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Identification of Muskmelon Viruses in Ankara Province

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ABSTRACT

Virus infected plants were collected from the muskmelon fields of Ankara province between 1981-1984. The viruses were identified on the basis of differential host range, serology, physical properties and electron microscopy. Two strains of cucumber mosaic virus (CMV strain no.5 and strain no.6), watermelon mosaic virus-1 and watermelon mosaic virus-2 (WMV_1 and WMV_2) were found with WMV_1 as the prevalent virus in muskmelon. It was followed by CMV. WMV_2 had minor importance. This is the first report dealing with the frequent presence of WMV_1 in Turkey.

INTRODUCTION

Muskmelon, (**Cucumis melo** L.) is one of the major crops of Central Anatolia region of Turkey. Recently, great decline in quality and quantity of production due to virus infections has been noticed by melon growers. In some areas, infected plants were extremely stunted, leaves were mottled and the fruits were deformed and unmarketable. In the other areas, only severe leaf symptoms but no stunting was detected.

Among the cucurbit viruses, cucumber mosaic virus (CMV) is one of the most widespread vegetable viruses in Turkey. It has been isolated from different vegetable varieties. Recently, besides CMV infection, watermelon mosaic virus-2 (WMV_2) was reported by Nogay and Yorganci (1984) as one of the most prevalent and destructive virus diseases of cucurbit plants of Marmara region.

This paper reports the occurence in Ankara of CMV, WMV_2 and also watermelon mosaic virus-1 (WMV_1), which was recently called watermelon strain of papaya ringspot virus by Purcifull et al. (1948 a), as well as comparative study of CMV strains.

MATERIALS AND METHODS

Leaf samples of muskmelon (**Cucumis melo** L.) showing mosaic were collected from different parts of Ankara city during 1981-1984.

Samples were placed plastic bags and brought to the laboratory in an ice-box. The specimens were processed immediately or stored at —25°C until use.

36 plant species belonging to 5 different plant families were used in order to differentiate the causal viruses and strains. Seeds of **C. melo** B-633-3, **Citrullus vulgaris** Schrad. «C. grey», 2 lines of **C. melo** (Cantalop PMR-45), **Cucurbita pepo** «Early Prolific Straight Neck», **Luffa acutangula, Vigna sinensis** «Black eye» and **Chenopodium amaranticolor** were kindly supplied by Dr. D.E. Webb, U.S.D.A. Agr. Res. Service, Beltsville, Maryland, **C. vulgaris** «Mallahi» by Dr. S. Cohen, Nat. Inst. Agr. Rchovot and **C. pepo** «Small sugar», **Pisum sativum** «Alaska» by Dr. D.E. Purcifull, Univ. of Florida, Gainsville. All diagnostic hosts used are listed in Table 1.

The test pants were kept in a greenhouse at 25 ∓ 5°C and 50-60 % RH in summer and at 20 ∓ 5°C in winter. During winter, 4500 lux of artificial light was given for 12 h additionally.

Samples were macerated in 0.05 M phosphate buffer pH 7.0 (lg/1 ml) and used as inoculum (Tomlinson et al. 1959, Nelson et al. 1962, Auger et al. 1974) and for serological tests. The test plants were lightly dusted with carborundum (500 mesh) and inoculated using glass spatulas.

Dilution end points, thermal inactivation points and their longevity in vitro were determined according to Noordam (1973). **Vigna sinensis** was used as local lesion host for CMV strains, **Luffa acutangula** for WMV_1 and **Chenopodium amaranticolor** for WMV_2.

Serological tests were performed using the antisera to Italian WMV_1, WMV_2, ZYMV (kindly provided by Dr. V. Lisa, Instituto di Fitovirologia Applicata, Torino/ITALY), to a Moroccan isolate WMV and a Florida isolate of WMV_1 and WMV_2 (kindly supplied by Dr. D.E. Purcifull, University of Florida), to CMV-C, WMV_1, WMV_2, peanut stunt virus. soybean mosaic virus, squash mosaic virus (kindly provided by Dr. H. Scott, University of Arkansas) and to melon necrotic spot virus (kindly provided by Dr. J. Gumph, University of Riverside). Controls were done with healthy muskmelon sap and with normal rabbit antiserum obtained from G.A.T.A./Ankara. The isolates identified as CMV on the basis of host range were tested using the agar medium of Erdiller (1982). Isolates identified as WMV_1 and WMV_2 were tested by immunodiffusion with sodium dodecyl sulphate (SDS)-treatment, according to Purcifull and Batchelor (1977) and Purcifull and Hiebert (1979).

For electron microscopic observations, a representative of each virus was partially purified. CMV preperations were treated with 1 % uranyl acetate (pH: 4.5) (Francki et al. 1979), otherwise 2 % phosphotungistic acid (pH: 6.5) was used (Milne and Grogan 1969). The grids were examined in Jeol JEM-100 electron microscope of Medical School of Ankara University.

RESULTS

During the surveys from 19891 to 1984, forty samples were collected. On the basis of host range and symptomatology, five of them were identified as CMV strain no.5, one of them as CMV strain no.6 (yellow strain), two of them as WMV_2 and thirty two as WMV_1 (watermelon strain of papaya ringspot virus, W-PRSV; Cohen and Nitzany 1963, Webb 1963, 1971, Milne et al. 1969, Smith 1972, Ebrahim-Nesbat 1972, 1974, Rahimian and Izahpanah 1978, Francki et al. 1979, Purcifull et al. 1984 a and b). The results are summarised in Table 1.

The isolates of CMV had a wider host range than those of WMV_1 and WMV_2. With the exception of watermelon and some melon cultivars, they infected most of the diagnostic hosts used and produced typical symptoms. CMV strain no.5 caused systemic necrosis and severe leaf deformation on top leaves of **N. glutinosa** (Fig. 1), whereas CMV strain no.6 only caused severe systemic chlorotic mosaic on the same host. CMV strain no.5 induced oak leaf pattern on the young leaves of **D. stramonium** whereas CMV strain no.6 caused severe chlorotic mosaic infection. Both strains produced very similar symptoms on the other host plants.

Severe blistering and mosaic of young leaves were the main symptoms of WMV_1-infected plants under field conditions (Fig. 2). Fruits of infected plants were small and deformed. WMV_1 isolates produced local lesions on melon, squash and watermelon varieties besides **L. acutangula** but failed to infect **Leguminosae, Solanaceae, Chenopodiaceae** spp.

Table 1. Reactions of diagnostic plants to Turkish isolates of CMV, WMV_2 and WMV_1

Test plant	CMV str.no:5	CMV str.no:6	WMV_1 (W-PRSV)	WMV_2
Cucumis melo L. «Yuva»	S	S	LS[1]	S
C. melo var. «Cantalopensis»	S	S	LS	S
C. melo «Hasanbey»	S	S	LS	S
C. melo «B-633-3»	—	—	L[2]	S
C. melo «Can. Imp. PMR-45»	—	—	LS	S
C. melo «Can. PMR-45»	—	—	LS	S
C. melo «Honey dew»	S	S	S	S
C. sativus L. «Dere»	S	S	—	S
Cucurbita maxima	—	—	—	—
C. pepo «Shi Lavan»	S	S	L	S
C. pepo «Black Jack»	S	S	—	S
C. pepo «E.P.S.N.»	S	S	L	S
C. pepo «Small sugar pumpkin»	S	S	L	S
C. pepo «Sakız»	S	S	L	S
Citrullus vulgaris «C. grey»	—	—	LS	S
C. vulgaris «Sugar Baby»	—	—	L	S
C. vulgaris «Mallahi»	—	—	LS	S
Ecbalium spp.	—	—	—	—
Luffa acutangula	—	—	L[3]	S
Pisum sativum «Alaska»	—	—	—	L[4]
Vigna sinensis «Black eye»	L[5]	L	—	—
Lupinus sativus	L	L	—	S
Capsicum annuum	S	S	—	—
Datura stramonium	LS[6]	LS	—	—
Lycopersicon esculentum	S	S	—	—
Nicotiana glutinosa	S[7]	S	—	—
N. tabacum L. var. «Samsun Maden 2421»	S	S	—	—
N. tabacum var. «Samsun Canik 190/5»	S	S	—	—
N. tabacum «White Burley»	S	S	—	—
N. tabacum «Xanthi»	S	S	—	—
Petunia spp.	S[8]	S	—	—
Amaranthus caudatus	LS	LS	—	—
Beta vulgaris	S	S	—	—

Table 1 (continued)

Chenopodium amaranticolor	L[9]	L	—	L[10]
C. quinoa	L	L	—	S[11]
C. murale	—	—	—	—

L) local infection ; S) systemic infection ; 1) blisters on young leaves ; 2) gray local lesions on cotyledons and top necrosis ; 3) necrotic local lesion on cotyledons at 1 mm diameter ; 4) necrotic local lesion at 1 mm diameter and top necrosis ; 5) necrotic local lesion at 1 mm diameter, surrounded with a red halo ; 6) chlorotic local lesion at 1 mm liamete rand oak leaf pattern type systemic infection ; 7) systemic necrosis ; 8) vein necrosis on inoculated leaf ; 9) chlorotic local lesion at 1 mm diameter ; 10) chlorotic local lesion at 2-3 mm diameter ; 11) sytemic chlorotic lesion at 2-3 mm diameter ; —) no infection.

