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Epidemiology and Control of Tomato Spotted Wilt Virus on Tobacco Plants in Kosova (Yugoslavia)

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ABSTRACT

During recent several years a very destructive disease of tobacco has occurred in the Province of Kosova in southern part of Yugoslavia. On the basis of test plant reactions, light and electron microscope investigation, properties in vitro, serological tests and epidemiology it has been established that this disease is caused by a strain of tomato spotted wilt virus (TSWV).

INTRODUCTION

Tomato spotted wilt virus (TSWV) is widespread in different regions of Yugoslavia (2, 3, 6). The last couple of years TSWV has become a very common virus in tobacco in the Province of Kosova, causing considerable damage. Three years ago, TSWV was isolated from tabocco in fields of various regions of Kosova. Generally, the TSWV isolates described up to now were usually similar to the type strain in host range and symptomatology (5), although some isolates may have exhibited distinctively different properties belonging to strains described by Best (1). TSWV usually occurs in tobacco in a mixture of several strains.

This paper deals with seven TSWV isolates found in tobacco including their host range, symptomatology and epidemiology and their control measures.

MATERIALS and METHODS

Seven virus isolates were investigated in the present study. They were found in tobacco in the Province of Kosova (southwest part of Yugoslavia). The isolates designated TSWV Pe, Gj, Pr, Fr, Gl, Pz, MT, caused severe systemic necrotic and ringspot symptoms in tobacco plants in field. The isolates were derived in 1985 and 1986 from tobacco (**N. tabacum**) cultivars «Jaka», «Virginia Hlo», «Prilep» and «Stolac»,

growing in commercial fields in Peja, Djakove, Prizren, Ferizaj, Gjilan, Prishtin, and Mitrovica e Titos counties. All isolates were mechanically transmitted and maintained in the greenhouse in the above quoted tobacco cultivars. Inocula were prepared by homogenizing leaves with chilled mortar and pestle in 0,01 M sodium phosphate buffer «pH 7», and were mechanically inoculated by carborundum.

The test plants used are listed in Table 1.

Properties in vitro were determined in the standard manner. Serological experiments in agar-gel double diffusion tests were performed with crude sap extracts, using antiserum against TSWV from the collection of Dr. Tsakiridis (Tobacco Institute of Greece, Drama), with titre 1:8.

Spontaneously infected tobacco specimens of **N. tabacum** cvs «Jaka», «Virginia Hlo», «Prilep» and «Stolac» and inoculated leaves of the same tobacco cultivars were used for electron microscopical studies. Strips of tobacco leaf tissue were fixed for 30 min. in 1 % (v/v) glutaraldehyde in cacadylate buffer «pH 7,2» and fixed for 1 hr in (v/v) osmium tetroxide. Then, the samples of tissue were deydrated in ethanol series and embedded in araldite. Sections were analysed by Siemens Em I.

Initial sources of insects for virus transmission tests were onion fields in Kosova-Krusha e Madhe. **Thrips tabaci** was maintained on tobacco plants which were also used as virus source in transmission tests.

RESULTS and DISCUSSION

1. Host range and symptoms

All virus isolates which were designated TSWV-Pe, Gj, Pr, Fr, Gl, Pz, MT, produced severe systemic necrotic and ringspot symptoms in tobacco plants in field (Fig. 1 a, b). Also, on the same test plant species the isolates provoked completely similar symptoms (Fig. 2 a, b; Table 1), which were characteristic for TSWV. It seems, therefore, that all the seven isolates investigated resemble necrotic and ringspot isolates of TSWV (1), because Table 1. Represents host-range investigation of TSWV-Pe isolate.

2. Stability in vitro

The following properties in vitro of the seven isolates from Kosova were estimated: thermal inactivation point (TIP), dilution end point

(DEP) and longevity in vitro (LIV). The experiments showed that our isolates had TIP between 46-48°C, DEP about 10^{-4} and LIV about 6 hr. They did not differ in these properties from most of TSWV strains described in the literature (1,8).

3. Serology

In agar gel double diffusion tests, all the seven isolates reacted positively with the antiserum against one TSWV isolate from Greece (8). When they were compared simultaneously with each other, precipitin lines were completely fused without any spur formation which showed a close serological relationship among them (Fig. 3 b). Positive reaction were obtained with both crude infective sap and purified virus preparation.

4. Investigations in the electron microscope

Electron microscope analysis of tobacco tissues naturally and experimentally infected with our isolates revealed to be characteristic isometric virus particles (Fig. 3 a). Their diameter was about 80 nm. The particles occurring usually in cluster of three or four particles. As can be seen in Fig. 3 a, each cluster was in the membrane bund interconnecting cisterna. The particles themselves were enveloped by membrane. Such particles were observed only in the cytoplasm and could not be found in every parts in infected cells. This type of virus particles is characteristic for TSWV.

5. Epidemiology and control

According to some reports (1, 4, 7, 8). **Thrips tabaci** is the only insect known to transmit TSWV in nature, and used as a primer criterion for identifying it as TSWV. The epidemiology of TSWV disease on tobacco is directly related with the habits and the ecology of its vector thrips. The activity and the rapid increase of thrips population favour also directly the early occurrence and the incidence of the disease. The size of thrips does not exceed 2 mm in length. It is an ubiquitous and very active insect. It can feed and reproduce on many different host plants. On account of its small size and activity it is very difficult to be studied. The insect feed on tobacco leaves in the larval stages and in the adult stage by sucking up the sap. The virus is known to infect over 160 species of plants. So, it is logical to suspect that some hosts other than tobacco may function in the overwintering the virus. Most of the perennial weed species, which are known as hosts of the virus, have been found to grow in or around the tobacco fields. The virus is transmitted by thrips in spring from weed hosts to tobacco

plants when these hosts begin to dry up. These observations provide reason to believe that the virus overwinters mainly in the perennial weed hosts. It has been observed that a high thrips population late in autumn, results in an increase of the primary infection level of the disease in the field next spring, if a mild winter conditions has prevailed. After the realization of the primary infection by either or both of the above mentioned ways, the disease causes a rapidly advancing secondary infection, if heavy thrips population is present. The primary infection usually does not exceed 4 % and it can be prevented sufficiently, while the secondary infection is probably responsible for more than 85 % of total infection. Tobacco losses vary from year to year and from area to area. In fact, no losses are caused if the weather is rainy and cool during spring and early summer, even no control program is used. On the contrary, when the weather conditions are favourable for thrips, yield losses caused by the virus can be up to 80 % or more if an effective control program is not applied. Only in few cases, when infected seedlings are transferred to the fields and favorable conditions of early and severe infection prevail, tobacco losses will be 100 %. The infection period begins in the seed bads at the leaf cross stage of the seedling in mid-May when first thrips appear in the field after transplanting. In the field only the period from transplanting to flowering around mid-July has economic importance. From the above infection period most critical is that of the seed bed and the first month in the field. To consider the complete protection of the seed beds from thrips infection is absolutely necessary, because otherwise none of the recommended means appears to give effective control of the disease in the fields. The effectiveness of spray is significaty increased when weeds surrounding the seed beds or fields are included in the spray program. Table 2 summarizes the recommended control program in seed-beds and fields. In Table 2, the names of the effective compounds and their recommended rates are shown too.

Table 1. The Reactions of Test Plants to Infection by Isolate TSWV-PE

Test plants	Symptoms	
	Local	Systemic
CHENOPODIACEAE		
Chenopudium quinoa Willd.	CL	O
C. amaranticolor Coste et Reyn.	CL	O
CUCURBITACEAE		
Cucumis sativus L.	CL	O
SOLANACEAE		
Datura stramonium L.	O	VC1, RS
Lycopersicon esculentum Mill.	NL	VC1, ST, W
Nicotiana glutinosa L.	NL	C, ST, D
N. megalosiphon Beursk et Muell.	NL	C, N, D
N. tabacum L. cv. Samsun	NL	C, RS, N, D
N. tabacum L. cv. Prilep	NL	C, RS, N, D
N. tabacum L. cv. Stolac	NL	C, RS, N, D
N. tabacum L. cv. H2	NL	RS, ST, N, D
N. tabacum L. cv. H10	NL	RS, ST, N, D
Petunia hybrida Vilm.	NL	O

C = clorosis or chlorotic, D = deformations, L = lesion, N = necrosis or necrotic, RS = ring-spotting, ST = stunting, VC1 = veinclearing, W = wilting, O = symptomless

Table 2. The Control Program of TSWV in Tobacco

a) In Seed Beds:

Treatment	Chemicals	Conc. gr/m² or %	Application
I. Disinfection	Furadan G-5 or Solvirex	4-5 gr/m²	At time preparing soil for seedling (20-30 day before)
	Methyl bromide or	40-50 gr/m²	5-7 day before seeding after application
	Dervinol (If is not used	0,4-0,5 gr/m² M. bromide)	Furadan
II. Insecticides	Systemin or	0,15-0,2 %	Every seven days
	Anthio 33	0,2-0,3 gr/m²	
	Pirimor	0,2-0,3 gr/m²	
	Orthene	0,2-0,3 gr/m²	

b) In Fields:

I. Disinfection	Furadan G-5 +	30-70 kg/ha	10-12 days before
	Timet	30-70 kg/ha	planting
	Dervinoll or	4-5 kg/ha	7 days before
	Tillam	5-7 kg/ha	planting
II. Insecticides	Systemin or	0,2-0,4 %	Every 15 days
	Anthio 33 or other	0,2-0,3 % insecticides	

Ö Z E T

KOSAVA (YUGOSLAVYA)'DA TÜTÜNDEKİ DOMATES LEKELİ SOLGUNLUK VİRUSUNUN EPİDEMİYOLOJİSİ VE ÖNLENMESİ

Yugoslavya'nın güneyinde, Kosova Bölgesindeki tütünlerde son birkaç yıldır çok tahripkar bir hastalık ortaya çıkmıştır. Test bitkileri, ışık ve elektron mikroskobu gözlemleri, in vitro bulgular, serolojik testler ve epidemiyolojisine dayalı olarak bu hastalığın Domates lekeli Solgunluk Virusunun (TSWV) bir ırkı tarafından oluşturulduğu ortaya çıkmaktadır.

LITERATURE CITED

1. Best, R.J., 1968. Tomato spotted wilt virus Advan. Virus Res, **13** : 65-146.

2. Buzancic, A. i M. Panjan, 1973. Nalaz virusa pjegavosti i venuce rajcice (Tomato spotted wilt virus TSWV) na duhanu u SR Hrvatskoj.

3. Buzancic, A. and N. Juretic, 1978. Some properties of tomato spotted wilt virus isolates in Yugoslavia Acta Bot. Croat **37** : 27-32.

4. Cho. J.J., R.L. Man, R.T. Hamasaki, and D. Gonsavler, 1988. Detection of tomato spotted wilt virus in individual thrips by Enzyme-linked Immunosorbent Assay. Phytopathology **78** : 1348-1352.

5. Ie, T.S., 1970. Tomato spotted wilt virus, C.M.I./A.A.B. Descriptions of Plant Viruses No. 39.

6. Mickosvki, J., 1969. Tomato spotted wilt virus na duvanu Jugoslavije (Lycopersicum virus 3 Smith) Zastita Bilja, **105** : 203-214.

7. Todorovski, B. and J. Mickovski, 1976. Study of **Thrips tabaci** Lind , Some of its biologic and ecologic characteristics as a virus vector on tobacco. Tobacco institute, Prilep nije dobro citirano.

8. Tsakiridis, J.P. and G.V. Jr. Gooding, 1972. Tomato apotted wil' virus in Greece. Phytopath. Medit., **11** : 42-47.

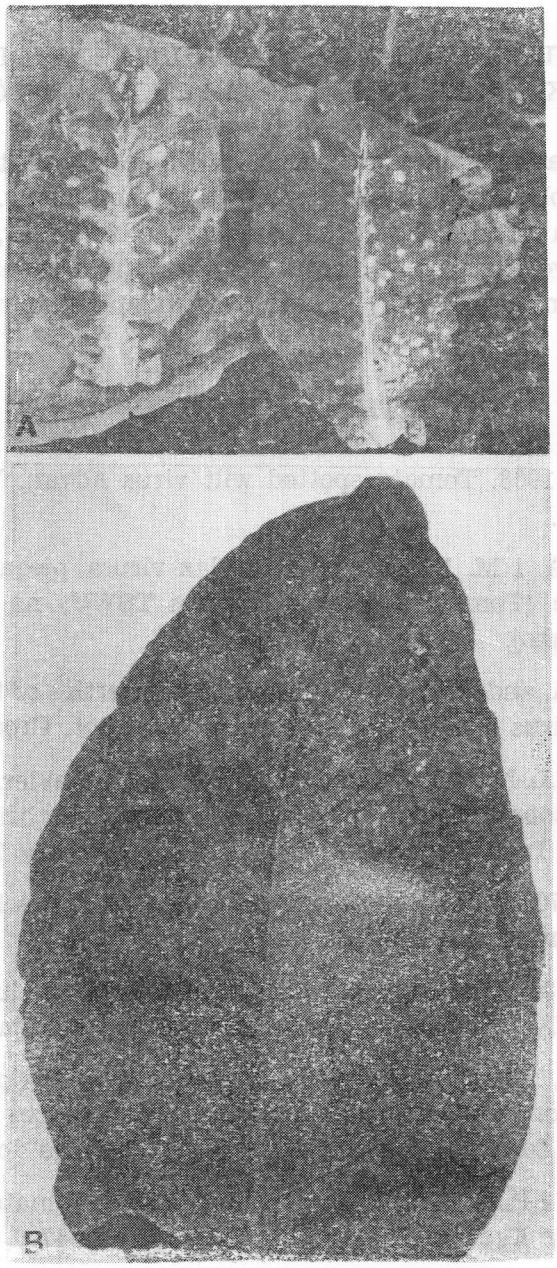

Fig. 1. A, B, Symptoms on leaves of **N. tabacum** cv. Virginia Hlo. caused by TSWV-Pe isolate (natural infection) a-local symptoms, b-systemic symptoms.

