZorgani and Abbadi (1978) recorded that large-scale usage of pesticides has become a source of great concern because of their possible effects on human health and on non-target components of the environment. Residues of pesticides were detected in human blood, soil, food, air and water. The presence of these substances constitutes certain risks to human health and increasing efforts therefore have been primarily directed towards minimizing the amount of residues in the environment. Besides, the frequent application of insecticides caused a high selection pressure, which may accelerate development of pest resistance to pesticides.

Obviously the research needed is to find alternative methods of control, complementary and not antagonistic to chemical control. IPM options are based on prophylactic methods such as using proper cultural practices, soil solarization, optimal fertilizer rates, inter-cropping, proper irrigation frequencies, replacement of preventive spraying with curative sprayings after pests are observed on crop, heat tolerant and TYLCV resistant varieties (Abdelrahman *et al*, 1992).

In the Sudan, the search for suitable plant species to be inter-planted with tomato to keep away the whitefly, and there by check the spread of TYLCV dominates inter-cropping research work
(Mohamed, 1994).

The present work aimed at studying the efficacy of inter-cropping three plant species. i.e. Coriander (*Coriandrum sativum*) , Aniseed (*pimpinella anisum*) and caraway (*Carum carvi*), within tomato field to divert whitefly away from the crop to minimize the TYLCV in the field without the need for heavy use of pesticides.

MATERIALS AND METHODS

The importance of some medicinal and aromatic plants inter-planted with tomato as repellents of the white fly (*Bemisia tabaci* Genn.), was investigated. From the family Umbelliferae, coriander (*Coriandrum sativum*), caraway (*Carum carvi*) and aniseed (*Pimpinella anisum*) inter-cropped with each of two commercial varieties of tomato (i.e. Omdurman and peto86) were used in this experiment during both winter and summer production seasons of the yeas 2000. In each season an area of ca 880 m2 (0.088 hectar) was reserved at the University of Gezira experimental farm, Wad Medani (14° 24" N, 33° 39" E, 407 meter above sea level). Each area was prepared according to the recommended land preparation method adopted for proper tomato production. Then each area was divided into

40 mustabas (wide ridge, 6 m long and I m wide). The distance between the mustabas was about 1 m.

Treatments and cultural practices:

The following four treatments were included in each test:

1- Caraway inter-cropped with tomato.
2- Coriander inter-cropped with tomato.
3- Aniseed inter-cropped with tomato.
4- Control (tomato only).

Each tomato variety in each treatment was represented by one mustaba. Caraway, Aniseed and Coriander were sown first on lines at both edges along the treatment mustaba. After 10 days 2-5 seed of tomato were deposited per hole at a distance of 30 cm between holes in two rows in the middle of each mustaba, After germination seedlings were thinned to 2-3 plants/hole. All other cultural practices were carried out as recommended for tomato production . Each experiment was arranged in a randomized complete block design (RCBD) with 5 replications for each treatment and each variety.

Estimation of the infection by tomato yellow leaf curl virus (TYLCV):

Immediately following the appearance of TYLC symptoms estimation of the severity of the disease on each tomato variety in each treatment was carried out. Out of the total number of plants in each mustaba the percentage number of TYLC infected plants was recorded. This was carried out three time at intervals of 15 days between estimates (i.e. till plants dried).

Data analysis:

Data collected was subjected to the appropriate transformation. The TYLC data was transformed using the *arc* sin e √ percentage method (Gomez and Gomez, 1984) The transformed data was then analyzed using analysis of variance and the means were subjected to comparison using the least significantly difference (LSD) and Duncan multiple range test (DMRT). The final results were given in tabular.

RESULTS AND DISCUSSION

Assessment of the percentage level of TYLC infection:

Immediately following the first appearance of the TYLC symptoms an estimation of the percentage level of infection was carried out three times at two weeks intervals. During winter season highly significant differences ($p < 0.01$) were found in the % level of TYLC infection between the two tomato varieties, between treatment and between the three sampling dates (Table 1). Results in Table 9 clearly indicated the progressive increase in percentage level of TYLC infection as the season progressed. Also these results showed that the variety Omdurman significantly suffered low incidences of TYLC infection throughout the growing season compared to peto86. The same picture is repeated during the summer season as seen in Table 2 where highly significant differences in percentage level of TYLC infection were also indicated between the varieties, between the treatments and between the sampling dates. However, during this season extremely high levels of TYLC infection particularly towards the end of the growing season, were exhibited on peto86 compared to Omdurman. From both seasons, Omdurman variety showed lower symptoms compared to peto86 in all treatments at different dates of count. This may reflect that Omdurman is possessing some degree of resistance to TYLC. In table 3, superiority of Omdurman over peto86 was clearly shown throughout all treatment during the two seasons and therefore most of the significant variation in the level of TYLC indicated between seasons and / or treatment could be attributed to the variety

Table 1.Effect of inter-cropping caraway, coriander and aniseed on percentage level of TYLC infection on two tomato varieties (Winter 2000).