WMV_2 was rarely found and could easily be distinguished by the symptoms produced on diagnostic host plants. WMV_2-isolates induced systemic infection on cucurbiteceaous plants and formed local lesions on **C. amaranticolor** and **P. sativum** «Alaska». **C. quinoa** has also been infected by our WMV_2 isolates and showed systemic chlorotic local reaction as responce to infection (Fig.3).

The physical properties of the viruses in crude sap are shown in Table 2.

Table 2. Physical properties of the isolated viruses

Viruses	Thermal inactivation point °C	Dilution end point	Longevity in vitro (days)
CMV str. no.5	70—75	10^{-6}—10^{-7}	4
CMV str. no.6	75—80	10^{-6}—10^{-7}	4
WMV_1	65—70	10^{-3}—10^{-4}	3—4
WMV_2	65—70	10^{-5}—10^{-6}	30—32

The CMV isolates reacted only with CMV-C antiserum in ouchterlony agar-gel double diffusion tests. In microprecipitation tests, precipitates were formed at dilution up to 1/8 of crude saps of both CMV strains and up to 1/32 of antiserum.

The WMV_1 isolates reacted with WMV_1 and WMV_2 antisera from Arkansas and ZYMV, WMV_1, WMV_2 antisera from Torino, but the strongest reactions were obtained with WMV_1 antiserum from Arkan-

sas. In microprecipitation tests, precipitates were formed up to dilutions of crude saps containing WMV_1 isolates and up to 1/32 of WMV_1 antiserum. No reaction was observed in SDS-immunodiffusion tests using any one of the antisera tested.

WMV_2 isolates reacted only with WMV_2 antiserum from Arkansas and Florida, the reactions obtained with antiserum from Florida were stronger than those with antiserum from Arkansas. The dilution end points using antiserum from Florida were 1/256 for the plant sap and 1/64 for the antiserum. SDS-treated WMV_2-containing saps showed better reactions in the agar medium of Erdiller (1982) than in SDS-immunodiffusion tests according to Purcifull and Hiebert (1979).

The isolates identified as CMV had polihedral particles of 28-30 nm in diameter, the particles of WMV_1 and WMV_2 were flexible threads about 750 nm long.

DISCUSSION

Virus infections producing mosaic symptoms in muskmelon were frequent in fields of Ankara province. There was a great decline in quantity and quality of production due to the infections. Lovisolo (1980) listed 18 viruses which naturally infect muskmelon and seven of them cause severe systemic mosaic which can not be differentiated visually. The viruses present in the above named area were CMV, WMV_1 and WMV_2, identified on the basis of the symptoms produced on the test plants. WMV_1 was widespread and damaging, CMV and WMV_2 were of minor importance.

The CMV isolates were easily identified by host range, symptoms produced on diagnostic hosts, serology and morphology (Milne et al. 1969, Izgi 1972, Tomlinson et al. 1973, Smith 1972, Francki et al. 1979). Two different CMV strains (strain no.5 and strain no.6) were found according to the symptoms produced on tests plants. The physical properties of the CMV strains were similar to those reported by Izgi (1972), Nogay and Yorganci (1984) but slightly higher than the data of some other investigators (Bhargava 1951, Cohen and Nitzany 1963, Tomlinson et al. 1973, Francki et al. 1979). These differences may result from the use of different strains.

Our WMV_1 isolates had a rather restricted host range and were able to infect cucurbitaceous plants only. Although longevity in vitro and dilution end points of our isolates were in the range described by Webb and Scott (1965), Diaz (1972) and Purcifull et al. (1984 a); the

thermal inactivation point was more than the results of those researchers. In microprecipitation tests, our WMV_1 isolates reacted with both WMV_1 and WMV_2 antisera, whereas WMV_2 isolates only reacted with WMV_2, these features WMV_1 also reported by Webb et al. (1965).

The WMV_2 isolates had wider host range and were identified by their ability to induce local lesion on **C. amaranticolor** and **P. sativum** «Alaska» (Webb and Scott 1965, Demski 1968, Webb 1971, Ebrahim-Nesbat 1974, Purcifull and Hiebert 1979). They also induced systemic chlorotic spotting on **C. quinoa** similar to Iranian isolates (Rahimian and Izahpanah 1978). The longevity in vitro of our WMV_2 isolates was in the same order as described by Van Regenmortel et al. (1961), Van Regenmortel (1971), Purcifull et al. (1984 b); thermal inactivation and dilution end points of our WMV_2 isolates were similar to the results of Nogay and Yorgancı (1984), but higher than the results of Fischer and Lockhart (1974), Auger et al. (1974), Edwardson (1974) and Bhargava (1977). There was a serological relationship between our WMV_2 isolates and the isolates from Arkansas and Florida.

WMV_1 and WMV_2 were detected as long and flexible rods as reported by Van Regenmortel (1971) and Purcifull et al. (1984 a and b).

ÖZET

ANKARA İLİ ÇEVRESİNDEKİ KAVUN VİRUSLARININ TESBİTİ

Ankara ili çevresindeki kavun ekim alanlarından, 1981-1984 yılları arasında, virusla bulaşık kavun yaprak örnekleri toplanmıştır. Toplam adedi 40 olan bu örneklerdeki viruslar, farklı konukçu bitki serisine sahip olmaları, serolojik reaksiyonları, fiziksel özellikleri ve elektron mikroskop incelemeleri esasına dayanılarak teşhis edilmişlerdir. Yapılan çalışmalar sonucunda, araştırma bölgesinde, hıyar mozayık virusunun iki farklı ırkı (Cucumber mosaic virus-CMV ırk no.5 ve ırk no.6), karpuz mozayık virusu-1 (Watermelon mosaic virus-1, WMV_1) ve karpuz mozayık virusu-2 (WMV_2)'nin mevcut olduğu ve bunlar içinde de en yaygın enfeksiyonun ise WMV_1'na ait olduğu saptanmıştır.

Bu çalışma, WMV_1 enfeksiyonunun Türkiye'deki varlığı üzerinde ilk araştırmadır.

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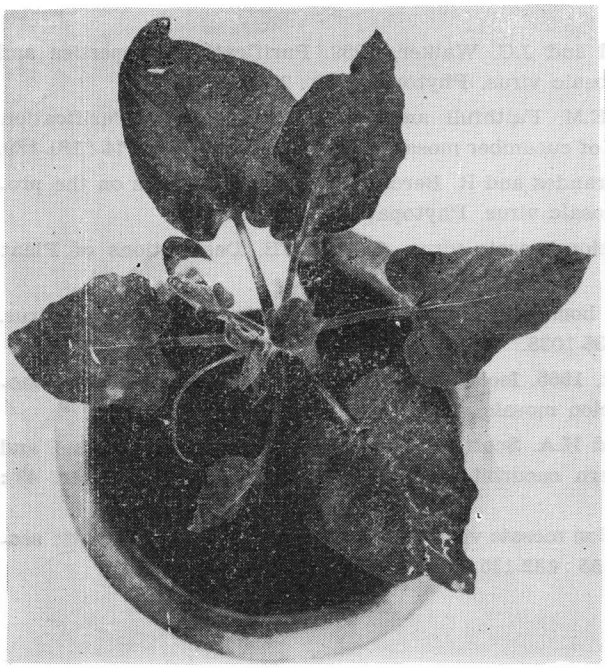

Fig.1. **Nicotiana glutinosa** plant showing systemic necrosis and severe deformation on young leaves 27 days after inoculation with CMV isolate no:21.

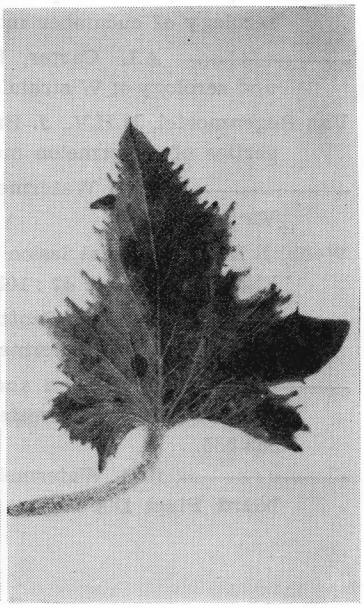

Fig.2. A leaf of local «Yula» cultivar of muskmelon showing blisters caused by WMV_1 infection.

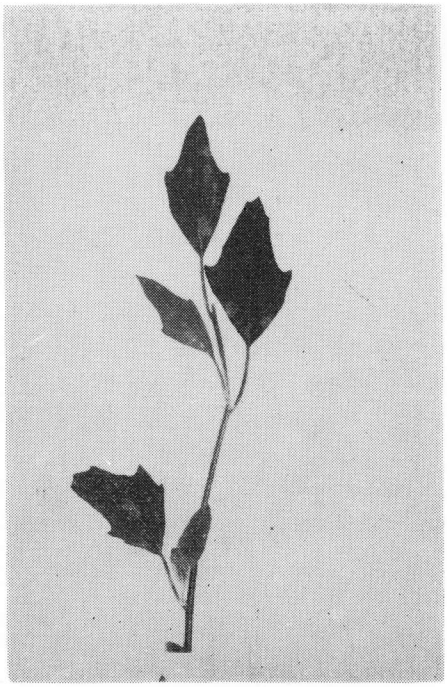

Fig.3. Leaves of **C. quinoa** showing systemic chlorotic spotting 27 days after inoculation with WMV_2 isolates.