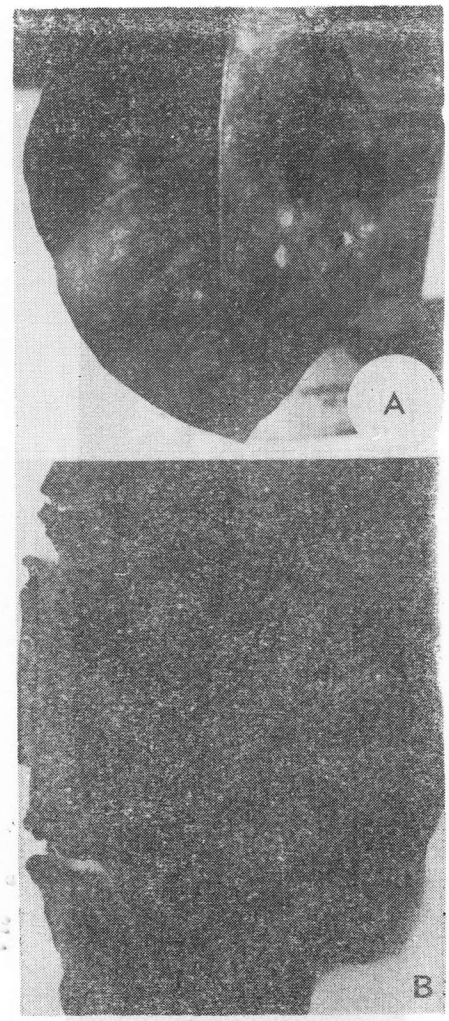

Fig. 2. Symptoms on leaves of **N. tabacum** cv. Hlo artificially infected by isolate Pe. a-Local symptoms on inoculated leaf. b-Systemic symptoms on young leaf.

Fig. 3. a-Ultrathin section through leaf tissue of spontaneously infected **N. tabacum** cv. «Kosovska Jaka», with isolate Pe of TSWV: clusters of virus particle (v): the particles are surrounded by a membrane (M). b-serological reaction between isolate Pe and Gl with TSWV antiserum (Pe and Gl sap of infected tobacco, H-sap of healthy tobacco plants, As-antiserum to TSWV).

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Tomato Leaf Curl Virus Management by Carbofuran plus Oil Combination

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ABSTRACT

In two field trials the incidence of Tomato leaf curl virus, transmitted by whitefly (**Bemisia tabaci**) was minimised by initial root dip of tomato seedlings in 0.1 % carbofuran solution for 1hr followed by 2 foliar sprays of Agricultural spray oil at 10 day interval, starting from 20 days after transplantation.

INTRODUCTION

Among the virus and yellows diseases infecting tomato, tomato leaf curl virus (TLCV) is the major constraint for successful cultivation and during 1984, Sastry, reported three strains of this virus. It is transmitted by the whitefly, **Bemisia tabaci** Gen. in which it perisits, but not for life. When once the virus is acquired by the whitefly, it will be viruliferous atleast for 14-20 days. This disease spreads only through this vector and it is not transmitted either through seed or by mechanical contact. There will be always source of inoculum as the virus perpetuates on 32 other crop and weed hosts (Sastry **et al.** 1978). Due to the availability of inoculum and large vector population tomato crop planted during December to May is prone to heavy incidence due to the favourable environment prevailing during these months, which is highly congenial for vector multiplication. As no resistant cultivar against TLCV is available and seems still faraway, the other way of getting high yields is by reducing the vector population. A reduction in vector population in the crop will land to a decrease in the incidence of this disease. With the emergence of newer systemic insecticides, the prospects of controlling virus spread by using these chemicals have become decidedly brighter. The preliminary studies of Sastry **et al.** (1974) indicated the possibility of reducing the disease incidence by three foliar sprays of Agricultural oil (1 %) or

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Carbofuran granules (1.5 Kg a.i./ha) at the time of transplanting. During 1982 field trials were conducted at the Experimental Farm of Indian Institute of Horticultural Research, Hessaraghatta, to minimise TLCV incidence and the results are presented in this communication.

MATERIAL and METHODS

The nursery of tomato var. 'Pusa ruby' was riased under insect proof conditions and the six week old seedlings were planted in 3x5 m. under completely randomized design, with four replications for each treatment. I each plot 42 seedlings were planted in 7 rows running breadthwise, keeping six seedlings in each row at equal distance. In the present study Carbofuron (flavable Paste, Rallis India Ltd.), dimethoate, monocrotophos and Agricultural spray oil were used and the concentration used is given in Table-1. In the case of Carbofuron treatment, the six week old seedlings were given a root dipping in 0.1 % Carbofuron solution for 1 hr and later they were transplanted. After 20 days, two additional sprays of Agricultural spray oil was given at 10 day intervals. A treatment having root dip of carbofuron without any further spray was also included. The other two insecticides and Agricultural spray oil were given as foliar sprays at 10 days intervals for three times commencing from 10 days after transplantation. The data on TLCV incidence and whitefly population were recorded each time a day prior to spraying. The counts of the whitefly were taken by lifting the leaves gently in the morning hours, when the whiteflies were not very much active. The leaf curl incidence was recorded one day prior to spraying as percentage of diseased plants with reference to healthy plants. The procedure followed was same as described by Sastry and Singh (1971).

RESULTS

The preliminary experiments on Carbofuron root dip for 1 hr at 0.3, 0.2 and 0.1 per cent gave plant mortality of 47.1, 26.8 and 4.6 per cent. Hence in the subsequent field experiment 0.1 per cent was used. The data presented in Table 1 clearly indicates that TLCV indidence can be successfully minimised to 12.63 per cent by Carbofuran plus oil treatment while it is 19.37 and 21.91 per cent respectively for the independent treatments of Carbofuran and Agricultural spray oil. While the values for dimethoate and monocrotophos were 24.36 and 25.13 per cent. The disease incidence in the control plots was 63.85 per cent. The corresponding values during the second experment were 9.82, 15.97,

17.26, 18.79, 20.81 and 28.36 per cent. The maximum yields obtained were 186.93 and 216.73 Q/ha in the first and second experiment respectively in the Carbofuran plus the Agricultural spray oil treatment. This increase in yield due to cobined treatment over the independent treatments of Carbofuran, Agricultural spray oil and control were 2.15, 31.2 and 158.7 per cent in the first experiment and 7.8, 13.5 and 53.0 per cent in the second experiment respectively.

DISCUSSION

There is a high TLCV incidence (63.8 %) in the first experiment conducted during January April 1982 when compared to the second experiment conducted during June-September 1982 (28.36 %). This less disease incidence is due to the low vector population for whose multiplication low temperature and high humidity prevailing during this season are not suitable. However, in both the experiments Carbofuran plus Agricultural spray oil treatments proved to be quite effective in minimising the disease spread, when compared with the other treatments. In earlier reports, Carbofuran treatment at 1.0 to 1.5 kg ai/ha was applied at the time of sowing transplanting the crops like soybean, okra, tomato, chillies etc. (Rataul and Labh Singh, 1976; Singh **et al.** 1971; Sastry **et al.** 1974, **Singh et al.** 1979). In 1969 Broadbent highlighted the prospects of systemic insecticides on vector control. Very little information is available on the combined use of insecticide plus Agricultural spray oil. Earlier Nene (1972) recommended two spray formulations consisting of (1) 0.2 % Thiodan (endosulfan) + 0.1 % metasystox (Oxydemeton methyl) + 2 % orchard oil (2) 0.1 malathion + 0.1 % metasystox + 2 % orchard oil for the control of **B. tabaci** on soybean, urd bean and other plants. From East Germany Zschiegner **et al.** (1971) also reported that leaf roll virus spread in potato crop will be reduced by the systemic insecticide plus oil in combination. The reduction of virus spread was 48, 55 and 75 per cent respectively for systemic insecticide, oil and systemic insecticide plus oil combination respectively. Kramer **et al.** (1978) also successfully reduced the virus spread in sugar beet by spraying dimethoate plus mineral oil combination than by the insecticide alone. The present studies clearly reveal that TLCV incidence can be minimized by combined use of systemic insecticide and mineral oil. In these studies, Carbofuran formulation (75 WP) was used instead of granular application (3 %) which is comparatively cheaper and the treatment is also not combursome. Besides this, the cost of Agricultural spray oil is cheaper than the insecticides. Another visual observation made during the study is that,

Carbofuran being systemic acts, as insecticide as well as nematicide as the treated plants were free of sucking insects and root knot nematode. Mahajan and Mayee (1977) also reported the control of root knot nematode and leaf curl virus of tomato by Carbofuran application at 9 Kg ai/ha. Till now no scientific data is available on the efficacy of initial root dip in Carbofuran solution followed by foliar sprays of mineral oil. The present studies reveal that the spread of tomato leaf curl virus can be minimized by the initial root dip of tomato seedlings in 0.1 % Carbofuran solution for 1 hr, followed by 2 foliar sprays of Agricultural spray oil at 10 day interval, starting from 20 days after transplantation.

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Ö Z E T

DOMATES YAPRAK KIVIRCIKLIĞI VİRUSU'NUN CARBOFURAN VE YAĞ KOMBİNASYONU İLE ÖNLENMESİ

Beyaz Sinek (**Bemisia tabaci**) ile taşınan Domates Yaprak Kıvırcıklığı Virusunun, iki tarla denemesi sonucundaki yoğunluğu, domates fidelerinin başlangıçta % 0.1'lik Carbofuran solüsyonuna 1 saat daldırılması ve bunu takip eden sürede, fide şaşırtmadan 20 gün sonra başlayarak, 10 günlük aralarla 2 kez yapraklara yağ püskürtülmesi ile minimuma indirilmiştir.

LITERATURE CITED

Broadbent, L. 1969. Disease control through vector control. In «Viruses, vector and vegetation» 593-630 (ed.) by KMaramorosch. New York: Interscience.

Kramer, W., O. Sass, R. Fritzsche, and G. Procseler, 1978. (Mineral oil insecticide combinations for the reduction of virus spread in sugarbeet production). Nachrichtemblatt for den Pflanzen schutz in der DDR, **32** : 29-30.

Mahajan, R. and C.D. Mayee, 1977. Combined control of root knot nematode and leaf curl disease in tomato. Nematol. medit., 5 : 141-145.

Nene, Y.L. 1972. A survey of the viral diseases of the pulse crops in Uttar Pradesh. G.B. Pant Univ. Agric. & Tech. Pantanagar Expt. Sta. Bull No. 4 : P. 191.

Rataul, H.S. and Labh Singh, 1976. Field studies on the control of soybean yellow mosaic virus transmitted by **Bemisia tabaci** Gen. by using different granular systemic insecticides. J. Res. Punjab agric. Univ., 13 : 298-302.

Sastry, K.S. 1984. Strains of tomato leaf curl virus and its preparation under field conditions. J. Turkish Phytopath., 13 : 87-90.

Sastry, K.S., K.S.M. Sastry, and S.J. Singh, 1974. Influence of different insecticides on tomato leaf curl virus incidence in the field. Pesticides 8 : 41-42.

Sastry, K.S. M., S.J. Singh, and K.S. Sastry, 1978. Studies on the epidemiology of tomato leaf curl virus. Indian J. Hort. 35 : 269-277.

Singh, H., G.S. Sandhu, and G.S. Mavi, 1971. Control of yellow mosaic virus in soybean, **Glycine max** (L) Merrill by the use of granular insecticides. Indian J. Entomol. 33 : 272-278.

Singh S.J., K.S. Sastry, and K.S.M. Sastry, 1979. Efficacy of different insecticides and oil on the control of leaf curl virus disease of chillies. Z. Pfl. Krankh. Pfl. Schutz. 86 : 252-256.

Zschiegner, H.J., W. Kramer, O., Sass, R , Fritzsche, and H. Dabnik, 1971. Successful restriction of the spread of non-persistent viruses by methods of virusvector control. Proc. 6th Br. Insectic. Fungic. Conf. pp. 319-323.