Data	Variety	% level of TYLC infection			
		Treatments			
		Caraway	Coriander	Aniseed	Control
20.2.2000	Omd.	14.939	15.422	16.336	21.166
	Peto86	17.067	19.226	18.476	55.988
4.3.	Omd.	28.721	29.775	32.819	37.813
	Peto86	36.607	38.641	38.139	52.098
18.3.	Omd.	38.379	37.230	39.486	39.486
	Peto86	41.706	43.760	44.151	58.635
SE± = 1.7084					

* Means were calculated from transformed data.

Table2. Effect of inter-cropping caraway, coriander and aniseed on percentage level of TYLC infection on two tomato varieties (Summer 2000).

Data	Variety	% level of TYLC infection			
		Treatments			
		Caraway	Coriander	Aniseed	Control
12.5.2000	Omd.	17.315	9.146	16.446	23.411

	Peto86	22.438	16.946	22.681	26.639
24.5.	Omd.	29.431	32.102	34.786	32.403
	Peto86	34.464	33.976	40.796	42.527
6.6.	Omd.	57.250	42.685	47.630	58.582
	Peto86	69.088	68.562	74.126	71.782
SE± 3.1656					

* Means were calculated from transformed data.

Table 3. Mean percentage level of TYLC infection on tomato during each of the growing seasons (Winter and Summer 2000) .

Treatments	% level of TYLC *	
	Winter	Summer
1- Caraway	29.57 c	38.33 b
2- Coriander	30.68 bc	33.90 c
3- Aniseed	31.58 b	39.41 ab
4- Control	41.00 a	42.56 a
SE±	0.6975	1.2923

* Means were calculated from the transformed data.

- Means followed by different letter (s) are significantly different (LSD).

In tables 4, 5 in comparison to the control treatment during each sampling date, the other treatments showed significantly low level of TYLC infection. However. Within each treatment significant differences as indicated before, were found between sampling dates in the level of TYLC infection.

From these results it could be indicated that when coriander is inter-cropped with tomato it could possibly substitute the insecticides in reducing the number of whitefly.

Also, coriander appeared to be less competitive with the tomato crop i.e. has no effects on tomato growth. This is added to the fact that coriander is a cheap and a popular crop used in local foods. For all these reasons coriander could be inter-cropped with tomato to achieve the ultimate goals. In contrast, caraway and aniseed were less popular crops, expensive and that caraway is highly competitive and may retard tomato growth.

An overall assessment of percentage level of TYLC, taking into considerations the seasonal, varietal and time of sampling, was presented in Table 6. Highly significant differences in TYLC level of infection were indicated between summer and winter season, between Omdurman and peto86 varieties, between the four treatments and between the three sampling dates. As the varieties and the treatments were the most important variables this data was further partitioned and analyzed as presented in Table 7 and 8. Regardless of the season. Significantly low infection by TYLC was inflicted on Omdurman than on the peto86 variety (Table 7). Table7 also showed that the incidence of TYLC on peto86 and / or Omdurman during winter was significantly lower than the disease intensity occurring during summer on either of the two varieties. On the other hand, Table 8 indicated that the three crops inter-cropped with tomato in this experiment have resulted in significant reduction in the incidence of TYLC infection on tomato, to a greater extent during winter than during summer season. The three treatments, however, were not significantly different in this regard but each of them during any part of the season is significantly different from the control treatment.

Table 4. Effect of inter-cropping caraway , coriander and aniseed with tomato on level of infection by TYLC at different dates (winter 2000).

Date	%level of TYLC infection			
	Treatments			
	Caraway	Coriander	Aniseed	Control
20.2.2000	16.00 f	17.32 f	17.43 f	23.58 e
4.3.	32.66 d	34.21 d	35.46 d	44.96 b
18.3.	40.04 c	40.50 c	41.82 bc	54.48 b
SE± 1.2080				

* Means were calculated from the transformed data.

- Values followed by different letter (s) are significantly different.

Table 5. Effect of inter-cropping caraway , coriander and aniseed with tomato on level of infection by TYLC at different dates
(winter 2000).

Date	%level of TYLC infection			
	Treatments			
	Caraway	Coriander	Aniseed	Control
12.5.2000	19.876	13.046	19.565	25.025
24.5.	31.947	33.039	37.789	37.465
6.6.	63.169	55.623	60.88	65.183
SE± 2.2384				

- Means were calculated from transformed data.

Table 6. percentage level of TYLC infection at three stages of two tomato varieties during winter and summer 2000.