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Untersuchungen über den Weichfaeule erzeugenden Erregerkomplex an Zuckerrüben

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ZUSAMMENFASSUNG

1983 wurden Zuckerrübenproben aus der Umgebung der Alpullu Zuckerfabrik mit dem Verdacht auf Rizomania an unser Institut geschickt. Im September 1984 und 1985 wurden die Stellen, an denen die Syptome auftraten, kontrolliert. Nach unseren Beobachtungen; verliert erst die Schwanzspitze an Turgeszens und die Gefaessbündel werden verfaerbt, das führt dann zum Erschlaffen und Vertrocknen der Primaerblaetter. Die neu gebildeten Sekundaerblaetter sind klein, schmal und langgestielt. Einige der befallenen Rüben sterben ab und der Rübenkörper vermorscht. Die extreme Bildung von Seitenwurzeln die als Baertigkeit bezeicnet wird, konnte nicht beobachtet werden.

Aus den Wurzeln der kranken Rüben wurden **Pythium, Phoma betae, Fusarium** sp., **Macrophomina phaseolina** und eine Art von Myxomycetes isoliert. Nach den Pathogenitaetstests waren **Pythium, Phoma betae** und eine Art von Myxomycetes deutlich pathogen. Durch mechanische Übertragung von Wurzelsaeften auf die Indikatorpflanzen konnte keine Infektion nachgewiesen werden. Die Ergebnisse der ELISA Tests waren im ersten Jahr schwach positiv und im zweiten Jahr negativ.

Nach unseren Meinungen, spielen die bodenbürtigen Pilze eine grosse Rolle bei diesem Krankheitsbild.

EINLEITUNG

Anfang der 50 er Jahren wurde zuerst in Oberitalien und danach in einigen europaeischen Laendern eine Krankheit an Zuckerrüben beobachtet und als Rizomania bezeichnet (1, 3, 4, 16). Gleichzeitig wurde über das Auftreten einer aehnlichen Krankheit in Japan berichtet (15, 20). In spaeteren Jahren wurde das Vorkommen dieser Krankheit in vielen anderen europaeischen Laendern u.a. in Griechenland nachgewiesen (11, 12, 17).

Die typischen Symptome von Rizomania können folgendermassen beschrieben werden: Die Blaetter sind von hellgrüner Farbe, welken schnell bei trockener Witterung und bleiben im Wachstum zurück.

Trotz ausreichender Bodenfeuchtigkeit erschlaffen sie. Besonders augenfaellig werden die Symptome erst bei der Ernte, so tritt eine deutliche Baertigkeit in Erscheinung, die durch extrem starke Bildung von Seitenwurzeln hervorgerufen wird. Haeufig ist die Pfahlwurzel abgestorben und vermorscht. Die Blaetter zeigen ausserdem stets ein Mosaik und eine Verschmaelerung der Blattspreite.

Diese Krankheit wird durch das Beet Necrotic Yellow Vein Virus verursacht, das durch die Zoosporen von **Polymyxa betae** übertragen wird. Rizomania ist für betraechtliche Ertragsverluste, sowie für erniedrigten Zuckergehalt bei Zuckerrüben verantworlich (6, 8, 9, 12, 17, 18, 19). 1983 wurden Zuckerrübenproben aus der Umgebung der Alpullu Zuckerfabrik mit dem Verdacht auf Rizomania an unser Institut geschickt. In September 1984 und 1985 wurden die Stellen an denen die Symptome vorkommen von uns kontrolliert.

Nach unseren Beobachtungen; verliert zunaechst die Schwanzspitze an Turgeszens und die Gefaessbündel verfaerben sich, was wiederum zum Erschlaffen und Vertrocknen der Primaerblaetter führt.

Die neu gebildeten Sekundaerblaetter sind klein, schmall und lang gestielt. Einige der befallenen Rüben sterben ab und der Rübenkörper. b.z.w. die Wurzelspitze ist vermorscht. (Abbildung 1, 2). Die extreme Bildung von Seitenwurzeln, die als Baertigkeit bezeicnet wird, wurde nicht beobachtet.

MATERIAL und METHODE

Die untersuchten Pflanzen und Bodenproben wurden in September 1984 und 1985 aus der Umgebung von Alpullu von uns entnommen. Die kranken Rübenpflanzen wurden mikroskopisch untersucht. Die Wurzelstücke der kranken Pflanzen wurden auf PDA ausgelegt und die wachsenden Pilze in Reinkultur gezüchtet. Die Vermehrung der Pilze erfolgte auf PDA Medien oder in Sand-Maismehlkultur. Die Sandkulturen der zu untersuchungen Pilze wurden im Verhaeltnis 1/20 mit steriler Erde gemischt. Die Pathogenitaetstests wurden mit dieser Erde in 7-facher Wiederholung in Töpfen mit 14 cm Durchmesser in einem Klimaraum angelegt. 7 Tage spaeter wurden die Rübensamen ausgesaet. Die Bonitierung der Pathogenitaet erfolgte erst nach 6 Wochen und dafür wurden die mit gewachsenen Rübenpflanzen bedeckten Flaeche berücksichtigt.

Die feinen Wurzeln der Rübenpflanzen wurden ausgewaschen und wurde von diesen mit Hilfe von 0,01 M Phosphat Puffer pH 7,0 Saft gewonnen. Mit diesem Wurzelextrakt wurden unter Zusatz von Celite die Testpflanzen **Chenopodium amaranticolor, C. quinoa** und **Gomphre-**

na globosa mechanisch inokuliert (10, 13, 14).

Aus der Naehe von kranken Rübenpflanzen wurden Bodenproben entnommen. Nach der Fangpflanzenmethode wurden die Töpfe mit diesen Bodenproben gefüllt und die Rübenkeimlinge in diese Töpfe gepflanzt bzw. die Rübensamen ausgesaet. Die Wurzel der aufgewachsenen Rübenpflanzen wurden dann für den ELISA-Test nach Westdeutschland (Institut für Phytopathologie und Angewandte Entomologie, Giessen) geschickt, ausserdem wurden auf ihren Pilz-und Bakterienbefall hin, Isolationen durchgeführt. Die Bodenproben wurden auch auf den Verdacht hin, auf Nematodenbefall untersucht.

ERGEBNISSE und DISKUSSION

Im ersten Jahr wurden aus den Wurzeln der kranken Rübenpflanzen **Fusarium** sp., **Macrophomina phaseolina, Phoma betae** und eine Art von Myxomycetes isoliert. Obwohl die Gefaessbündel der Rübenpflanzen braeunlich verfaerbt waren, konnte man in den Gefaessbündeln kein Pilzmyzel beobachten.

Die Ergebnisse der Pathogenitaetstests des ersten Jahres bzw. von 1984 werden in der Tabelle 1 aufgezeigt. Wie aus Tabelle 1 zu ersehen ist, war **Phoma betae** der Wirksamste unter den getesteten Pilzen. Obwohl eine Art von Myxomycetes in dem ersten Versuch am wirksamsten war, zeigte er in dem zweiten Versuch nicht die selbe Pathogenitaet. Nach Cornoldi soll ein bestimmter Zusammenhang zwischen Rizomania, Weichfaeule und den Bodenpilzen bestehen, die unbedingt naeher untersucht werden sollte (2). Unter türkischen Bedingungen sollte man **Macrophomina phaseolina** für wichtig erachten. Obwohl dieser Pilz unter Klimaraumbedingungen nicht besonders wirksam erschien, dürfte er unter Feldbedingungen und besonders an nicht regelmaessig bewaesserten Standorten eine wichtigere Rolle bei diesem Krankheitsbild spielen.

Um die Untersuchungen noch zu erweitern, wurden Felder, auf denen die Krantheitssymptome sehr stark und augenfaellig auftraten in 1985 kontrolliert und es wurden Bodenproben entnommen. In die Töpfe, die mit diesen Bodenproben gefüllt worden waren, waren Rübensamen ausgesaet. Die Wurzeln von jungen Rübenpflanzen wurden auf PDA ausgelegt und Pilzisolate gewonnen.

Tabelle 1 : Ergebnisse der Pathogenitaetstests mit isolierten Pilzen (1984).

Fungus	Gesamt mit Rübenpflanzen bedeckte Flaeche (cm^2)		Als Prozentsatz der Gesamtflaeche	
	Erster Versuch	Zweiter Versuch	Erster Versuch	Zweiter Versuch
Phomabetae	683	385	63.35	35.7
Myxomycetes	526	963	48.8	89.3
Macrophomina phaseolina	950	898	88.1	83.3
Fusarium	884	1078	82.0	100
Kontrolle	1078	962.5	100	89.3

Tabelle 2 : Die Ergebnisse von Isolationen aus Wurzeln von Keimlingen aus verseuchten Bodenproben (1985).

	Wiederholungen			
	1	2	3	4
Uzunköprü	Fus., Pythium	Fus., Phoma, Bak., Pythium	Fus., Pythium	Fus., Pythium, Bak.
Das Dorf Türkmen (1)	Fus., Pythium Bak.	Fus., Pythium, Bak.	Fus., Pythium, Phoma	Fus., Pythium, Bak.
Das Dorf Türkmen (2)	Fus., Pythium Alternaria	Pythium, Fus.	Bakterium	—
Keşan/ Zentrum	Pythium, Fus., Bak.	Mucorales, Fus., Botrytis	Fus., Pythium, Botrytis+Bak.	Fus., Pythium, Bak.
Karapınar/ Uzunköprü	Pythium	Bakterium, Penicillium	Bakterium, Fusarium	—
Boztepe/ Keşan	Pythium	Pythium	Fusarium, Botrytis	Fusarium, Bakterium
Babaeski/ Minnetler	Fusarium, Bakterium	Fusarium, Bakterium	Fusarium, Bakterium	Fusarium, Bakterium

Im zweiten jahr wurden Sandkulturen von **Fusarium** sp., **Pythium, Macrophomina phaseolina** und **Phoma betae** hergestellt und Pathogenitaetstests durchgetührt. Die Bonitierung erfolgte nach 6 Wochen und es konnte folgende Ergebnisse festgestellt werden.