Table-1 : Effect of different insecticides and oil on the whitefly population and tomato leaf curl virus incidence.

Treatment	January - April, 1982			June - September, 1982		
	Total No. of whiteflies*	Percentage of TLCV	Calculated yield in Q/ha	Total No. of whiteflies*	Percentage of TLCV	Calculated yield in Q/ha
1. Carbofuran (0.3 %)	32	12.63	186.93	13	9.82	216.73
2. Mineral oil (1 %)						
3. Carbofuran (0.1 %)	43	19.37	153.81	20	15.97	201.06
4. Dimethoate (0.05 %)	63	24.36	138.81	38	18.79	190.11
5. Mineral oil (1 %)	48	21.91	142.47	26	17.26	190.88
6. Monocrotophos (0.05 %)	71	25.13	121.58	54	20.81	178.65
7. Control	126	63.85	72.25	82	28.36	141.63

* Total number of whiteflies counted on 300 leaves

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Effect of Some Stionic Combinations and Host Nutrition on Viral/Mycoplasmal Diseases in Citrus

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ABSTRACT

Effect of different citrus stionic combinations and host nutrition on viral/mycoplasmal diseases has been investigated. Incidence of greening disease in rootstock trials varied from 43.33 to 91.66 % in mandarins and 55.66 to 100 % in sweet orange. Among the seven rootstocks used for Kinnow and Coorg mandarins, greening disease incidence and die-back index were minimum on Rough lime and Cleopatra mandarin rootstocks respectively. None of the nine rootstocks used for sweet orange var. Mosambi and Sathgudi had significant effect on greening disease. Prevalence of tristeza virus as revealed by indexing in Sathgudi was recorded least on Rubidiox trifoliate rootstock. Greening, tristeza, psorosis and exocortis were the common diseases recorded. Incidence of greening disease in nutritional trial varied from 83.33 to 100 % in sweet orange var. Sathgudi. Different levels of nitrogen and potassium did not have significant effect on greening disease and die-back index.

INTRODUCTION

Citrus is third most important fruit crop in India and occupy about 9.1 % of the total area under fruits in the country. Mandarins (**Citrus reticulata** Blanco) consitute about 23 % of the total area under citrus. With a wide and varied influence of rootstocks already recognized and with regional peculiarities and responses of different stionic combinations the problem of finding out suitable rootstocks for various species and varieties of citrus growing successfully in different environment has become complicated. At the same time, selection of rootstock has become more important due to widespread decline, for reasons other than the stionic factors. Die-back or decline of citrus in India is a complex syndrome and has been attributed to both non-parasitic and parasitic egents (Chohan and Knorr, 1970). In order to

Contribution No. 3/89 of I.I.H.R., Bangalore.

study the role of different rootstocks/scion combinations and host nutrition in imparting tolerance against different viral/mycoplasmal/rickettsia-like diseases prevalent in South India, the rootstock and nutritional trials planted at the Experimental Farm of Indian Institute of Horticultural Research, Bangalore were surveyed and indexed and the information obtained from this study is presented in this paper.

MATERIALS and METHODS

Field observations on the prevalence of different virus and virus-like diseases and dieback were recorded in the following rootstock and nutritional trials at the Institute farm in mandarins and sweet oranges.

The first rootstock trial was laid out during July 1977 for mandarin vars. Kinnow and Coorg with 7 rootstocks namely, Rough lemon, Rangpur lime, Kodakithuli, Cleopatra mandarin, Troyer citrange, Carrizo citrange and Trifoliate. The experimental design was randomized block design (RBD) with four replications and each plot consisting of 6 trees. Second rootstock trial was laid out for sweet orange vars. Mosambi and Sathgudi in August 1979 involving 9 rootstocks namely, Carrizo and Troyer citranges, Cleopatra mandarin, Citrumello, Kodakithuli, Pomeroy trifoliate, Rubidiox trifoliate, Rough lemon and Rangpur lime. Each treatment was replicated 3 times in a RBD. A nutritional trial involving 6 levels of nitrogen viz., 200, 400, 600, 800, 1000 and 1200 g N/tree/year, 3 levels of K viz., 0, 200, and 400 g K_2O/tree/year and a constant level of 200 g of P_2O_5/tree was laid out in August 1979 using sweet orange var. Sathgudi on Rangpur lime rootstock. In all there were 18 treatment combinations replicated 3 times in a factorial RBD.

Observations on the incidence of greening disease and die-back were recorded in 1984 in mandarins and in 1986 and 1988 in sweet oranges. For recording the die-back index, 0 to 5 scale was followed where 0 means no death of branches and 5 means death of more than 80 % branches or of whole tree. Budwood samples from trees selected at random from the field experiments were collected and indexed under glasshouse conditions for different viruses, viroid, greening and MLO pathogens by the procedures and techniques given in the USDA handbook (Childs, 1968). The presence of greening in some field plants was also confirmed by thin layer chromatography technique (Schwarz, 1968).

RESULTS and DISCUSSION

Effect of rootstocks:

Mandarins: On the basis of visible symptoms in the rootstock trials

the extent of greening disease varied from 62.5 to 91.6 % in Coorg mandarin and 43.3 to 91.6 % in Kinnow mandarin. Plants were showing severe symptoms on all the rootstocks. Severity of die-back varied from 2.12 to 3.74 in Coorg mandarin and 1.41 to 3.47 in Kinnow mandarins (Table-1). Maximum die-back in both Coorg and Kinnow mandarins was recorded on Trifoliate citrange rootstock followed by Troyer citrange and other rootstocks. Minimum die-back was recorded on Cleopatra mandarin rootstock. Indexing results summarised in Table-2 clearly indicate that greening disease and tristeza virus were invariably present in Coorg mandarin scion on all the rootstocks. Mild or severe strain of tristeza virus was detected in 33 to 100 % plants and greening in 83 to 100 % plants irrespective of the rootstocks. Psorosis was detected only in two stionic combinations to the extent of 16.66 %. Vein enation and woody gall virus and exocortis viroid were not detected in Coorg mandarin.

Sweet oranges: The incidence of greening in sweet orange var. Sathgudi on different rootstocks varied from 0 to 33 % in 1986 and 55.6 to 100 % in 1986; maximum being on Pomeroy citrange and Cleopatra mandarin rootstocks in 1986 and on Carrizo citrange and Cleopatra mandarin rootstocks in 1988 (Table 3). Minimum incidence of greening was recorded on Kodakithuli rootstocks in both the years. In Sweet orange var. Mosambi, the incidence of 'greening' varied from 0 to 33 % in 1986 and 60.6 to 100 % in 1988 (Table 3). Die-back index in Mosambi varied from 1.83 to 3.83, maximum being on Cleopatra mandarin and minimum on Rangpur lime rootstocks. None of the field plants on any rootstock exhibited gum oozing or scaling of bark symptoms of psorosis but young leaf symptoms were observed in about 20 % plants. Typical symptoms of exocortis viroid viz., stunting of plants and cracking and scaling of bark on rootstock portion were observed in 12 % plants in case of Rangpur lime, Carrizo and Pomeroy citranges and Rubidiox trifoliate rootstocks. On indexing, tristeza virus was detected in sweet orange var. Sathgudi on all the rootstocks ranging from 26.6 to 86.6 % (Table 4). Association of severe strains was more on Pomeroy and Carrizo citranges than on other rootstocks. Detection of greening by indicator plants and TLC technique varied from 53.3 to 100 % minimum being on Kodakithuli rootstock and maximum on Pomeroy citrange. Psorosis virus was detected in 33.3 to 53.3 % on the basis of young leaf symptoms. Exocortis viroid was detected in 0 to 20 % plants; maximum being on Rangpur lime rootstock, followed by Carrizo citrange, Pomeroy citrange, Rubidiox trifoliate, Troyer citrange, Kodakithuli and others. Vein enation and woody gall virus was not detected in any stionic combination.

Effect of nutrition:

In nutritional trial in sweet orange var. Sathgudi, maximum incidence of greening disease was recorded at N_1 level on 1986 followed by N_6, N_4 and other treatments (Table 5). Minimum disease was observed at K_2 level followed by K_3 and K_1 levels but different levels were statistically at par with each other. In 1988, the incidence of treening varied from 86.1 to 94.4 % at different nitrogen levels and did not differ from each other statistically. Similarly, different levels of potassium had no significant effect of greening (Table-6). Dieback index at different levels of N and K was higher in 1988 than in 1986 and different levels of N or K had non-significant effect on die-back index in both the years (Tables 7,8).

Results presented above clearly indicate that the most common viral and viral like diseases associated with mandarins and sweet oranges were greening, tristeza, psorosis and exocortis. Capoor (1963) attributed die-back in citrus to tristeza virus infection alone; Fraser and Singh (1968) to greening disease alone and Raychaudhuri **et al.** (1972) to greening and fungal complex. Sharma and Saxena (1988) have observed greening disease predominantly associated with sweet orange and tristeza virus with acid lime in South India and psorosis, exocortis, blastomania and rubbery wood to a limited extent. Since there were no old citrus plantations harbouring these diseases nearby, the source of primary inoculum might have been the infected sweet orange and mandarin budlings. Greening is transmitted by citrus psylla (**Diaphorina citri**) and tristeza by a large number aphids (mainly **Toxoptera citricida**), the secondary spread must have been very fast as the moderate climate in this part of the country is quite favourable for multiplication and movement of the vectors. General conditions of mandarins deteriorated so fast that the entire plantation had to be uprooted in 1985. None of the rootstocks had significant effect on the incidence of greening disease both in mandarins as well as in sweet oranges Similar observations have been recorded earlier also in different varieties of sweet orange budded in different rootstocks (Cheema **et al.**, 1984; Kapur **et al.** 1984; Mehrotra **et al.** 1983). Tristeza virus has been detected to a very high percentage in both mandarins and sweet oranges, irrespective of the rootstocks used. Both the varieties of mandarin as well as of sweet orange and almost all the rootstocks used in the present trials have been reported highly resistant or resistant to two strains of tristeza virus (Naidu and Ramakrishnan, 1983) but moderate to severe decline has also been reported due to different strains of tristeza virus under different agroclimatic regions by several wor-

kers (Mali and Chaudhuri, 1979; Capoor, 1975; Burns et al. 1980). Since the budwood for raising the budlings on different rootstocks was obtained from old line trees, the higher incidence of tristeza might have been due to infected donor trees. Moreover, in the absence of employment of nucellar scion in both mandarins and sweet oranges, beneficial or ill-effects of rootstocks with respect to tristeza virus are difficult to assess. Exocortis has been considered to be a major disease of Rangpur lime, Trifoliate orange, some citranges and citrons but even the non-sensitive rootstocks like Sour orange and Rough lemon have also been reported to induce stunting on artificial inoculations (Cohen et al. 1980). Different levels of nitrogen have been reported to enhance the severity of tristeza virus in acid lime (Sharma, 1988) and P and K in sweet orange (Dornelles and Souza, 1980) but no such effect was observed for greening in sweet orange var. Sathgudi in the present studies.

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Ö Z E T

TURUNÇGİLLERDE VİRAL VE MIKOPLAZMA KAYNAKLI HASTALIKLAR ÜZERİNE BAZI STİONİK KOMBİNASYONLARIN VE KONUKÇU BESLENMESİNİN ETKİSİ

Viral/Mycoplazmal hastalıklar üzerinde farklı turunçgil stionik kombinasyonları ve konukçu beslenmesinin etkileri araştırılmıştır. Anaçlardaki denemelerde yeşillenme hastalığı yoğunluğu mandarinlerde % 43.33 ile % 91.66, tatlı portakallarda % 55.66 ile % 100 arasında değişmektedir. Kinnow ve Coorg mandarinlerinde kullanılan 7 anaç arasında, yeşillenme hastalığı yoğunluğu ve geriye doğru ölüm index'i, sırasıyla Rough lime ve Cleopatra mandarin anaçlarında minimumdur. Tatlı portakal varyeteleri Mosambi ve Sathgudi için kullanılan 9 anaçtan hiçbirisi yeşillenme hastalığı üzerinde önemli bir etki göstermemiştir. Sathgudi'de indexlenerek ortaya çıkarılan Tristeza virusunun varlığı Rubidiox trifoliata anacı üzerinde kaydedilmiştir. Yeşillenme, tristeza, psorosis ve exortis kaydedilmiş en bilinen hastalıklardır. Besin maddesi ile yapılan denemelerde yeşillenme hastalığı oranları tatlı portakal var. Sathgudi'de % 83.33 ile % 100 arasında değiş-

mektedir. Değişik seviyelerdeki azot ve potasyum, yeşillenme hastalığı ve geriye doğru ölüm index'i üzerinde önemli bir etki yapmamıştır.

LITERATURE CITED

Burns, R.M., E.C. Calavan, R.I. Blue and B.W. Lee, 1980. Effects of tristeza virus inoculations in Valencia oranges on six rootstocks. - Proc. 8th Conf. I.O.C.V. edts. Calavan **et al.** 1980. Univ. California Riverside, p. 28-31.