Season	Variety	% level of TYLC infection		
		Date		
		1st	2nd	3rd
Winter	Omd.	16.978 c	32.282 e	41.379 d
	Peto86	20.189 fc	41.371 d	47.038 c
Summer	Omd.	16.581 c	32.180 e	51.537 b
	Peto86	22.176 f	37.940 d	70.890 a
SE± 1.2683				

* Means were calculated from the transformed data.
- Values followed by the different letter (s) are significantly different (DMRT).

Table 7. percentage levels of TYLC infection on two tomato varieties during winter and summer seasons 2000.

Variety	% level of TYLC infection	
	Seasons	
	Winter	Summer
Omdurman	30.213 d	33.433 c
Peto86	36.199 b	43.668 a
SE± 0.7322		

*Means were calculated from the transformed data.
- Values followed by the different letter (s) are significantly different (LSD).

Table 8. Effect of inter-cropping caraway, coriander and aniseed with tomato on percentage level of TYLC infection during winter and summer 2000.

Season	% level of TYLC infection			
	Treatments			
	Caraway	Coriander	Aniseed	Control
Winter	29.570 d	30.676 d	31.576 cd	41.004 ab
Summer	38.331 b	33.903 c	39.411 b	42.558 a
SE± 1.0355				

* Means were calculated from the transformed data.
- Values followed by different letter (s) are significantly different (DMRT).

Assessment of tomato yield:

Only two picks were carried out to estimate the yield (kg /ha) of tomato in each treatment. The data summarized in Table 9 indicated highly Significant differences in yield between the varieties (Omdurman and Peto86) and between the four treatments (caraway, coriander, aniseed and control) as well as between the picks.

The actual influence of treatments on yield of the two tomato varieties during the winter season was presented in Table 10.The significantly higher yields were obtained by the variety Omdurman in the coriander and aniseed treatments (4361.660 and 4266.670 kg/ha, respectively). Although the lowest yield of both varieties were obtained from control treatment (200 kg/ha), but that was not significantly different from the yield obtained from the caraway treatment (128.6 kg/ha). This indicated that coriander and aniseed offered les competition with tomato compared to caraway.

Therefore, inter-cropping with tomato during winter does not seem to improve the yield of tomato of the two varieties as compared to the control treatment particularly in the case of Omdurman where the total yield was extremely low (128.9 kg /ha) compared to the control treatment (200.000 kg /ha). On the other hand, coriander inter-cropping has resulted in significantly higher yield for both varieties (4361.7 kg /ha for Omdurman and 3351.7 kg /ha for Peto 86) compared to only 200 kg /ha and 326.7 kg /ha for the control treatment of the two varieties respectively.

Table 9. Effect of inter-copping caraway, coriander and aniseed on the yield of two tomato varieties (kg /ha) at harvest dates (winter 2000).

Data	Variety	Yield (kg /ha)*			
		Treatments			
		Caraway	Coriander	Aniseed	Control
16.4.2000	Omd.	203.34gh	5320.00a	4966.68a	269.98gh
	Peto86	1006.60fg	2833.32cd	2356.66de	566.66gh
2.5.	Omd.	54.54h	3403.32bc	3566.66bc	130.02gh
	Peto86	303.32gh	3870.00b	1600.00ef	86.66h
SE± 277.3361					

*Means were calculated from the original data.

-Values followed by different letter (s) are significantly different (DMRT).

Table 10. Effect of inter-copping caraway, coriander and aniseed on the yield of two tomato varieties (kg /ha)

Treatments	Yield (kg /ha)*	
	Omdurman	Peto86
Caraway	128.94 d	654.99 d
Coriander	4361.66 a	3351.66 b
Aniseed	4266.67 a	1978.33 c
Control	200 d	326.66 d
SE± 196.11		

*Means were calculated from the original data.

-Values followed by different letter (s) are significantly differen

CONCLUTION AND RECOMMENDATIONS:

Results of this study have clearly indicated that all the three crops inter-cropped with tomato have resulted in reduction of *Bemisia tabaci* (Genn.) numbers. However, effects of these repellent plants were more apparent during winter than summer season. It is therefore recommended to intensify the use of these crops with tomato grown during winter season.

To maintain the effects of these plants throughout the long tomato growing season, it is recommended that these plants be planted at least twice during the season. The first sowing is to commence 10 days before transplanting tomato, and the other to follow 45 days later.

In order to reduce the competition exerted by some of those repellent plants, particularly caraway, it is recommended to avoid planting caraway in the same mustaba of the tomato crop. Also results of the study have indicated the clear superiority of coriander, over caraway and aniseed during both seasons in repelling *Bemisia tabaci*. In addition, coriander is an available, cheap and more popular crop than caraway and aniseed. Consequently, it is recommended that coriander is to be inter-cropped with tomato during either winter and summer season.

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