Tabelle 3: Die Ergebnisse der Pathogenitaetstests mit im zweiten Jahr isolierten Pilze.

Fungus	Gesemt mit Rübenpflanzen bedeckte Flaeche (cm^2)	Als Prozentsatz der Gesamtflaeche
Pythium	38.5	4
Phoma betae	479	44
Macrophomina phaseolina	873	81
Fusarium	937	87
Kontrolle	1078	100

Wie aus der Tabelle 3 zu ersehen, ist Pythium der wirksamste Pilz in Bezug auf «Fehlstellen». **Phoma betae** zeigte ungefaehr dasselbe Ergebnis wie im ersten Jahr (Abbildung 3). In den Kontrollparzellen bzw. Töpfen zeigten die Rübenpflanzen ein besseres Wachstum, die Blaetter von jungen Rübenpflanzen waren grösser und grüner als in den mit **Fusarium** und **Macrophomina phaseolina** inokulierten Töpfen. Besonders zu erwaehnenswert ist, dass obwohl in den mit Fusarium verseuchten Töpfen viele Rübenpflanzen vorhanden waren, hatten diese zum Teil nekrotisierte schwache Haarwurzel, die sich spaeter leicht erkranken könnten. Die Bodenproben wurden mit dem Verdacht auf **Heterodera schachtii** im nematolcgischem Labor des Forschungsinstitut für Pflanzenschutz in Bornova untersucht. Es konnte keine Nematodenbefall festgestellt werden. Nach dem in diese Bodenproben Rübensamen ausgesaeet und die Haarwurzel von jungen Rübenpflanzen auf PDA ausgelegt wurden, entwickelten sich neben den verschiedenen Pilzkolonien auch Bakterienkolonien. Für naehere Untersuchungen wurden diese Wurzel an Dr. Saygılı weiter gegeben. Nach dem Tabaktest waren die Ergebnisse negativ, es gab also keine pathogene Bakterien. Das augenfaelligste Symptom von Rizomania, die extreme Bildung von Seitenwurzeln, die als Baertigkeit bezeichnet wird, wurde nicht beobachtet. Um die Rolle von Viren bzw, beet necrotic yellow vein virus festzustellen wurden mechanische Inokulationen durchgeführt.

Durch mechanische Übertragung von Wurzelsaeften auf Indikatorpflanzen wie **Chenopodium amaranticolor, C. quinoa** und **Gomphrena globosa** konnte keine Virusinfektion nachgewiesen werden. Maric et al. in Jugoslavien hat ebenfalls negative Ergebnisse mit den Testpflanzen

erhalten (14). In anderen Laendern, bei Arbeiten von verschiedenen Autoren gelang jedoch die Übertragung von beet necrotic yellow vein virus, der Erreger von Rizomania, auf 15 Pflanzenarten aus der Familie der Chenopodiaceae, zusaetzlich auch bei **Tetragonia expensa** und **Gomphrena globosa**. Jedoch ist die Zahl der positiv reagierenden Testpflanzenarten sehr verschieden (4, 8, 13, 17, 20).

Nach der Fangpflanzenmethode wurden in den verseuchten Bodenproben junge Rübenpflanzen angezogen und die Wurzeln dieser Pflanzen für den ELISA-Test nach Deutschland geschickt. Die Ergebnisse dieses Tests wurden in Tabelle 4 dargestellt.

Tabelle 4 : Ergebnisse des ELISA Test mit aus der Türkei geschickten Wurzelproben

Bodenprobe	E_{405} 1 Stunde	E_{405} 2 Stunden	Die Sporen von Polymyxa betae
Uzunköprü/Malkoç	0.017	0.061	+
Babaeski/Tilkipınar	0.065	0.190	—
Uzunköprü/Malkoç	0.069	0.174	—
Kontrolle	0.000	0.013	
Positive Kontrolle	0.500—1.500		

Wie Tabelle 4 zeigt, waren die Ergebnisse sehr schwach positiv. Sporen von **Polymyxa betae**, dem Vektor des Erregers von beet necrotic yellow vein virus, war nur im einer Wurzelprobe vorhanden. Im zweiten Jahr wurden sieben Proben verschickt, alle Ergebnisse waren jedoch negativ.

Bei einem starken Auftreten von Rizomania spielen ökologische Faktoren, insbesondere sehr hohe Bodenfeuchtigkeit und Bodentemperaturen eine grosse Rolle (7, 8, 12, 19).

Da die Krankheitssymptome auch auf den schlecht bewaesserten Feldern auftraten und die Baertigkeit nicht beobachtet wurde, sprach der Verdacht gegen virale Erreger. Die negativen Elisa-Testergebnisse im zweiten Jahr unterstützten unsere Meinung.

Zwischen unseren Ergebnissen und denen von Vestberg et al. (21) gibt es eine ausgepraegte Parallelitaet. In dieser Arbeit wurden **Pythium debaryanum** und **Phoma betae** als Pathogene nachgewiesen. Spaeter

wurden auch in grosser Zahl Fusarien isoliert, die nicht pathogen waren. Die diese Krankheit überwindende Keimlinge wuchsen langsamer und zeigten eine verminderte Qualitaet (21).

Aufgrund unserer Ergebnisse und Beobachtungen dürften die bodenbürtigen Pilze eine grosse Rolle bei diesem Krankheitsbild spielen.

Wir sind Herrn Professor Dr. E. SCHLÖSSER für die Durchführung der ELISA-Tests, Frau Dipl. Ing. Server ÖZKUT (M. Sci) für die nematologischen und Herrn Dr. H. SAYGILI für die bakteriellen Untersuchungen dankbar.

ÖZET

ŞEKER PANCARLARINDA YUMUŞAK ÇÜRÜKLÜK OLUŞTURAN ETMEN KOMPLEKSİ ÜZERİNDE ARAŞTIRMALAR

1983 yılında Alpullu Şeker Fabrikası pancar yetiştirme alanlarından Rizomania şüphesiyle bölümümüze şeker pancarı örnekleri gönderilmiştir. 1984 ve 1985 Eylül'ünde bu belirtilerin oluştuğu alanlar bizzat gezilmiştir. Gözlemlerimize göre; önce pancar kökünün uç kısmı turgorunu kaybetmekte ve iletim demetleri esmerleşmektedir. Bunun sonucu olarak primer yapraklar pörsümekte ve ölmektedirler. Yeni oluşan yapraklar küçük, dar ve uzun saplıdır. Hastalanan pancarların bazıları ölmekte ve çürümektedirler. «Sakal Köklülük» denilen yan köklerin aşırı oluşumu gözlenmemiştir.

Hasta pancarların köklerinden **Pythium, Phoma betae, Fusarium** sp., **Macrophomina phaseolina** ve bir Myxomycetes üyesi izole edilmiştir. Patojenisite testlerine göre, **Pythium, Phoma betae** ve Myxomycetes üyesi fungus belirgin olarak patojen bulunmuştur. Köklerden elde edilen özsuyun indikatör bitkilere mekanik inokulasyonu ile bir virus enfeksiyonu kanıtlanamamıştır. ELISA Testi sonuçları birinci yıl şüpheli pozitif, ikinci yıl ise negatiftir.

Görüşümüze göre, bu hastalık tablosunda toprak kökenli funguslarının büyük etkileri vardır.

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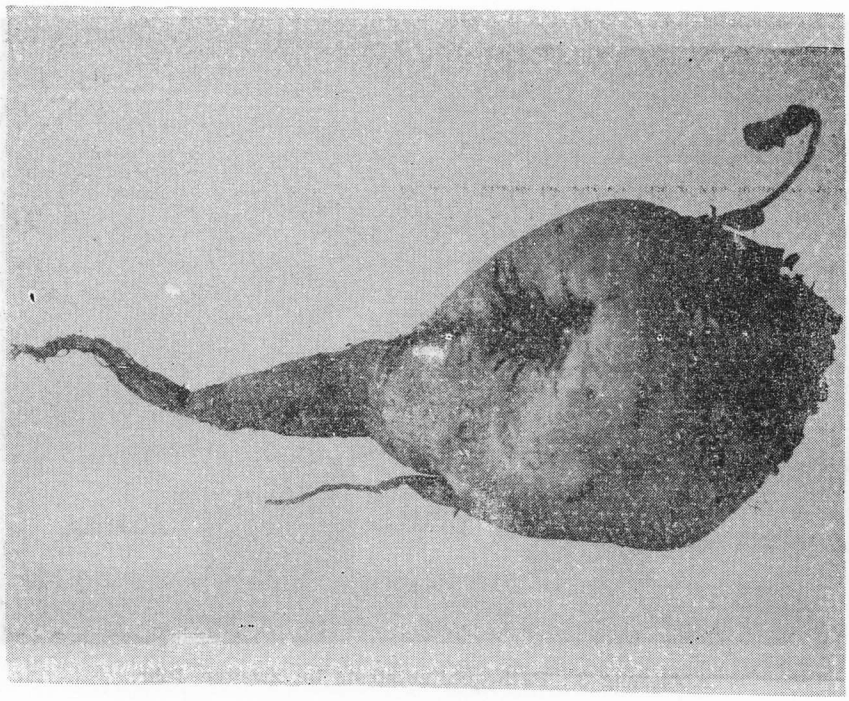