Capoor, S.P. 1963. Decline of citrus trees in India - Bull. Natl. Inst. Sci. India, **24** : 48-64.

Capoor, S.P. 1975. Role of tristeza virus in citrus die-back complex. - Indian J. Hort. **32** : 2-6.

Cheema, S.S., R.S. Dhillon and S.P. Kapur, 1984. Role of stionic combinations in sweet orange decline. II Susceptibility of old line and nucellar combinations to citrus diseases. - J. Res. Punjab Agric. Uni. **21** : 199-202.

Childs, J.F.L., 1968. Indexing procedures for 15 virus diseases of citrus trees. - U.S.D.A. Agric. Handbook No. 333, p. 1-96.

Chohan, J.S. and L.C. Knorr, 1970. Diseases. In Citrus Decline in India: Causes and Control edts. Chadha **et al.** 1970. p. 79-97.

Cohen, M., W.S. Castle, R.L. Phillips and D. Gonsalves, 1980. Effect of exocortis viroids on citrus tree size and yield in Florida. - Proc. 8th Conf. I.O.C.V. eds Calavan **et al.** 1980. Univ. California Riverside, p. 195-200.

Dornelles, G.M.M. and E.L.S. Souza, 1980. Interrelation among rootstocks, leaf composition and stem pitting on sweet orange scions. - Ibid. p. 32-39.

Fraser, L.R. and Daljit Singh, 1968. Citrus die-back in India. - The contribution of greening virus. - Proc. 4th Conf. I.O.C.V. edt, J.F.L. Childs, p. 140-144.

Kapur, S.P., S.S. Cheema and R.S. Dhillon, 1984. Reaction of certain citrus stionic combinations to viral/mycoplasmal disease. - Indian J. Hort. **41** : 142-143.

Mali, V.R. and K.G. Chaudhuri, 1979. Indexing results of citrus decline on rough lemon rootstock. - Indian Phytopath. **32** : 496-498.

Mehrotra, N.K., J.S. Jawanda and V.K. Vij, 1983. A comparative evaluation of rootstocks for pineapple orange (**C. sinensis** Osbeck.) under aridirrigated conditions of Punjab. - The Punjab Hort. J. **23** : 12-16.

Naidu, R. and K. Ramakrishnan, 1983. Reaction of citrus clones against tristeza virus. Proc. Intl. Citrus Symp. held at I.I.H.R., Bangalore, 1977. edts. K.L. Chadha and RN.Pal, p. 438-443.

Raychaudhuri, S.P., T.K. Nariani, G.R. Singh, S.M. Vishwanath and I.J. Kapoor, 1972. Epiphytology of the greening disease of citrus in India. Final Tech. Report. PL-480 Project, I.C.A.R., New Delhi.

Schwarz, R.E., 1968. Thin layer chromatographical studies on phenolic markers of the greening virus in various citrus species. - S. African J. Agric. Sci. **11** : 797-801.

Sharma, S.R. 1988. Cross protection in relation to tristeza virus in India. - Proc. Natl. Symp. Pl. Virus Problems in India, p. 49-50.

Sharma, S.R. and A.K. Saxena, 1988. Virus and virus-like diseases of citrus in South India and their management. Pl. Dis. Res. **3** : 127.

Table-1 : Effect of different rootstocks on greening disease and dieback index in mandarins in 1984

Rootstocks	Coorg mandarin		Kinnow mandarin	
	% Greening	Die-back index	% Greening	Die-back index
1. Rough lemon	75.0	3.12	75.0	2.91
2. Rough lime	62.5	2.45	43.33	2.62
3. Kodakithuli	66.5	2.87	62.8	3.08
4. Cleopatra mandarin	62.5	2.12	58.33	1.41
5. Troyer citrange	91.66	3.29	77.5	3.33
6. Carrizo citrange	83.33	2.83	83.33	3.07
7. Trifoliate citrange	75.0	3.74	91.66	3.47
S.Em ±		0.3653		0.2818
C.D. 5 %		1.0852		0.8372

Table-2 : Virus and virus-like diseases associated with declining Coorg mandarin trees on different rootstocks as revealed by indexing

Sl. No.	Rootstock	Indicator plants with viruses, viroid and greening symptoms						
		Kagzi lime		Rough lemon		Mosambi		Rangpur lime
		Tristeza (Mild)	Tristeza (Severe)	Vein enation	Woody gall	Greening	Psorosis	Exocortis
1.	Rough lemon	* 2/25	1/5	0/5	0/5	5/5	0/5	0/5
2.	Rough lime	3/6	0/6	0/6	0/6	6/6	0/6	0/6
3.	Kodakithuli	3/6	2/6	0/6	0/6	6/6	1/6	0/6
4.	Cleopatra mandarin	2/6	0/6	0/6	0/6	6/6	1/6	0/6
5.	Troyer citrange	3/5	2/5	0/5	0/5	5/5	0/5	0/5
6.	Carrizo citrange	1/6	2/6	0/6	0/6	5/6	0/6	0/6
7.	Trifoliate citrange	0/4	4/4	0/4	0/4	4/4	0/4	0/4

* Number of field plants infected/tested

Table-3 : Effect of different rootstocks on greening disease and dieback index in sweet orange

Rootstocks	var. Sathgudi			var. Mosambi		
	Greening		Dieback	Greening		Dieback
	1986	1988	index	1986	1988	index
1. Carrizo citrange	22.22	100.00	3.49	5.55	100.00	2.05
2. Cleopatra mandarin	33.33	100.00	2.49	11.10	100.00	3.83
3. Troyer citrange	16.66	66.33	2.77	0.00	77.33	2.87
4. Citrumello	16.66	60.66	2.72	33.33	100.00	2.55
5. Kodakithuli	0.00	55.66	2.05	16.66	60.66	2.66
6. Pomeroy citrange	33.33	94.33	3.38	11.10	100.00	2.10
7. Rubidioux trifoliate	5.55	88.66	2.55	5.55	83.33	1.88
8. Rough lemon	5.55	77.66	2.77	5.55	72.00	2.33
9. Rangpur lime	5.55	83.33	2.27	27.77	72.00	1.83
S.Em	10.2487	14.0583	0.4221	9.005	11.2310	0.2500
C.D. 5 %	30.7198	42.1427	1.2653	26.9808	33.6674	0.7496
C.D. 1 %	37.1748	58.0652	1.7433	37.1478	46.3877	1.0328

Table-4 : Virus and virus-like diseases associated with sweet orange var. Sathgudi as revealed by indexing

	Indicator plants with virus, viroid and greening symptoms					
	Acid lime		Mosambi		Rangpur lime/	Rough lemon
	Tristeza		Greening	Psorosis	Etrog citron	Vein enation
	Mild	Severe			Exocortis	and woody gall
1. Carrizo citrange	4/15 *	9	14	7	2	0
2. Cleopatra mandarin	5	4	14	6	0	0
3. Troyer citrange	6	2	10	5	1	0
4. Citrumello	4	2	9	5	0	0
5. Kodakithuli	2	3	8	8	1	0
6. Pomeroy citrange	3	10	15	7	2	0
7. Rubidioux trifoliate	2	2	12	6	2	0
8. Rough lemon	4	3	10	7	0	0
9. Rangpur lime	3	4	11	5	3	0

* Number of field plants infected out of 15 plants indexed in each case.

Table-5 : Effect of different levels of N and K on percentage of greening disease in sweet orange var. Sathgudi in 1986

	N_1	N_2	N_3	N_4	N_5	N_6	Mean
K_1	83.33	41.66	16.66	75.0	41.66	41.66	50.0
K_2	75.0	33.33	50.0	8.33	33.33	75.0	45.83
K_3	50.0	50.0	25.0	50.0	25.0	83.0	47.22
Mean	69.44	41.66	30.55	44.44	33.33	66.66	

	N	K	N x K
S.Em ±	8.4370	5.9659	14.6134
C.D. (5 %)	24.26	17.155	42.02

Table-6 : Effect of different levels of N and K on percentage of greening disease in sweet orange var. Sathgudi in 1988

	N_1	N_2	N_3	N_4	N_5	N_6	Mean
K_1	100.00	83.33	83.33	100.00	91.66	83.33	90.27
K_2	91.66	91.66	91.66	75.00	91.66	100.00	90.27
K_3	91.66	100.00	83.33	83.33	91.66	91.66	90.27
Mean	94.44	91.66	86.11	86.11	91.66	91.66	

	N	K	N x K
S.Em ±	4.9963	3.5329	8.6539
C.D. 5 %	14.367	10.159	24.88

Table-7 : Effect of different levels of N and K on die-back index in sweet orange var. Sathgudi in 1986

	N_1	N_2	N_3	N_4	N_5	N_6	Mean
K_1	2.56	2.75	2.51	2.88	2.83	2.35	2.65
K_2	2.21	2.6	2.71	2.21	2.53	2.61	2.48
K_3	2.93	2.46	2.68	2.71	2.66	3.23	2.78
Mean	2.57	2.60	2.63	2.60	2.67	2.73	

	N	K	N x K
S.Em ±	0.2049	0.1449	0.355
C.D. 5 %	0.5893	0.4167	1.02

Table-8 : Effect of different levels of N and K on die-back index in sweet orange var. Sathgudi in 1988

	N_1	N_2	N_3	N_4	N_5	N_6	Mean
K_1	3.08	2.91	3.1	33.3	3.08	2.91	3.07
K_2	3.18	2.93	3.58	3.66	3.43	4.0	3.46
K_3	3.08	2.73	3.58	3.08	2.91	3.41	3.13
Mean	3.11	2.86	3.42	3.36	3.14	3.44	

	N	K	N x K
S.Em ±	0.2669	2.2029	0.397
C.D. 5 %	0.8251	0.5834	1.4292

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Tuber, Graft and Dodder Transmission of Potato Diseases Caused by Mycoplasmalike Organisms (MLO) in Erzurum Region

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ABSTRACT

In Erzurum Region % 40.5 of the tubers obtained from the potato plants (cv. Famosa, Granula, İzola Marfona) showing the sysptoms of the diseases caused by MLOs gave hairy sprouts, 14.9 % were not sprouted and the rest were normal. 30.6 % of the plants raised from these tubers exhibited symptoms and 21.6 % of them failed to emergence. These diseases transmitted to various test plants (**Lycopersion esculentum** Mill., **Datura stramonium** L., **Capsicum annuum** L., **Solanum melongena** L., **Vinca rosea L.**) by dodder and graft while mechanical inoculations gave negative reactions.

INTRODUCTION

Plant mycoplasmas, formerly considered as viruses, were first detected in the ultra-thin sections of the phloem tissues of the plants exhibiting witches broom (yellow type) symptoms (Doi **et. al.** 1967). Their detection has opened a new area in plant pathology.

In Turkey the stolbur disease of potatoes was first observed in Bolu (Sahtiyancı, 1966), later on in the same year Sahtiyancı and Varlı (1966) reported the incidence of the same disease in Erzurum Region under the name of stolbur virus disease of potatoes. Çıtır (1985) described three kinds of MLO diseases of potatoes in Erzurum by evaluating their visible symptoms in field conditions.

In Erzurum District in 1986-1987 the ratios of the potato tubers infected by MLOs were 5.2 % (not-sprout) 3.0 % (hairly shrout) in storages while under field conditions the ratio of infected plants were 24 % (Açıkgöz and Gülsoy, 1988). The yield loss determined in four different potato cultivars was 26-73 % in 1988 (Açıkgöz, 1988).

In the identification of the MLO s as the causal agents of the potato diseases causing high yield reductions in Erzurum, the transmission

ways should be determined. In these diseases grafting and dodder has been often used for experimental transmission. Semencik and Peterson (1971) observed the transmission of the causal agent of haywire diseases (MLO) by grafting Klein **et al.** (1975), reported that MLO can be transmitted by dodder from stolbur and parastolbur infected tomato plants to **Vinca rosea** L.. Siller **et al.**, (1987) used dodder in the transmission of whitches broom. Tubers were also proved to be effective in the transmission of the MLOs. As a matter of fact Nagaich and Giri (1975) found the transmission ratio by tubers varies 6-33 % according to potato cultivars.

This study was carried out by using four potato cultivars to determine the dodder, graft and tuber transmission ways of potato diseases caused by MLOs in Erzurum Region.

MATERIALS and METHODS

Leaf samples at the ten plants of Nicola, Marfora, Famosa and Granula potato cultivars were collected from Merkez, Pasinler and Oltu. These samples were tested for the presence of viruses by mecanical sap inoculations to indicator plant viz., **Gomphrena globosa** L., **Nicotiana tabacum** L., **N. glutinosa** L., **N. clevelandii** Gray, **Chenopodium amaranticolor**, Costa Reyn, **C. quinoa** Willd, **Datura stramonium** L., **Datura stramonium** L., **Capsicum annuum** L., **Solanum melongena** L. from the plants which gave negative reaction to above inoculations were used in this study. After harvesting, the tubers were stored 5-6 months and then they were kept in 20°C for germination. Afterwards these tubers were planted into pots containing disinfected soil and the plants were examined for symptom exhibition.