Abbildung 1 : Symptome an dem Rübenkörper

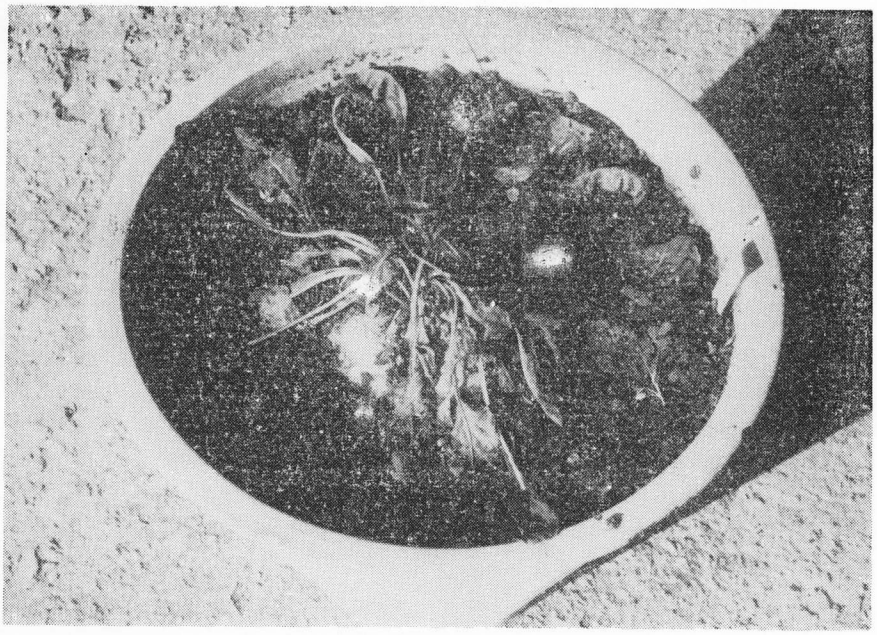

Abbildung 2 : Erschlaffte und zugrunde gegangene Rübenpflanze.

Abbildung 3 : Pathogenitaetstests im zweiten Jahr.

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Epidemiology of Downy Mildew on Muskmelon (**Cucumis melo** L.) caused by **Pseudoperonospora cubensis** (Berk. and Curt.) Rostow

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ABSTRACT

Epidemiology of downy mildew on muskmelon (**Cucumis melo** L.) caused by **Pseudoperonospora cubensis** (Berk. and Curt.) Rostow. has been investigated. Temperature above 35°C arrested infection as well as sporulation and lesions became brown necrotic. Relative humidity above 75 per cent was conducive to disease development. Apparent infection rate (r) showed positive correlation with temperature and moisture conditions.

INTRODUCTION

In pot house, muskmelon (**Cucumis melo** L.) was observed to succumb to downy mildew infection caused by **Pseudoperonospora cubensis** (Berk. & Curt.) Rostow. at all the growth stages viz., cotyledonary, true leaves-flowering, flowering-fruiting and fruiting-fruit maturity stage contrary to usual flowering-fruiting stage under natural field conditions. Possible correlation between main environmental factors like temperature and humidity on the epidemiology of the disease were therefore investigated and findings are presented in this paper.

MATERIALS AND METHODS

Cotyledonary or true leaves (intact/detached) of the same age group and uniform size of muskmelon cv. 'Durgapura Madhu' were used to investigate the effect of temperature and relative humidity on infection and sporulation of **Pseudoperonospora cubensis** under laboratory conditions. Different relative humidity levels were obtained artificially following Buxton and Mellanby (1934). Sporulation was measured with a haemocytometer as number of sporangia produced on five leaf discs (5 mm each) after shaking them in 0.1 per cent Mercuric Chloride ($HgCl_2$) solution (1 ml per disc). Under field conditions, appearance and development of disease in relation to temperature, relative humidity and rain fall were studied on muskmelon cv. 'Durgapura Madhu' at Agriculture Research Station, Sriganganagar - a subtropical belt of Rajasthan State. Downy mildew intensity was recorded at 5

days interval and weather data were obtained from the Meteorology laboratory located at the Research Station itself. The apparent infection rate (r) was calculated according to Van der Plank (1963) using the formula:

$$r = \frac{2.3}{t_2 - t_1} \log_{10} \frac{x_2(1-x_1)}{x_1(1-x_2)}$$

RESULTS

Effect of temperature on infection and sporulation: It was revealed (Table I) that 20°C was optimum for both infection and sporulation. At 0°C there was neither infection nor sporulation and at 30°C there was only a meagre sporulation. At 35°C, there was some sporulation at 2 and 4 hr of incubation after infection but no sporulation at all at 40°C and 45°C. At 40°C and 45°C with 2 hr of incubation not only there was loss of sporulation completely but also the lesions soon became brown to necrotic (Table II).

Effect of relative humidity on infection and sporulation: High relative humidity above 75 per cent was observed conducive to both infection as well as sporulation (Table III). At 25 per cent relative humidity there was neither infection nor sporulation. Low humidity regime followed by high humidity resulted in 708.86 sporangia per mm^2 in comparison to only 167.08 sporangia per mm^2 in reverse situation (Table IV).

Environement in relation to downy mildew appearance and development under field conditions: During 1981, the muskmelon was sown on 20.7.1981 as an off-season crop and prior to first appearance of downy mildew 11.9.1981, there occurred a light shower of rain fall (1.1 mm) on 8.9.1981. Similarly in 1982, when the muskmelon was sown on 24.2.1982 as a main season crop, there were again rains on 26.4.1982 (6.8 mm) and 28.4.1982 (1.7 mm) bringing down the temperature and increasing relative humidity before appearance of the disease on 29.4.1982. During both these years downy mildew developed rapidly and registered per cent disease indices of 71.50 and 67.00 respectively. In 1982, further rains on 7.5.1982 (4.5 mm) and 12.5.1982 (56.00 mm) inspite of prevailing high temperature around 40°C helped the increase in relative humidity and consequently also the disease. In 1985, downy mildew appeared on 7.5.1985 and there occurred no rains prior to it. However, it is assumed that disease initiation perhaps had some bearing with regular irrigations given at 7-10 days interval, the-

reby altering the microclimate of the crop in favour of the pathogen. Downy mildew development during this period was also slow and the maximum per cent disease index was only 37.00. Thus, the apparent infection rate (r) during 1981 and 1982 was comparatively more than 1985 (Table V). The temperature in 1985 reached as high as 46.1°C coupled with very low relative humidity and it was only 1.6.1985 onward that the relative humidity increased because of intermittant rains with some consequent decrease in temperature making further development of the disease possible.

DISCUSSION

Heavy rains, high relative humidity and dew have been observed as conclusively deciding factors for not only onset but also progress of downy mildew on cucurbits (Weber, 1923; Hiura, 1929). In Israel, Duvdevani et al. (1946) also have shown that in the absence of rain prevention of dew largely precluded downy mildew development on cucumber under conditions in which exposure of the leaves to dew resulted in severe downy mildew incidence. Boelema (1967) observed that a serious outbreak of downy mildew on Gem squashes occurred in the Transwal, South Africa following high rain fall. Likewise, in Florida (U.S.A.). Blazques (1975) also observed that low rain fall arrested development of downy mildew on watermelon even under favourable temperatures. Thomas (1977) reported that epiphytotics of downy mildew on cantaloupes in Southern Texas (U.S.A.) did not occur until new periods were at least of 5-6 hr duration even though the inoculum was present and temperatures were favourable. Under present study also thus not only the initiation but further progress of the disease tended to be mainly dependent on prevailing moisture conditions, temperature being secondary in importance affecting the infectivity of air borne sporangia negatively in agreement to Cohen and Rotem (1971). Moisture seemingly not only helped dissemination but also germination of zoospores of **P. cubensis.** In Punjab (India) which closely approaches Sriganganagar conditions environmentally, Bains and Jhooty (1978) have also accounted mainly occasional rainfalls to explain the behaviour of **P. cubensis** on muskmelon.

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ÖZET

KAVUN BİTKİSİNDE **Pseudoperonospora cubensis** (Berk. and Curt.) Rostow.'İN NEDEN OLDUĞU MİLDİYÖ HASTALIĞININ EPİDEMİYOLOJİSİ

Bu çalışmada kavun (**Cucumis melo** L.) bitkisinde **Pseudoperonospora cubensis** (Berk. and Curt.) Rostow'in meydana getirdiği mildiyö hastalığının epidemiyolojisi incelenmiştir. 35°C'nin üzerindeki sıcaklık derecelerinin infeksiyon ile sporulasyonu durdurucu yönde etki yaptıkları ve lezyonların ise nekrotik olmalarına yol açtıkları saptanmıştır. % 75'in üzerindeki orantılı nem basamaklarının hastalık gelişimine olumlu yönde etkide bulunduğu görülmüştür. Görülebilir infeksiyon miktarının (r) sıcaklık ve nem koşulları ile pozitif ilişki içinde olduğu da bulunmuştur.

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Table I. Effect of temperature on infection and sporulation of **Pseudoperonospora cubensis** on muskmelon var., «Durgapura Madhu»

Temperature°C	Per cent infection*	Sporangia produced per mm² **
0	00.00	00.00
15	70.00	506.33
20	100.00	742.58
25	90.00	405.06
30	00.00	101.26

* Average of five detached leaves ** Average of six counts

Table II. Effect of post-infection exposure of high temperature on lesion development and sporulation in **P. cubensis** and muskmelon var., «Durgapura Madhu» host parasite combination.

	Temperature (C) and exposure duration (hr)								
	35			40			45 (C)		
	2	4	6	2	4	6	2	4	6 (hr)
Lesion colour*	YB	YB	B	B	BN	NB	ND	ND	ND
Sporangia produced**	303.80	101.26	00.00	00.00	00.00	00.00	00.00	00.00	00.00

* YB— Yellow Brown B— Brown BN— Brown Necrotic ND— Necrotic Dead

** Sporangial count per mm² represent average of six counts

Table III. Effect of relative humidity on infection and sporulation of **Pseudoperonospora cubensis** on muskmelon var., «Durgapura Madhu»

Relative Humidity %	Per cent infection *	Sporangia produced per mm² **
25	00.00	00.00
50	10.00	202.53
75	60.00	607.59
90	100.00	759.49
100	100.00	810.13

* Average of five detached leaves ** Average of six counts

Table IV. Effect of alternate low and high relative humidity on sporulation of **P. cubensis** on muskmelon var., «Durgapura Madhu»

Alternate Relative Humidity exposures (%)		Sporangia produced *
100	25	167.08
25	100	708.90

* Sporangial count per mm² represent average of six counts

Table V. Development (Apparent infection rate 'r') of **P. cubensis** on muskmelon var., «Durgapura Madhu» under field conditions at Agriculture Research Station, Sriganaganagar during 19981, 1982 and 1985.

Year	Period From	To	Mean R.H. (%)	Mean Temperature Min	Max (C)	Mean Rain fall (mm)	Infection/Unit/day/ 'r' - rate of disease development
1981	Sept 11	to 16	66.6	23.2	39.5	0.0	0.2500
	Sept 16	to 21	69.8	24.5	38.3	0.0	0.0782
	Sept 21	to 26	74.6	23.9	34.1	0.0	0.1748
	Sept 26	to Oct 1	75.0	24.1	35.9	0.0	0.0588
	Oct 1	to 6	66.2	18.4	35.0	0.0	0.0598
1982	Apr 29	to May 4	61.0	20.6	36.8	0.0	0.1987
	May 4	to 9	61.6	22.9	38.6	0.86	0.2014
	May 9	to 14	68.0	22.8	32.9	11.20	0.1094
	May 14	to 19	65.8	18.5	33.1	0.0	0.1163
	May 19	to 24	53.6	22.1	35.9	0.0	0.1163
1985	May 7	to 12	36.8	23.6	40.2	0.0	0.0347
	May 12	to 17	27.8	21.6	40.7	0.0	0.0397
	May 17	to 22	29.4	23.0	45.1	0.0	0.0296
	May 22	to 27	39.8	27.3	44.0	0.0	0.0097
	May 27	to June 1	33.8	27.7	44.1	0.0	0.2808
	June 1	to 6	52.0	25.6	42.2	11.06	0.1184
	June 6	to 11	63.8	25.1	38.1	7.86	0.1129

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Investigations on the Reactions of some Triticale And Wheat Varieties against Wheat Bunt Disease (**Tilletia foetida** «Wall.» Liro.) in Çukurova Region

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ABSTRACT

39 triticale and 7 commercial wheat varieties were tested against to wheat bunt disease populations in Çukurova region. It was determined that all triticale varieties tested were immun and all wheat varieties tested were sensitive against to the disease.

INTRODUCTION

Triticale is a cereal variety obtained by crossing the wheat and rye. Triticale is more resistant to cold and dry conditions and to cereal diseases that wheat. It is also more productive in acidic and sandy soils. Triticale is a precocious cereal than barley. On the other hand, some triticale varieties are more productive than bread wheats, and durum wheats of 6-44 %, and 5-71 %, respectively (Demir, 1983).

Recently, many breeding studies have been made for developing triticale lines in the world. Some triticale lines developed in India (TL 238,257,319,419) were found to be 15-20 % more productive than wheat varieties in 1968. It had also been found that these triticale lines were more resistant against to some cereal diseases such as stripe rust (**Puccinia striiformis**), powdery mildew (**Erysiphe graminis**), loose smut (**Ustilago nuda tritici**) and karnal bunt (**Tilletia indica**) Gill et al., 1981). One of the triticale lines, Towan, had been found to be resistant line against to **Urocystis agropyri, E. graminis, Tilletia caries, Puccinia graminis, Puccinia recondita** and **Septoria tritici** and semiresistant line against to **Heterodera avenae** in Australia in 1977 (Brauwer and Castleman 1981). Another line, Carman, had been found as resistant against to the strains of **P. graminis, P. recondita, T. caries**, and **U. nuda tritici** in Manitoba and Saskatchewan (Gustafson et al., 1982). Singh et al. (1976) found that the commercial wheat varieties, Girija, Shailja, and Sonalika, were sensitive and 18 triticale varieties were resistant against to **T. caries** and **T. foetida.** In the studies made in India, it was found that while 15 of 150 wheat varieties tested were immun and 2 of them were resistant, 121 triticale lines were immun

against to **T. caries**. (Singh et al. 1979). In the studies made in Russian, it was indicated that 7 triticale lines were resistant against to powdery mildew, loose smut, common bunt and leaf rust diseases (Shulyndin, 1978).

This study was carried out to determine the reactions of some triticale varieties to wheat bunt disease.

MATERIALS AND METHODS

Triticale varieties used had been obtained from Agronomy Department of Agriculture Faculty of Çukurova University. Spore populations of common bunt disease of wheat used had been obtained our laboratuvory stocks, and identified as **T. foetida**, but determination studies at strain level had not been made.

6 triticale varieties and 1 wheat variety in 1983, and 39 triticale varieties and 7 wheat varieties in 1985 were used in the studies. The triticale and wheat seeds were artificially contamined by rinsing them with **T. foetida** spores at the ratio of 0.3 % in 250 ml erlenmayers for five minutes, and sowed as 40 g seeds per plot, each of 2 m^2. Sowings were made in December 15, 1983 and November 20, 1985. All spikes were examined as healty and diseased in full ripeness stage, and diseased spike ratios were determined.

Both the two experiments were conducted according to randomized block design with three replicates, and the countings were made in the replicates, containing highest disease spikes. It was evaluated that the varieties containing no diseased spike as immun (I), the ones containing between 1 % and 10 % diseased spikes as resistant (R), and the ones containing diseased spikes more than 10 % as sensitive (S) (Sing et al. 1979).

RESULTS AND DISCUSSION

The results of the studies made in 1983-1984, and in 1985-1986 growing seasons have been given in Table 1 and 2.

Table 1. The reactions of some triticale and wheat varieties in 1983-1984 growing season.

Variety	Species	Ratio of bunted spike (%)	Type of reaction
Bulk 181	Triticale	0.00	I
Bacum	»	0.00	I
Beagle	»	0.00	I
Mapache	»	0.00	I
Sıskıyou	»	0.00	I
Bakırçay (x)	»	0.00	I
Cumhuriyet 75	Wheat	34.22	S

(x) This variety had been used as registirated in Turkey.

Table 2. The reactions of some triticale and wheat varieties in 1985-1986 growing season.

Variety	Species	Ratio of bunted spike (%)	Type of reaction
Beagle	Triticale	0.00	I
B-226	»	0.00	I
B-059	»	0.00	I
Palouse	»	0.00	I
B-227	»	0.00	I
A-313	»	0.00	I
B-461	»	0.00	I
A-204	»	0.00	I
Mapache	»	0.00	I
B-247	»	0.00	I
A-419	»	0.00	I
Bacum	»	0.00	I
B-858	»	0.00	I
A-225/21	»	0.00	I
A-571	»	0.00	I
Sıskıyou	»	0.00	I
A-708	»	0.00	I
Bulk 181	»	0.00	I
Bakırçay	»	0.00	I
H-507.71A/Bg/2Cumh.75A-1112-0AP4	»	0.00	I

Table 2. (Continued)

Variety	Species	Ratio of bunted spike (%)	Type of reaction
Delfin 205	»	0.00	I
Drira Out CrossX21295-0AP 9	»	0.00	I
H-507.71A/2Bg/Cumh.75A.1112-0AP5	»	0.00	I
Drira/M2AX-15893-0AP	»	0.00	I
Delfin 76	»	0.00	I
M4/FS17951/Bg/"S"X29755-B-0AP	»	0.00	I
IRA/Bg/X25570-0AP3	»	0.00	I
Bg1/M2A X 15671-0AP2	»	0.00	I
Juanillo 98 X 21295-0AP	»	0.00	I
Pubby/Bg/B-38-0AP2	»	0.00	I
Drira Out Cross X 21295-0AP13	»	0.00	I
IRA/Bg/X15570-0AP2	»	0.00	I
Drira Out Cross X 21295-0AP6	»	0.00	I
Drira Out Cross X 21295-0AP8	»	0.00	I
IRA/Bg/R Tobact-0AP	»	0.00	I
Drira Out Cross X 21295-0AP10	»	0.00	I
Selfert/Cineum//Bg/B-52-0AP2	»	0.00	I
Selfert/Cineum//Bg/B-52-0AP3	»	0.00	I
Ram'S' X 12257-0AP2	»	0.00	I
Cumhuriyet 75	Wheat	76.34	S
Orso	»	56.46	S
Lachish-Line	»	39.50	S
Panda 2R	»	44.30	S
Creso	»	30.63	S
Gemini	»	35.92	S
Manital	»	39.82	S

As shown in Table 1 and 2, diseased spikes in various ratios were seen in wheat varieties while no diseased spike was seen in triticale varieties.