In determination of the transmission by grafting (Smith, 1977) infected plants obtained from infected tubers were used as inoculum sources. These plants were grafted to **Lycopersion esculentum** Mill, **Datura stramonium** L., **Capsicum annuum** L., **Solanum melongena** L. The grafted plants were kept in a insect proof glasshouse for 6-8 days to provide succesful union of stalks and the transmission of the causal agents. After 20-30 days the symptom development were observed.

For transmission by dodder (Shade, 1981), **Cuscuta campestris** was maintained on healty tabocco plants in a glasshouse. Pieces of healthy cuscutas were allowed to parasitize on diseased plants for at least 15-30 days and then trained on to the plants indicated above and **Vinca rosea** L.. After the establisment of cuscutas on the test plants

for about two weeks, they were removed and then the test plants were observed for symptom producing.

RESULTS

The results of germination tests (Table 1) showed that nearly half of the tubers gave normal sprouts, while the others were hairy (40.5 %) and not-sprout (14.9 %).

Table 1. Percentages of hairy sprout, not-sprout and normal sprout tubers in potato cultivars.

Potato cultivars	% Hairy sprout	% not-sprout	% Normal sprout
Farmosa	52.6	8.5	38.9
Granula	51.3	6.6	42.1
İzola	26.5	14.9	58.6
Marfona	31.5	29.7	38.8
Mean	40.5	14.9	44.6

The tubers collected from the plants showing the symptoms of the disease caused by MLOs produced infected plants, normal plants and in some others no emergence was observed (Table 2).

Table 2. Percentage of emergence, infected and symptomless plants raised from the diseased tubers.

Potato cultivars	% Fail to emergence	% Diseased plants	% Symptomless plants
Famosa	32.3	23.5	44.2
Granula	15.7	29.4	54.9
İzola	17.6	35.3	47.1
Marfona	20.9	34.3	44.8
Mean	21.6	30.6	47.1

The diseased plant exhibited five different types of symptoms as described below;

a) Purple pigmentation and upward rolling of basal parts of young leaflets.
b) Numerous and thin cylindrical stems with simple leaves.
c) Production of aerliar tubers.
d) Shorting of internodes and swelling of nodes.
e) Chlorotic shoots, wiltage and early plant deaths.

The transmission of MLO from potato plants to healty test plants by grafting and dodder was succesfully achieved. The symptoms observed on the transmitted test plants are described below:

Lycopersion esculentum Mill. Profuse proliferation of axillary shoots and complete modification of leaves, flowers, non functional. The plants are usually severely stunted the apical leaves being obviously reduced in size and shape.

Datura stramonium L. The plants are usually severely stunted interveinal chlorosis accompanied by proliferation of axillary shoots, smalling and narrowing of leaves.

Capsicum annuum L. Plants more or less stunted. Apical leaves reduced, somewhat flavescent, with interveinal curling and chlorosis. Leaves were transiently rolled. Infected leaves smaller than normal, and deformed. Leaves are stiff, dry and leathery.

Solanum melongena L. Upright habit with slight proliferation of axillary buds into short shoots with some rolling of apical leaves.

Vinca rosease L. Plants stunted, axillary shoots increased the apical internodes are slightly shortened and discoloration on leaves.

DISCUSSION

In Erzurum Region varicus symptoms such as purple top-wilt, aerial tuber, hair sprout and not sprout on tubers similar to those described by Wright **et. al.** (1981) for the aster yellows of MLO were observed on potatoes. Symptamatological definitions of these potato diseases in Erzurum implies that they are MLO origin. On the other hand the development of typical symptoms on the plants raised from the infected tubers show that the causal agents can be transmitted by tubers. As a matter of fact Wright **et. al.** (1981). Indicated that the MLOs of these potato diseases can survive in tubers and the plants in the second year develop symptoms. The ratio of the tuber transmission varies between 6-33 % depending on the cultivars (Nagaich and Giri, 1975). In our studies the mean transmission was 30.6 %. Additionaly 21.6 % fail to emergence. Possibly this was due to the not-sprout tubers.

Potato diseases caused by MLOs were transmitted to **Lycopersion esculentum** Mill., **Datura stramonium** L., **Capsicum annuum** L., **Solanum melongena** L. by grafting as stated by Panjan et. al. (1970), Nagaich **et. al.** (1973) Nagaich (1978). Harding and Teakle (1985) were also shoved that purple top wilt disease agent of potatoes can be transmitted from tomatoes by grafting. The other way of MLO trans-

smission, through dodder (Ploaie and Maramoroch, 1969; Nagaich **et. al.** (1973), Nagaich (1978) was also achieved in our studies since the agent was succesfully transmitted from infected potatoes to various test plants indicated above including **Vinca rosea** L. by dodder.

Ö Z E T

ERZURUM BÖLGESİNDE MİKOPLAZMA BENZERİ ORGANİZMA (MLO)'LARIN NEDEN OLDUĞU PATATES HASTALIKLARININ YUMRU, AŞI VE KÜSKÜT İLE TAŞINMASI

Erzurum bölgesinde MLO'ların neden olduğu hastalıkların simptomlarını gösteren patates bitkilerinden (Famosa, Granula, İzola, Marfona) elde edilen yumruların % 40.5'i ipliksi sürgün, % 14.9'u kör ve geriye kalanları normal sürgün verdi. Bu yumrulardan elde edilen bitkilerin % 30.6'sı simptom sergiledi ve bunların % 21.6'sı çıkış yapmadı. Bu hastalıklar çeşitli test bitkilerine (**Lycopersion esculentum** Mill., **Datura stramonium** L., **Capsicum annuum** L., **Solanum melongena** L., **Vinca rosea** L.) aşı ve küsküt ile taşındılar fakat mekanik inokulasyona negatif reaksiyon verdiler.

LITERATURE

1. Açıkgöz, S., 1988. Erzurum yöresinde Mikoplazma Benzeri Organizma (MLO)'ların Patates Çeşitlerinde Simptomları Hastalık Seyri ve Zararı Üzerinde Araştırmalar. (IV. Türkiye Fitopatoloji Kongresi Tebliği).

2. Açıkgöz, S. and E. Gülsoy, 1988. Erzurum Yöresinde Mikoplazma Benzeri Organizma (MLO)'lar ile Enfekteli Patates Bitki ve Yumru Dağılımları ve Oranları Üzerinde Araştırmalar. Doğa Dergisi (Baskıda).

3. Beemster, A.B.R. and A. Rozendaal, 1972. Potato Viruses: Properties and Symptoms. p. 115-143. In J.A. de Box (Ed.), Viruses of Potato and Seed-Potato Production. Centre for Agricultural Publishing and Documantation Wageningen, Holand.

4. Çıtır, A., 1985. Preliminary Investigation of Potato Diseased Caused by Mycoplasmalike Organisms (MLO) in Erzurum Region. I. Turk. Phytopathol., **14** (2) : 52-63.

5. Doi, Y., K. Teranako, K. Yora and H. Asuyama, 1967. Mycoplasma or PLT group-like microorganisms found in the phloem elements of plants infected with bulberry dwarf, potato witches broom, aster yellows or paulownia witches broom. Ann. Phytopath. Soc. Japan **33**, 259-266.

6. Harding R.M. and D.S. Taekle, 1985. Mycoplasma-like Organisms as Causal Agents of Potato Purple Top Wilt in Quessland. Aust. J. Agric. Res. **36** : 443-449.

7. Klein M., S.Z. Gries, and B. Snch. 1975. Association of Bacterialike Organisms With a New Potato Disease. Phytopathology. **66** : 564-569.

8. Nagaich, B.B., S.D.M. Kaley, S.B.K. Giri, S.V.P. Bhardwaj, 1973. Investigations on Hairy Sprout Disease of Potato Final Technical Report. Central Potato Research Institute, Simla (H.P.), Kapoor Art Press.

9. Nagaich, B.B., B.K. Giri, 1975. Purple top roll disease of potatoes. Proceedings of the Indian National Science Academy **41** (4) : 367-372.

10. Nagaich, B.B. 1978. Investigations on Purple top Roll and witches broom diseases of the potato. Central Potato Research Ins. Simla (H.P.).

11. Panjan, M., A. Saric, and M. Wrischer, 1970. Mycoplasmaanliche Gebilde in Tomatenpflanzen nach Infektion mit Kartoffelgelbsucht. Phtyopathol. Z. **69** : 31-35.

12. Ploaie, P., and K. Maramorosch, 1969. Electron microscopic demonstration of particles resembling mycoplasma or psittacosis - lymphogranulomatrachome group in plants infected with European yellows-type diseases. Phytopathology. **59** : 536-544.

13. Sahtiyancı, Ş. 1966. Patates Stolbür-Virüsü ve Türkiye'de ilk müşahadesi. Bitki Koruma Bülteni. **6** (1) : 24-29.

14. Sahtiyancı, Ş. and G. Varlı, 1966. Patates Stolbur hastalığı yıllık raporu. Erenköy Böl. Zir. Müc. Araş. Ens. İstanbul. (Basılmamış).

15. Semancik, J.S. and J. Peterson, 1971. Association of a Mycoplasma with Haywire Disorder of Potatoes. Phytopathology. **61** : 1316-1317.

16. Shade, Ch. 1981. Bitki Virüs Hastalıkları. Metod Kısmı tercüme eden. Sahtiyancı, Ş. Erenköy Bölge Zirai Mücadele Enst. 94 s.

17. Siller, W., B. Kuhbandner, R. Marwitz, H. Petzold, E. Seemüller, 1987. Occurence of mycoplasmalike organisms in parenchyma cell of **Cuscuta odorata**. Journal of Phytopat. **119** (2) : 147-159.

18. Smith, K.M. 1972. A Textbook of Plant Virus Diseases. Academic Press. New York and London. 684 p.

19 Wright, N.S., J. Raine and V. Valenta, 1981. Mycoplasmas. p: 91-93. In W.C. Hooker (Ed.) Compendium of Potato Diseases. The American Phytopathological Society. U.S.A. 125 p.

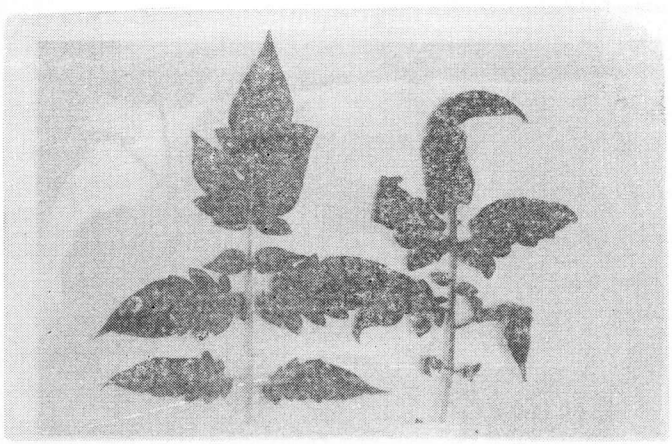

Fig 1. **Lycopersion esculentum** Mill. a) Healthy leaves
b) Infected leaves

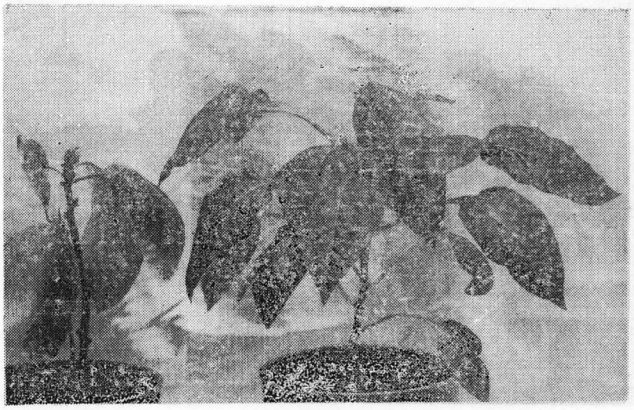

Fig 2. **Capsicum annuum** L. a) Infected plant, b) Healthy plant.

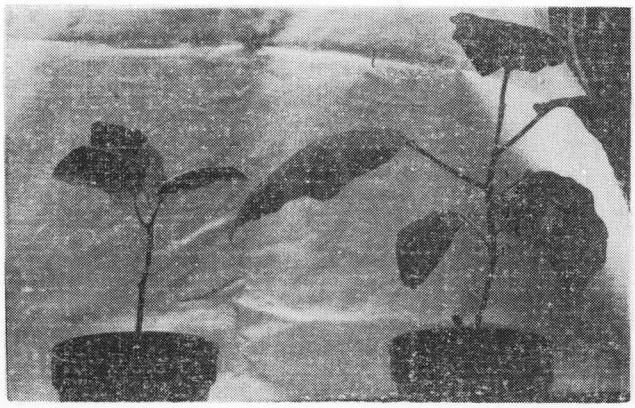

Fig 3. **Solanum melongena** L. a) Infected plant, b) Healthy plant.