According to the studies made in two growing seasons, it was de-vtermined that all triticale varieties tested showed resistance in immunite degree against to **T. foetida** while all wheat varieties tested showed susceptibility. The results obtained from these studies have agreed with the studies made in various countries (Singh et al. 1979, Gill et al. 1981, Brauwer and Castleman 1981, Gustafson et al. 1982).

Regarding these results and other studies, it can be suggested that the triticale varieties having good properties, such as much more productive and resistance to the disease, could be cultivated instead of rye, wheat and barley in the regions, that have problems in growing of latter cereal species.

ACKNOWLEDGMENT

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ÖZET

ÇUKUROVA'DA BAZI TRİTİCALE VE BUĞDAY ÇEŞİTLERİNİN BUĞDAY SÜRME HASTALIĞI (**Tilletia foetida** «Wall» Liro)'NA KARŞI REAKSİYONLARI ÜZERİNDE ARAŞTIRMALAR

Çukurova'da buğday sürme hastalığı etmeni **Tilletia foetida** populasyonuna karşı testlenen 39 triticale ve 7 ticari buğday çeşidinden triticale çeşitlerinin tamamı immünite derecesinde dayanıklı, 7 ticari buğday çeşidi de duyarlı reaksiyon göstermişlerdir.

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The Effects of Exhaust Gas on Seed Germination and Seedling Growth of Cucumber (**Cucumber sativus** L.) and Wheat (**Triticum aestivum** L. subsp. **vulgare**)

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ABSTRACT

In this study, effects of exhaust gas on seed germination and seedling growth of cucumber (**Cucumis sativus** cv. **Beite Alpha**) and wheat (**Triticum aestivum** subsp. **vulgare** cv. Cumhuriyet 75) were investigated. An inhibition and delay in germination of seeds fumigated with exhaust gas was determined. In **C. sativus**, while the percentage of the control group was 94 %, at the end of fumigation period it went down to 81 % in 0,264 m^3 exhaust gas application for 3 days, and 60 % in 1,052 m^3 exhaust gas application for 3 days as 3 hours per day. In **T. aestivum** germination was 98 % in the control series 93 % and 83 % respectively in the other two experimental series. At the same time an inhibition in the length of the radicle as well as the hypocotyl was observed. In **T. aestivum** the number of lateral roots too suffered an inhibition.

INTRODUCTION

The effects of automobil exhaust gas on the plants as pollutants is a well known fact now. Although the studies on the effects of NO_x, SO_2 and O_3 have been attracting the attention of investigators more (Hill and Bennett, 1970; Runeckles, 1982; Lane and Bell, 1984) but some work has been done on the effects of exhaust gas on the plants too (Kammerbauer et al., 1986).

The aim of the presennt work is to enlighten the effects of exhaust gas on the seed germination and seedling growth of some economically important plants.

MATERIALS and METHOD

The materials used were cucumber (**Cucumis sativus** L. cv. **Beite Alpha**) and Wheat (**Triticum aestivum** L. subsp. **vulgare** cv. Cumhuriyet 75). The effects of exhaust gas were studied by the method outlined in detail by Türkan (1988). The appearence of radicle was accepted as the criterion for germination.

The seeds of cucumber and wheat were separated in to lots of 100. The dishes with seeds were treated with exhaust gas for 3 days; as 10 minutes per day with 0,264 m^3 and as 3 hours per day with 1,052 m^3. These were placed in pethidishes containing a layer of filter paper. 7 ml of water was added at the beginning and during the treatment. The same amount was added after two days. All experiments were conducted in replicates.

RESULTS and DISCUSSION

The results showing the percentage germination of the seeds are given in table 1 and fig. 1.

Table 1. Percentage germination of the seeds at the end of fumigation (3 days). (Mean of 3/100 seeds)

Species	Series	Total Germination (%)
C. sativus	a	94
	b	81
	c	60
T. aestivum	a	98
	b	93
	c	83

a: Control b: 0,264 m^3 exhaust gas application for 3 days, as 10 minutes per day. c: 1,052 m^3 exhaust gas application for 3 days as 3 hours per day.

As it is clear from the table 1 and fig. 1, exhaust gas results in an inhibition as well as a decrease in the germination. In **C. sativus**, while the percentage germination of the control group is 94 %, at the end of fumigation period it goes down to 81 % and 60 % respectively in the other two experimental series. The germination percentage in **T. aestivum** is 98 % in the control series and 93 % and 83 % in the series subjected to exhaust gas treatments. These results show that **C. sativus** seeds are more sensitive to the exhaust gas than **T. aestivum.**

An inhibition in the length of the radicle as well as the hypocotyl was observed at the end of 4 days in both the species (Table 2, Fig. 2, 3). The length of radicle and hypocotyl in **C. sativus** in the series fumigated with 0,264 m^3 was 4,80 and, 2.63; and in the series famigated with 1,052 m^3 it was 1,96 and 1,34 cm; whereas the control seedlings showed these lengths around 6,41 and 2,98 cm respectively. Similar results were obtained in the case of **T. aestivum.**

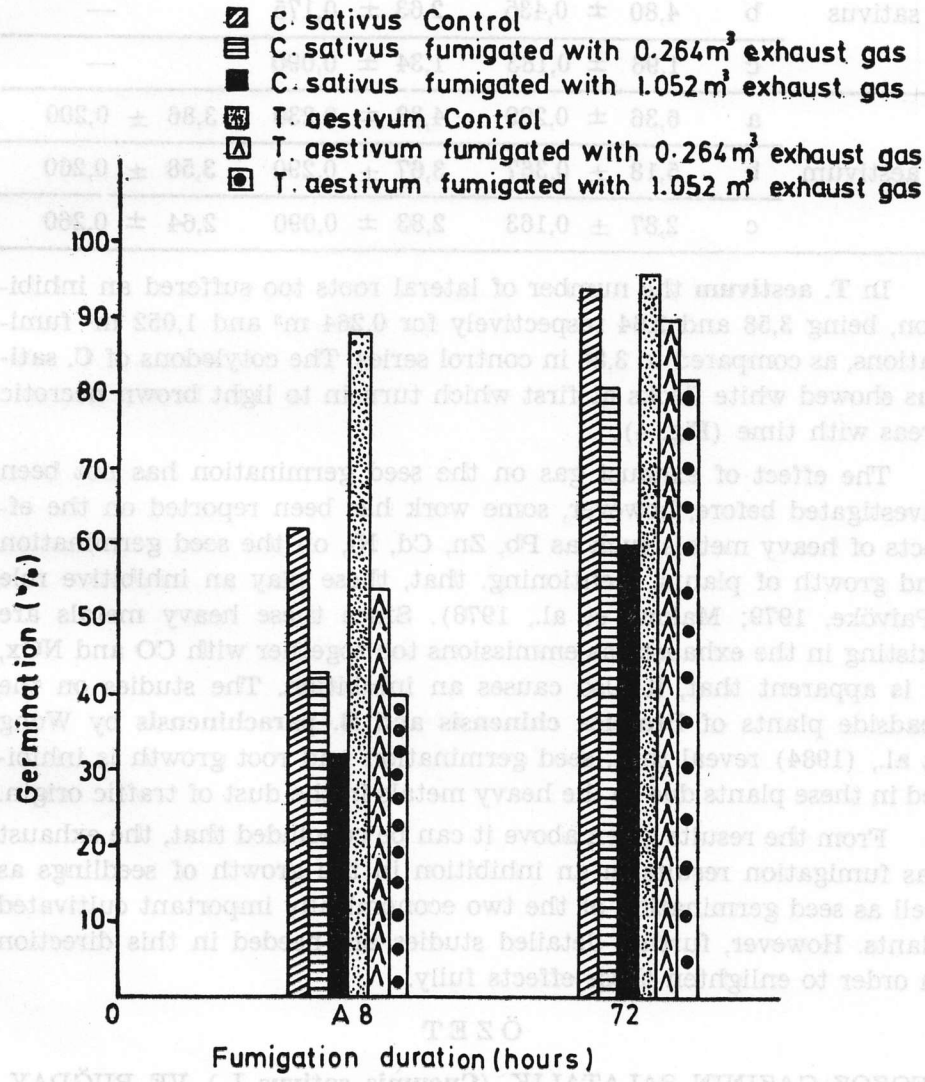

Fig. 1: The germination percentage of the seeds in relation to the fumigation time and amount of exhaust gas.

Table 2. Seedling growth in control and fumigated series (Mean of 50 seedling).

Species	Series	Mean length of radicle per plant (cm)	Mean length of hypocotyl per, plant (cm)	Average number of lateral roots per, plant
C. sativus	a	6.41 ± 0,239	2,98 ± 0,221	—
	b	4,80 ± 0,435	2,63 ± 0,175	—
	c	1,96 ± 0,183	1,34 ± 0,090	—
C. aestivum	a	6,36 ± 0,299	4,38 ± 0,230	3,86 ± 0,200
	b	5,18 ± 0,367	3,67 ± 0,290	3,58 ± 0,260
	c	2,87 ± 0,163	2,83 ± 0,090	2,64 ± 0,260

In **T. aestivum** the number of lateral roots too suffered an inhibition, being 3,58 and 2,64 respectively for 0,264 m^3 and 1,052 m^3 fumigations, as compared to 3,86 in control series. The cotyledons of **C. sativus** showed white flecks at first which turn in to light brown necrotic areas with time (Fig. 4).

The effect of exhaust gas on the seed germination has not been investigated before, however, some work has been reported on the effects of heavy metals such as Pb, Zn, Cd, Ni, on the seed germination and growth of plants, mentioning. that, these play an inhibitive role (Paivöke, 1979; Malone et al., 1978). Since these heavy metals are existing in the exhaust gas emmissions too together with CO and NOx, it is apparent that, it also causes an inhibition. The studies on the roadside plants of **Brassica chinensis** and **B. parachinensis** by Wong et al., (1984) reveal that, seed germination and root growth is inhibited in these plants due to the heavy metals in the dust of traffic origin.

From the results given above it can be concluded that, the exhaust gas fumigation results in an inhibition in the growth of seedlings as well as seed germination of the two economically important cultivated plants. However, further detailed studies are needed in this direction in order to enlighten these effects fully.

ÖZET

EGZOZ GAZININ SALATALIK (**Cucumis sativus** L.) VE BUĞDAY (**Triticum aestivum** L. subsp. **vulgare**) TOHUMLARININ ÇİMLENME VE FİDE GELİŞİMİNE ETKİLERİ

Bu çalışmada, egzoz gazının salatalık (**Cucumis sativis** cv. **Beite**

Alpha) ve buğday (**Triticum aestivum** subsp. **vulgare** cv. Cumhuriyet 75) tohumlarının çimlenme ve fide gelişimi üzerindeki etkisi araştırıldı. Egzoz gazına maruz bırakılan tohumlarda çimlenmenin engellendiği ve geciktirildiği saptandı. Fumigasyon bitiminde kontrol **C. sativus** tohumlarının çimlenme oranı % 94 iken, 3 gün, günde 10 dk 0,264 m^3 gaza maruz bırakılanlarda % 81, 3 gün, günde 3'er saat 1,052 m^3 gaz uygulananlarda % 60'a düşmüştür. **T. aestivum**'da ise kontrolde % 98 olan çimlenme oranı 0,264 m^3 ve 1,052 m^3 ga zuygulananlarda sırasıyla % 93 ve % 83 olmuştur. Aynı zamanda **T. aestivum**'da radikula, hipokotil ve ek kök gelişiminin de engellendiği saptanmıştır.

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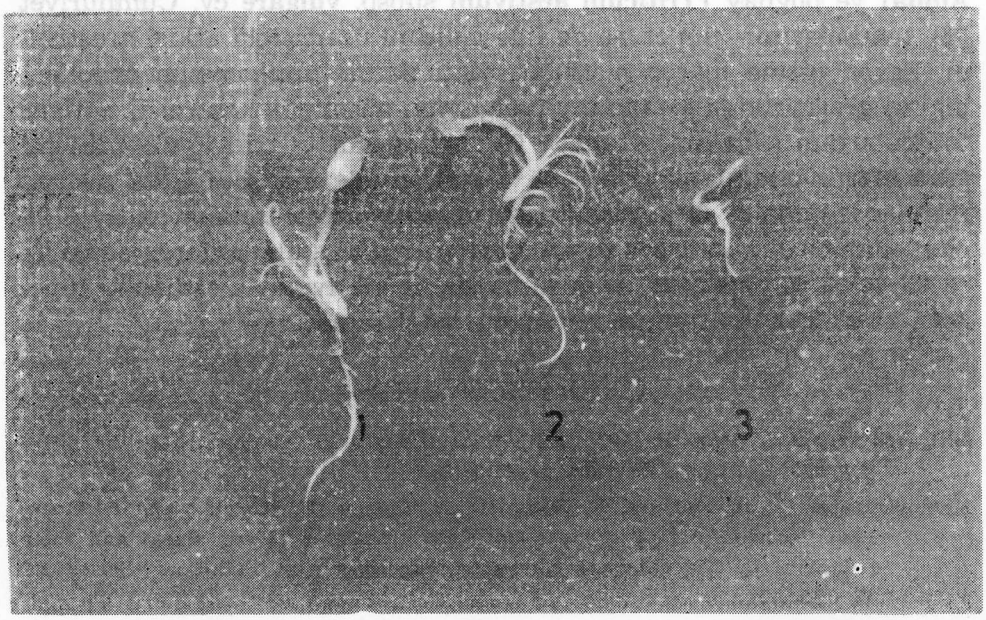

Fig. 2: Growth of radicle and hypocotyl in 6 days old **C. sativus** seedlings at the end of fumigation. (1: Control, 2: 0,264 m3 gas application, 3: 1,052 m3 gas application).

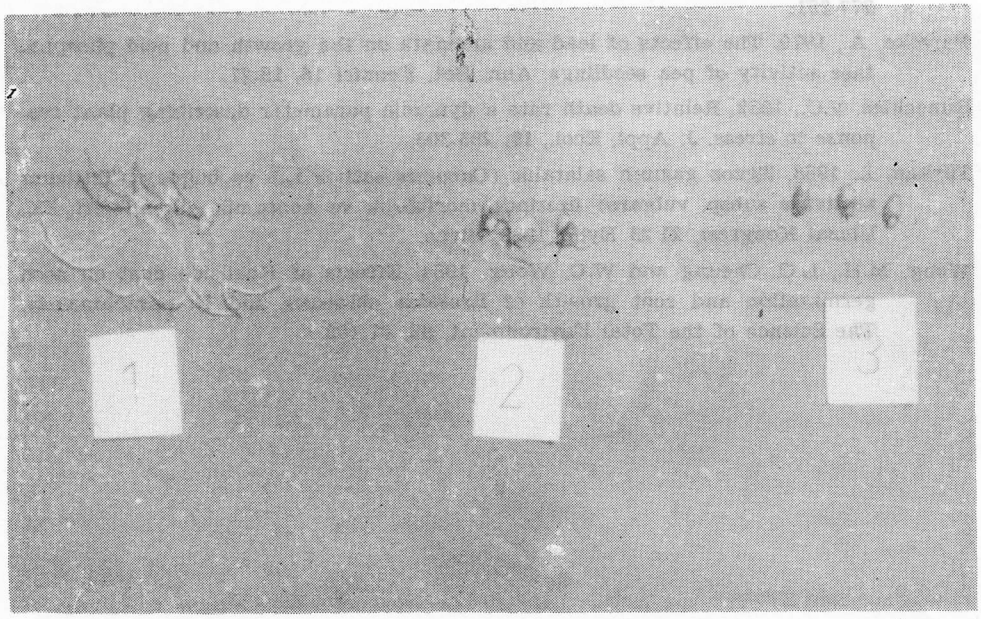

Fig. 3: Growth radicle and hypocotyl in 6 days old **T. aestivum** seedlings at the end of fumigation. (1: Control, 2: 0,264 m3 gas application, 3: 1,052 m3 gas application).

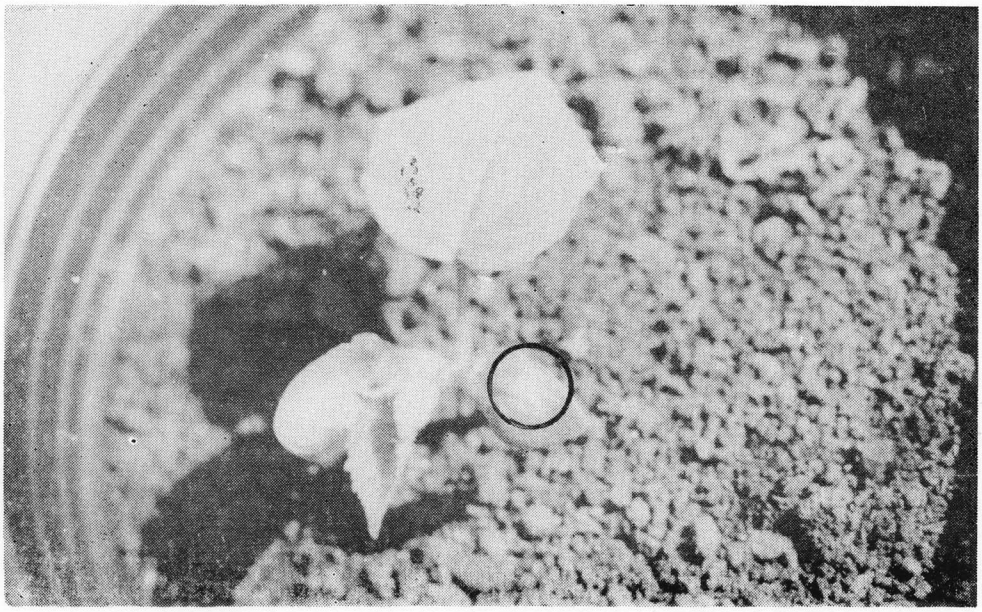

Fig. 4: A view of the **C. sativus** ctyledons exposed to exhaust gas.

All Correspondance Should Be Made To
TÜRKİYE FİTOPATOLOJİ DERNEĞİ
Zirai Mücadele Araştırma Enstitüsü
Bornova, İZMİR TURKEY