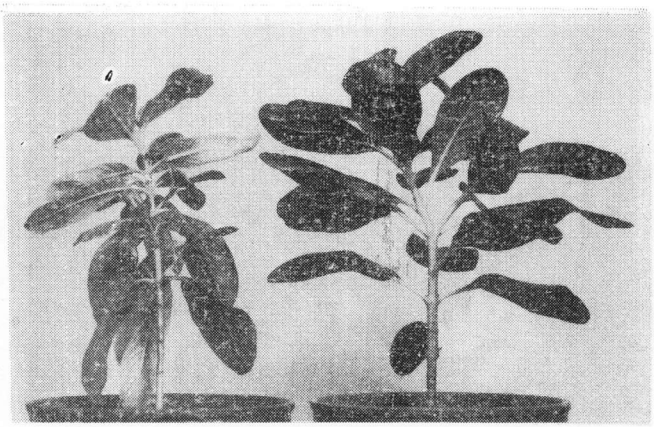

Fig 4. **Vinca roesa** L. a) Infected plant, b) Healthy plant.

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Investigation on the Physiological Variation of **Macrophomina phaseolina** (Tassi.) Goid. in Aegean Region

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ABSTRACT

In this study several aspects charcoal rot caused by **M. phaseolina** were studied. The fungus was isolated in 362 out of 504 diseased specimen collected in the region (71.82 %). 333 isolates studied exhibited variations for cultural characteristics such as colony colour, mycelia growth, colonial radius (mm), and the number of sclerotia and they grouped in their colonial radius and the number of sclerotia.

INTRODUCTION

Tobacco, being one of the most important export crop, is commonly grown in all regions of Turkey. Aegean Region is ranked first among the other regions in terms of both area sown and production in 1983/84 growing area season.

M. phaseolina which is the causal pathogen of the charcoal rot disease of tobacco, could find a proper living media in Aegean region because of its soil and climatical conditions. As in various countries of the world, the fungus is isolated from several crop species. WYLLIE and ROSENBROCK (1985) reported that the fungus had a host range of about 400 plant species. DHINGRA and SINCLAIR (1978), mentioned that annual yield depression in several crops was 10-15 % although losses in quite difficult to mesure.

Charcoal rot studies conducted in Turkey have been unsufficient. BREMER (1944), reported that the causal organism was common in various plant species of Aegean region; that it caused an epidemy on tobacco depressing the yield by 6 % between that period of 1935-38.

BORA (1970) reported that **M. phaseolina** was obtained along with the other damping-off pathogens in seedling beds in Turkey. Also, YILDIZ (1977), studied on the sugar melon wilt disease and he mentioned that **M. phaseolina** has occurred with the other wilt causal agents.

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The variation of **M. phaseolina** (Tassi.) Goid. was densely studied depending on different criteria such as sclerotial diameter (HAIG, 1977), isolates morphology and their growth type and rate in culture (REICHERT and HELLINGER, 1947) and pathogenicity.

IBRAHIM et al (1979), claimed that pathogenicity seemed to be the most reliable criterion for idendification. EL-DAHAB et al. (1983), grouped 16 isolates as virulent, moderately virulent and weakly virulent.

ARCA and YILDIZ (1988), studied on the incidence of charcoal rot, pathogenicity of 52 **M. phaseolina** isolates, and also the reactions of 24 tobacco cultivars/lines against the pathogen. They found out that the mean incidence over the two years (1985/86) in Izmir area was 53,75 %. There were some differences among the 52 isolates studied in terms of their virulence, and they could be grouped in their virulences. 24 tobacco cultivars/lines were found to be susceptible to this pathogen.

MATERIALS and METHODS

34 towns and 123 villages of five provinces (Aydın, Balıkesir, Izmir, Manisa, and Muğla) in Aegean region were selected as research sites.

The isolates of **M. phaseolina** used in this research were obtained from the diseased plant samples collected from these places mentioned above. It was made use of 333 isolates in laboratory studies.

In the laboratory studies PDA was used for examining the **M. phaseolina isolation**, colony colour, type of mycelial growth, colonial diameter and the number of sclerotia (PENCIC, 1977). In the amount of 40 mg/lt streptomycine sulphate was added to the medium to inhibite any bacterial activities. Number of samples were determined as one sample per 15000 bale in towns of five cities. After having collected the samples, they were marked and placed in envolopes and stored, after words.

Isolation of the pathogen was realized by cutting of the basal part of the plant disenfecting in the NaOCl 0,5 % for 2 minutes, washing under sterile water; cutting in to three pieces each of 1 cm and placing on the PDA. Colonies from which tips were received to use in hyphal studies were procured from hyphal end of isolates grown at 30°C for two days (DHINGRA and SINCLAIR, 1973).

For identification some of the characteristics of **M. phaseolina** isolates, pieces of 5 mm in diameter taken from the tip of two-days old

colonies were placed on PDA taking the care of side where colony developed being faced to PDA. Colonial characteristics such as colour, mycelial growth type and colonial measurements were taken two days after sowing, and sclerotia countings four days after sowing both at 25°C (DHINGRA and SINCLAIR, 1973). Sclerotia countings were carried out five different locations which had similar distance from the center of each petri dishes under 20 x 10/0,25 (0,45 mm^2) magnification.

RESULTS and DISCUSSION

Of the 504 specimen collected from Aegean region, 362 (71,82 %) were found to be infected with **M. phaseolina.** KARCILIOĞLU et al. (1985), reported that it was quite common in the region with the percentage of 34,9 % and 66,1 % in 1983 and 1984, respectively.

As it is known, **M. phaseolina** can infects various crop species especially under dry climatical conditions and water stress. DHINGRA and SINCLAIR (1978), declared that disease rate is increased by rising temperatures and optimum temperature was 25-35°C. JAIN and KULKARNI (1966), notified that the pathogen could survive in the soil over the hot summer period in India. The mean max. soil temperature in 10 cm depth was measure in July-August of 1985 as 33,6°C and in August of 1986 33,4°C in Aegean region. These figures indicate that the causal organism could survive easily in Aegean conditions.

Several researchers studied the variation of **M. phaseolina** and they mostly grouped the isolates as physiological strain, form, type or subspecies (ANONYMOUS, 1955; SULAIMAN and PATIL, 1977; REICHERT and HELLINGER, 1947). However, there has been no grouping model commonly accepted as it is in several other pathogens. Variation studies of **M. phaseolina** were done depending on sclerotial size (HAIG, 1977), cultural characteristics such as mycellium growth, colour, colonial type and pathogenicity (REICHERT and HELLINGER, 1947; DHINGRA and SINCLAIR, 1973; GOSH and SEN, 1976; SULAIMAN and PATIL, 1977; IBRAHIM et al, 1979).

Criteria applied in this study such as colour, radius, mycellium growth and type in two days colonies, and number of sclerotia in four-days colonies were also used by SULAIMAN and PATIL (1977); GUPTA and KOLTE (1984) and DHINGRA and SINCLAIR (1973) (sclerotial size instead of number).

Isolates studied were differ in their colonial colour, type of mycellium growth, colonial radius and number of sclerotia (Graph 1). Isolates were found to be in several colour tons. They are mainly beige,

green, and grenish-beige. However, colonies with colourless, yellow, pink and even black were also appeared. While some isolates altered their colours other did not. DHINGRA and SINCLAIR (1973), reported that the colour of nine isolates were mostly brown, but by aging the colour turned to dark grey. SULAIMAN and PATIL (1977), declared that the colours of two isolates were oil-green and dark grey. EL-HELALY et al. (1973), reported that they obtained a colourless pathogenic mutant.

The mycelial growth type of **M. phaseolina** was found as velvety, hairy, hairish-velvety, airy, and cottony. Similar observation were declared by several authors (DHINGRA and SINCLAIR, 1973 and REICHERT and HELLINGER, 1947). However cultural characteristics studied were different than those of reported elsewhere. This was attributed to the differences in area sampled, and the number of specimen. It should be also pointed out that differentiation is subjective. 333 isolates growing after two days at 25°C they could be grouped according to their radius as 0-15 mm (slow growth), 16-30 mm (medium growth) and 31-45 mm (fast growth). DHINGRA and SINCLAIR (1973) also used the same grouping while they were studying with nine isolates. Isolates were also grouped depending on the number of sclerotia produced as 0-20 (none or a few), 21-40 (medium) and 41-55 (plentiful). This results also fit to the SULAIMAN and PATIL (1977)'s findings.

Ö Z E T

EGE BÖLGESİNDE **Macrophomina phaseolina** (Tassi.) Goid.'NIN FİZYOLOJİK VARYASYONU ÜZERİNDE ARAŞTIRMALAR

Tütünde **M. phaseolina**'nın neden olduğu Özükuru hastalığı üzerinde çalışılmıştır. Bu fungus, Ege Bölgesinden toplanan 504 hastalıklı bitkinin 362'sinden (% 71,82) izole edilmiştir. Ele alınan 333 izolat kültürel karakteristikleri (koloni rengi, miselyal gelişmesi), koloni yarıçap (mm) ve sklerot sayıları açısından önemli farklılıklar göstermiş ve gruplandırılmışlardır.

LITERATURE CITED

ANONYMOUS, 1955. Annual Report of the Jute Agric. Res. Inst. 1954-55, 138 pp.

ARCA, G.; M. YILDIZ, 1988. Ege Bölgesi'nde Tütünde Özukuru Hastalığı (**Macrophomina phaseolina** (Tassi.) Goid.)'nın Durumu, Patojenisitesi ve Yerel Çeşitlerin Duyarlılıkları Üzerinde Araştırmalar. V. Türkiye Fitopatoloji Kongresi Bildiri Özetleri, 18-21 Ekim 1988, Antalya, 123.

BORA, T. 1972. İzmir, Manisa, Muğla İllerinin Tütün Fideliklerinde Çökerten Hastalığının Zarar Derecesi, Fungal Etmenlerin Genuşlarının Tanımı, Dağılışı ve Patojenisiteleri Üzerinde Araştırmalar. E.Ü. Zir. Fak. Yayınları, No: 183, p. 83.

BREMER, H., 1944. On wilt diseases in Southwest Anatolia. İstanbul Yazıları. **18** : 1-44.

DHINGRA, O.D.; J.B. SINCLAIR, 1973. Variation among isolates of **Macrophomina phaseoli (Rhizoctonia bataticola)** from different Regions (1972) Phytopath. Z., **76**, 200-204.

———————————— 1978. Biology and Pathology of **Macrophomina phaseolina.** Imprensa Universitaria Universidade Federal De Vicosa. p. 166.

EL-DAHAB, M.K.A.; TARABETH, A.M.; MOHAMED, S.E. 1983. Studies on sunflower diseases in Egypt 1. studies on charcoul rot and its control. Review of Plant Pathology **62** (3) : 1148.

EL-HELALY, A.F.; M.K. ABO-EL-DAHAB; M.A. EL-COORANI, 1973. New diseases of potato tubers in Egypt; leak, grey mold and charcoal rot United Arap Republic Journal of Phytopathology (1970, publ. 1971) 2, 1-7. Review of Plant Pathology **52** (4) : 1235.

GHOSH, S.K.; C. SEN, 1976. Comparative physiological studies on four isolates of **Macrophomina phaseolina**. Indian Phytopathology (1973 publ. 1974) 26 (4) 615-621. Review of Plant Pathology **55** (1) : 264.

GUPTA, S.C.; S.J. KORTE, 1984. Cultural characteristics of leaf and root isolates of **M. phaseolina** (Tassi.) Goid. from groundnut. Indian Journal of Microbiology (1981) 21 (4) 345-346 Review of Plant Pathology **63** (11) : 5224.

HAIG, S.C. 1977. **Macrophomina phaseoli** (Maubl.) Ashby and **Rhizoctonia bataticola** (Taub.) Butler. Ann. Rop. Bot. Gard. Paradeniya (1930) **11** : 213-249. Ann Annotated Bibl. of M.Ph. 1905-1975, 329.

IBRAHIM, I.A.; A.M. KAMARA; N.G. GAHIN, 1979. Studies on two isolates of **Sclerotium bataticola** Taub. Acta Phytopathologica Academiae Scientiarum Hungaricae **14** (3/4) 383-390.

JAIN, A.C.; S.N. KULKARNI, 1966. Root and stem-rot of sesamum. Indian Oilseeds J. (1965), 9 (3) : 201-203 Review of Applied Mycology **45** (8) : 2207.

KARCILIOĞLU, A.; M. ESENTEPE; E. ONAN; E. SEZGİN, 1985. Ege Bölgesi İkinci Ürün Ekim Alanlarında Görülen Hastalık, Zararlı, Yabancı Otlar ve Bunların Doğal Düşmanları Üzerinde Araştırmalar. Bornova Zirai Mücadele Araştırma Enst. 8/A 600. 001-1 no'lu projenin sonuç raporu (basılmamış).

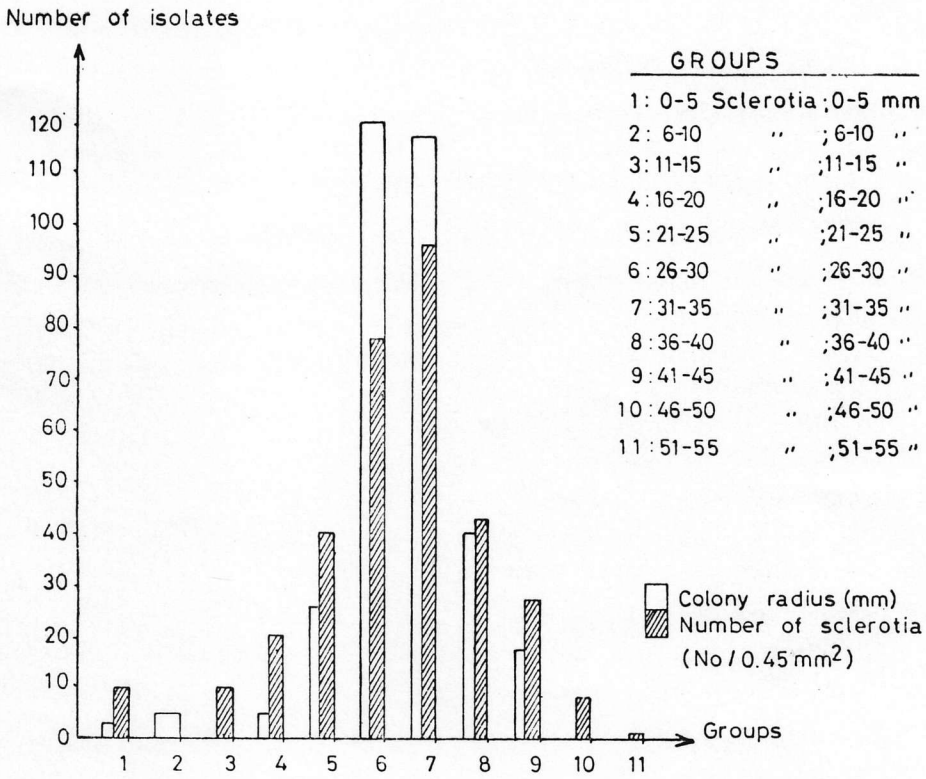
PENCIC, V., 1977. **Sclerotium bataticola** as a causal agent of stem and root rot of maize in Serbia. Agron. Glasn (1970) **32** : 69-76 An Bibl. of M. ph. 1905-1975, 1592.

REICHERT, I.; E. HELLINGER, 1947. On the occurence, morphology and parasitism of **Sclerotium bataticola.** Plastine J. Bot. **6** : 107-147.

SULAIMAN, M.; B.C. PATIL, 1977. Existence of phsiological races of **Macrophomina phaseoli** causing root rot Cotton. Beitr. Trop. Subtrop. Land-wirtsch. Tropenveterinarmedizin, (1966) **4** : 291-298.

WYLLIE, T.D.; S.M. ROSENBROCK, 1985. Crop rotation as a means of controlling populations of **Macrophomina phaseolina** in Missouri soils. Phytopatholgy **75**, (from Annual Meeting).

YILDIZ, M., 1977. Ege Bölgesinde Kavun Solgunluk Etmeninin Patojenisitesi, Irkları ve Yerel Çeşitlerin Dayanıklılıklarının Saptanması Üzerinde Araştırmalar. Doçentlik Tezi (Basılmamış).



GRAPH 1: Distrubution of the isolates sampled from five cities on the bases of their radius and number of sclerotia

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Effectiveness Of Some Fungicides Against Covered Kernel Smut Disease (**Sphacelotheca sorghi** «Link» Clin.» On Sorghum (**Sorghum vulgare** Pers. var. **technicum** «Koern.» Jav.) in Çukurova Region

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ABSTRACT

Vitavax 75 W, Baytan 7.5 DS and Plantineb 80 WP fungicides were tested to sorghum covered kernel smut disease (**S. sorghi**) on sorghum plants. It was determined that two systemic fungicides controlled the disease effectively.

INTRODUCTION

Sorghum covered kernel smut disease is a common smut disease observed on sorghum plants. Viennot-Bourgin (1949) indicated that crop losses due to the disease were estimated as 10 % in Bombay region of India, and 40-50 % in some district of the region. The soil humidity of 40 % is necessary for infection. The temperature necessities are 16°C minimum, 40°C maximum and 20-23°C aptimum for germinating of smut spores. Infection occur when the first leaves emerge in the field. Sorghum germination is completed in 1-2 days at 37°C, in 2-3 days at 30°C, in 3-4 days at between 20°C and 23°C and 4-6 days at 16°C. If sorghum germination period is long and the temperature is suitable for fungus germination, the infections take place easily, and maximum infections occur. Tarr (1962) indicated that the losses due to the sorghum covered smut disease were estimated as about 30 % on sorghum in Venezuella and as 30-40 % on sweet sorghums in Italy. Bremer (1948) reported that there was sorghum covered smut disease in Turkey, firstly. The author also reported that the disease had caused great losses, and the control of the disease could be possible with seed treatment.

Hansing (1970), in field experiments, found that Vitavax at the dose of 2.67 ounce per a bushel seed (75 g per 100 kg) was effective against to the disease. Popov and Silaev (1980), in seed treatment studies, found that Vitavax and Benlate fungicides could be effective against to the disease.

EFFECTIVENES OF SOME FUNGICIDES AGAINST COVERED KERNEL SMUT DISEASE

Sorghum covered kernel smut disease had been observed in Sout-Eastern Anatolia, during the years of 1973-1980. The disease were also observed in Southern region, Karataş district of Adana in 1985 at high infestation levels.

Because of it has not found any scientific notice on control of sorghum covered kernel disease until today in Turkey, this study was carried out to determine the effectiveness of some chemical to control the disease.

MATERIALS and METHODS

Sorghum seeds were taken from an infested field, and smut spores were obtained from smutted spikes taken from the same diseased field in 1985. The fungicides taken place in the experiment were given in Table 1.

Table 1. Fungicides tested against to the covered kernel smut disease in Adana

Fungicides	Active ingredients and rate	Dosages (g.a.i./100 kg seeds)
Vitavax 75 W	Carboxin, 75 %	112.5
Baytan 7.5 DS	Triadimenol, 7.5 %	15.0
Plantineb 80 WP	Maneb, 80 %	160.0

The experiments were conducted according to randomized block design with four characters and three replicates. Each plot was 6 m^2 (2 x 3 m). 45 g seed contamined with 0.5 % spores were used for each plot. Sorghum seeds were contamined with spores of the fungus by rinsing in a glass jar of one litre. Contamined seeds and the fungicides were put in an erlenmayer of 250 ml and rinsed for five minutes. After the treatment, the seeds were sown by hand in rows in may 5, 1986. The fungicides were evaluated by counting healty and diseased spikes in the plots at spike maturing period. Efficacy of the fungicides were calculated by Abbott formula.

RESULTS and RISCUSSION

The results obtained from the experiment have been given in Table 2.

Table 2. Efficacy of the fungicides tested to sorghum covered kernel smut disease

Treatments	Replicates							
	Ratio of diseased spikes (%)				Efficacy of fungicides (%)			
	1	2	3	Mean	1	2	3	Mean
Carboxin	0.0	0.0	0.0	0.0	100.0	100.0	100.0	100.0
Triadimenol	0.0	0.0	0.0	0.0	100.0	100.0	100.0	100.0
Maneb	8.9	0 0	0.0	2.9	55.0	100.0	100.0	85.1
Untreated	20.0	26.4	18.3	21.5	—	—	—	—

As shown in Table 2, mean ratio of diseased spikes were found for untreated character as 21.5 %, while the efficacy values for Carboxin, Triadimenol and Maneb were found as 100.0 %, 100.0 % and 85.1 %, respectively. The result obtained with carboxin in this study have agreed with the results reported by Hansing (1970), and Popov and Sılaev (1980). Consequently it was concluded that the two systemic fungicides, Carboxin and Triadimenol could be recommended to control of sorghum covered kernel smut disease caused by **S. sorghi.**

On the other hand, it was earlier noticed by Tyler (1938) that dry spore inoculation method used in the study was suitable to obtain certain severity of the disease. El-Helaly (1939) also found that the best artificial infections could be obtained with the fungus spores at the rate of 0.1 % - 1.0 % of seed weight.

Further studies would be necessary in main sorghum growing regions to recommend the alternative fungicides to control of the disease.

Ö Z E T

ÇUKUROVA BÖLGESİNDE SÜPÜRGE DARISI (**Sorghum vulgare** Pers. var. **techicum** «Koern» Jav.)'NDA SORGUM KAPALI RASTIĞI (**Sphacelotheca sorghi** «Link» Clin.)'NA KARŞI BAZI FUNGİSİDLERİN ETKİNLİKLERİ

Sorgumda tohumla taşınan sorghum kapalı rastığı hastalığına karşı pratik mücadele yöntemlerinin saptanması amacıyla yürütülen bu çalışmada Vitavax 75 W, Baytan 7.5 DS ve Plantineb 80 WP ilaçları kullanıldı.

Tohum ilaçlaması şeklinde yapılan denemelerde Vitavax 75 W ve Baytan 7.5 DS ilaçları sırasıyla 112.5 g ve 15 g a.i./100 kg tohum dozlarında % 100, Plantineb 80 WP ise 160 g.a.i/100 kg tohum dozunda % 85.1 oranında etkili bulunmuşlardır.

LITERATURE CITED

Bremer, H., 1948. Türkiye Fitopatolcjisi. Cilt II. 1, 37. Neşriyat Müd. Sayı : 657.

El-Helaly, A.F., 1939. Studies on the control of Kernel Smut of Sorghum. Bul. Min. Agric. Egypt, 233.

Hansing, E.D. 1970. Control of seed-borne fungi with systemic fungicides. Rev. of Plant Path., **50**, 1, 1970.

Popov, V.I., A.I. Sılaev, 1980. Effectiveness of seed dressing of sorghum against two species of smut disease. Rev. of Plant Path., **59**, 4, 1980.

Tarr, S.A.J., 1962. Diseases of Sorghum, Sudan Grass and Broom Corn. The Commonwealth Mycological Institute, Kew Surrey, 196-198.

Tyler, L.J., 1938. Variation in **Sphacelotheca sorghi** (link.) Clinton Univ. Minn. Agric. Exp. Sta. Tech. Bull. 133.

Viennot-Bourgin, G., 1949. Les Champignons Parasites des Plants Cultivées. Tome I. Libraires de L'Academie de Médecine, 120 Boulevand Saint-Germain, Paris-6.

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Studies on the Determination and Identification of Fungal Agent of the Diseases Isolated from the Roots, Stems and Leaves of Potatoes in Erzurum Region

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ABSTRACT

Thirteen fungus species namely **Alternaria alternata** (Fr.) Keissler, **Alternaria solani** Sorauer, **Colletotrichum atramentarium** (B. et Br.) Taub., **Curvularia fallax** Boedijn, **Fusarium acuminatum** Ellis and Everhart, **Fusarium avenaceum** (Corda ex Fr.) Sacc., **Fusarium equiseti** (Corda) Sacc., **Fusarium solani** (Mart.) Sacc., **Rhizoctonia solani** Kühn., **Ulocladium atrum** Preuss, **Ulocladium consortiale** (Thüm.) Simmons, **Verticillium albo-atrum** Reinke and Berth. and **Verticillium dahliae** Kleb. were identified from the isolates obtained from the roots, stems and leaves of the infected plants collected in the highest potato producing Districts of Erzurum. The pathogenicity tests proved that these species are primer causal agents of the diseases of potato plants.

INTRODUCTION

Potatoes are under the threat of various fungi and so far in the world **Aecidium cantensis** Arthur, **Alternaria alternata** (Fr.) Keissler, **Alternaria solani** Sorauer, **Angiosorus solani** (Barrus) Thirum. and O'Brien, **Botrytis cinerea** Pers., **Choanephora cucurbitarum** (Berk. et Rav.) Thaxter, **Colletotrichum atramentarium** (B. et Br.) Taub., **Curvularia** sp., **Erysiphe cichoracearum** DC ex Merat, **Fusarium acuminatum** Ellis and Everhart, **Fusarium avenaceum** (Corda ex Fr.) Sacc., **Fusarium equiseti** (Corda) Sacc., **Fusarium eumartii** Carp., **Fusarium oxysporum** Schl., **Fusarium solani** (Mart.) Sacc., **Helicobasidium purpureum** (Tul.) Pat., **Macrophomina phaseoli** (Maubl.) Ashby, **Mycovellosiella concors** (Casp.) Deighton, **Phoma andina** Turkensteen, **Phytophthora cryptogea** Pethybr., **Phytophthora drechsleri** Tucker, **Phytophthora erythroseptica** Pethybr., **Phytophthora infestans** (Mont.) de Bary, **Phytophthora megasperma** Drec., **Phytophthora parasitica** Dastur, **Polyscytalum pustulans** (Owen and Wakef.) Ellis, **Puccinia pittieriana** Henn., **Rhizoctonia solani** Kühn., **Rosellinia** sp., **Sclerotinia intermedia** Ramsey, **Sclerotinia minor** Jagger, **Sclerotinia sclerotiorum**

(Lib.) de Bary, **Sclerotium rolfsii** Sacc., **Septoria lycopersici** Speg., **Spongospora subterranea** (Wallr.) Lagerh., **Stemphylium botryosum** Wallr., **Synchytrium endobioticum** (Schilb.) Perc., **Ulocladium atrum** Preuss, **Ulocladium consortiale** (Thüm.) Simmons, **Verticillium albo-atrum** Reinke and Berth. and **Verticillium dahliae** Kleb. (Anon., 1981; Rai and Singh, 1981; Bhargava, et al., 1983; Theberge, et al., 1985) has been reported as being the causal agents of the diseases on roots, stems and leaves of potato plants.

In the surveys carried out in the potato fields of Ege, Marmara, Black Sea, Middle Anatolia and East Anatolia Regions in 1981-1982 Turkensteen and Eraslan (1985) determined various fungi species **A. alternata, A. solani, B. cinerea, C. atramentarium, F. oxysporum, F. solani, M. phaseoli, P. infestans, R. solani, Rosellinia** sp., **S. Minor, S. subterranea, S. botryosum, V. albo-atrum, V. dahliae, Cladosporium cladosporioides** Fries, **Drechslera** sp., **Epicoccum purpurescens** Ehrenb. ex Schelcht., **Fusarium culmorum** (Smith) Sacc. and **Verticillium tricorpus** Isaac on roots, stems and leaves of potatoes additionally to the agents indicated above.

The purpose of this study is initially to determine and identify the fungal agents of the potato diseases going to be isolated from the roots, stems and leaves and then to examine their pathogenicity including the symptom expression of the plants.

MATERIALS and METHODS

Roots, stems and leaves of potato plants exhibiting various disease symptoms were taken during the surveys in the Districts of Erzurum (Central, Pasinler, Oltu and Narman) having the highest acreage of potato cultivation. These samples were brought to laboratory in polythene bags and they were divided into lots according to the similarities between the symptoms and then many isolates were made from the material of each lot. Pure cultures of the isolates were grouped by taking their macroscobic and microscobic features into consideration. Then they were examined and the fungus species were identified on the basis of colony and morphological characters (Mordue, 1967; Simmons, 1967; Hawksworth and Talboys, 1970 a, b; Booth, 1971; Ellis, 1971; Mordue, 1974).

Pure cultures of the fungi species were manitained at 23-27°C on potato dextros agar by subculturing to fresh medium in every fifteen days until to be used as inoculum sources in pathogenicity tests.

For testing the pathogenicity of the species two potato cultivars

Isola and Diamant were used. The methods described by Alay (1965), Scheffer (1967), Döken (1977), Carling and Leiner (1986) were used in the inoculation of **Verticillium** spp., **Fusarium** spp., **Colletotrichum atramentarium** and **Rhizoctonia solani** respectively. For **Alternaria** spp., **Curvularia** sp. and **Ulocladium** spp. the method of Seung-Hun, et al. (1982) was applied.

RESULTS

All together thirteen species of fungi were identified from the isolates obtained from the roots, stems and leaves of potatoes collected in Central, Pasinler, Oltu and Narman Districts of Erzurum in 1987. The fungus species and their distribution among the Districts are given in Table 1.

Table 1. The fungal agents of potato plants and their distribution in the highest potato producing Districts of Erzurum.

Fungi species	Districts			
	Central	Pasinler	Oltu	Narman
Alternaria alternata	+	+	+	+
Alternaria solani	—	—	+	—
Colletotrichum atramentarium	+	+	+	+
Curvularia fallax	—	+	—	—
Fusarium acuminatum	—	+	—	+
Fusarium avenaceum	+	+	+	—
Fusarium equiseti	+	+	—	—
Fusarium solani	+	+	+	+
Rhizoctonia solani	+	+	+	+
Ulocladium atrum	+	+	+	+
Ulocladium consortiale	+	+	+	+
Verticillium albo-atrum	+	+	—	+
Verticillium dahliae	—	+	+	—

+ Present — Nonpresent

In view of the microscobic studies the fundamental distinguishing characters among the isolated species can be shortly defined as follows. **A. alternata:** Conidia obpyriform, oval-ellipsoid, in chains (Fig. 1), **A. solani**: Conidia ellipsoidal, tapering to a beak, usually solitary (Fig. 2), **C. atramentarium:** Conidia cylindrical, aseptate and setose

sclerotia common (Fig. 3), **C. fallax**: Conidia often curved, sometimes triradiate stauroconidia were formed (Fig. 4), **F. acuminatum**: Macroconidia broadly falcate, microconidia sparse, chlamydospores globose-oval, intercalary in chains or knots (Fig. 5), **F. avenaceum**: Macroconidia narrowly fusoid, curved, microconidia and chlamydospores absent (Fig. 1), **F. equiseti**: Macroconidia falcate, apical cell attenuated and bented inwards, microconidia absent, chlamydospores globose, intercalary in chains (Fig. 7), **F. solani**: Macroconidia inequalaterally fusoid, microconidia abundant, chlamydospores usually form terminally on short lateral branches in singly or in pairs (Fig. 8), **R. solani**: Right angle branching of hypae with irregular-globose sclerotia (Fig. 9), **U. atrum**: Conidia mostly subspherical, verrucose, predominantly two oblique septa intersecting at right angles, solitary (Fig. 10), **U. consortiale**: Conidia obovoid-ellipsoidal, smooth or verrucose, accosionally in short chains (Fig. 11), **V. albo-atrum, V. dahliae**: Conidia ellipsoidal, usually aseptate, produce singly on verticillately branched conidiophores in both species, but distinguished from each other by having dark resting mycelia in **V. albo-atrum** and microsclerotia in **V. dahliae** (Fig. 12, 13).

In the pathogenicity tests the potato cultivars Isola and Diamant which were inoculated by the isolated fungus species gave similar symptoms as of those recorded from the naturally infected plants which the samples had been taken. As a result of foliage inoculations **A. alternata** produced brown lesions advancing from the leaf margins into healthy tissues, **A. solani** infections appeared as circular-ovoid dark brown lesions having concentric rings, on the other hand light brown distinctly zonate lesions on the tip and margins of leaves were the symptoms caused by **C. fallax.** The leaves inoculated by **U. atrum** showed brown lesions on leaf margins while **U. consortiale** produced small ovoid brown lesions. The plants infected by **F. acuminatum, F. avenaceum, F. equiseti, F. solani ,V. albo-atrum, V. dahliae** shared the general symptoms as wiltage and finally the collapse of the whole plant. Additional symptoms obtained as a result of **F. acuminatum** and **F. equiseti** were brown sunken lesions on stem bases, roots and roting of roots respectively. The other two disease agents damaging the stem bases and roots of potato plants were **R. solani** which caused red-brown sunken necrosis and **C. atramentarium** produced black numerous sclerotia and affected cortex tissue easily detached from the central cylinder.

DISCUSSION

In the highest potato producing Districts of Erzurum thirteen

fungus species pathogenic on leaves, stems and roots of potatoes were determined from which **A. alternata, A. solani, C. atramentarium, F. solani, R. solani, V. albo-atrum** and **V. dahliae** were previously recorded in Turkey by various researchers (Zengin, et al., 1971; Döken, 1977; Turkensteen and Eraslan, 1985). **F. equiseti** and **U. atrum** which were only encountered on tubers in storages of Erzurum (Gündüz, 1977) were also found to be the causal agents of wilting including decay of roots as indicated by Bhargava, et al. (1983) and necrosis of leaves respectively. Although there is no information about the pathogenicity of **U. consortiale, F. avenaceum** and **F. acuminatum** on potatoes in Turkey, it was also determined that the first one is the leaf spot and the last two are the wilt disease agents of potatoes. The latter also produces ovoid sunken lesions on lower stem which was also observed by Rai and Singh (1981). On the other hand the pathogenicity test revealed that **C. fallax** which was isolated from the potato leaves exhibiting brown lesions gradually developing from the margins and tips of leaves is a primer causal agent of the disease. There was no apparent information about the pathogenicity of **C. fallax** on potatoes only the report of Theberge, et al. (1985) which indicated that a **Curvularia** species causes disease on leaves.

Ö Z E T

ERZURUM YÖRESİNDE PATATES KÖK, GÖVDE VE YAPRAKLARINDAN İZOLE EDİLEN FUNGAL ETMENLERİN BELİRLENMESİ VE TANILANMASI ÜZERİNDE ÇALIŞMALAR

Erzurum'un en fazla patates üretimi yapılan yörelerinde enfekteli patates bitkilerinden alınan kök, gövde ve yapraklarda 13 fungus türü belirlenmiştir. Bu türler **Alternaria alternata** (Fr.) Keissler, **Alternaria solani** Sorauer, **Colletotrichum atramentarium** (B. et Br.) Taub., **Curvularia fallax** Boedijn, **Fusarium acuminatum** Ellis and Everhart, **Fusarium avenaceum** (Corda ex Fr.) Sacc., **Fusarium equiseti** (Corda) Sacc., **Fusarium solani** (Mart.) Sacc., **Rhizoctonia solani** Kühn., **Ulocladium atrum** Preuss, **Ulocladium consortiale** (Thüm.) Simmons, **Verticillium albo-atrum** Reinke and Berth. ve **Verticillium dahliae** Kleb. olup, yapılan patojenite çalışmaları sonucunda bunların patateslerde primer hastalık etmenleri olduğu ortaya konmuştur.

LITERATURE CITED

Alay, K., 1965. **Pulvanaria floccifera**'ya karşı **Verticillium lecanii** ile biyolojik savaş imkânları üzerinde araştırmalar. Bitki Koruma Bülteni, **5** : 113-120.

Anonymous, 1981. Compendium of potato diseases. W.C. Hooker (Ed.) The American Phytopathological Society, Minnesota, 125 p.

Bhargava, S.N., D.N. Shukla, S. Narendra, R.S. Pandey and D.K. Dwivedi, 1983. A new incidence of **Fusarium equiseti**. National Academy Science Letters, **6** : 81.

Booth, C., 1971. The genus **Fusarium**. C.M.I., London, 237 p.

Carling, D.E. and R.H. Leiner, 1986. Isolation and characterization of **Rhizoctonia solani** and binucleate **Rhizoctonia solani-like** fungi from aerial stems and subterranean organs of potato plants. Phytopathology, **76** : 725-729.

Döken, M.T., 1977. Erzurum şartlarında yetiştirilen patateslerin köklerinden izole edilen **Colletotrichum atramentarium** (B. et Br.) Taub'un biyolojisi, morfolojisi ile zarar şekli üzerinde araştırmalar. Atatürk Üniv. Ziraat Fakültesi Yayını, 227, 70 p.

Ellis, M.B., 1971. Dematiaceous Hyphomycetes. C.M.I., London, 608 p.

Gündüz, H.H., 1977. Erzurum ve çevresinden toplanan bozuk patates ve soğanların mikrofungus florası üzerinde araştırmalar. Atatürk Üniv. Ziraat Fakültesi Dergisi, **8** : 21-31.

Hawksworth, D.L. and P.W. Talboys, 1970 a. **Verticillium albo-atrum**. C.M.I. Descriptions of Pathogenic Fungi and Bacteria, **26** : 255.

———————————, 1970 b. **Verticillium dahliae**. C.M.I. Descriptions of Pathogenic Fungi and Bacteria, **26** : 256.

Mordue, J.E.M., 1967. **Colletotrichum coccodes**. C.M.I. Descriptions of Pathogenic Fungi and Bacteria, **14** : 131.

———————, 1974. **Thanatephorus cucumeris**. C.M.I. Descriptions of Pathogenic Fungi and Bacteria, **41** : 406.

Rai, R.P. and B.P. Singh, 1981. A new disease of potato incited by **Fusarium acuminatum** Ell. and Ev. Current Science, **50** : 1037-1038.

Scheffer, R.P., 1967. Effect of the wilt Fusaria on water transport in tomato. Sourcebook of laboratory exercises in plant pathology, W.H. Freeman (Ed.), The American Phytopathological Society, 181-183.

Seung-Hun, BY Y., S.B. Mathur and P. Neergaard, 1982. Taxonomy and pathogenicity of four seed-borne species of **Alternaria** from sesame. Trans. Br. mycol. Soc., **78** : 447-458.

Simmons, E.G., 1967. Typication of **Alternaria, Stemphylium** and **Ulocladium**. Mycologia, **59** : 67-91.

Theberge, R., H.W. Rossel and G. Thottapilly, 1985. Sweet potatoes. International Institute of Tropical Agriculture, 146-147.

Turktensteen, L.J. and F. Eraslan, 1985. Türkiye fungal ve bakteriyel patates hastalıkları sürveyi. Ege Bölge Zirai Araştırma Enstitüsü Yayını, İzmir, 20 p.

Zengin, H., G. Yıldırım and E. Gülsoy, 1971. Sakarya ilinde patates hastalıkları üzerinde araştırmalar. Zirai Mücadele Araştırma Yıllığı, **5** : 86.

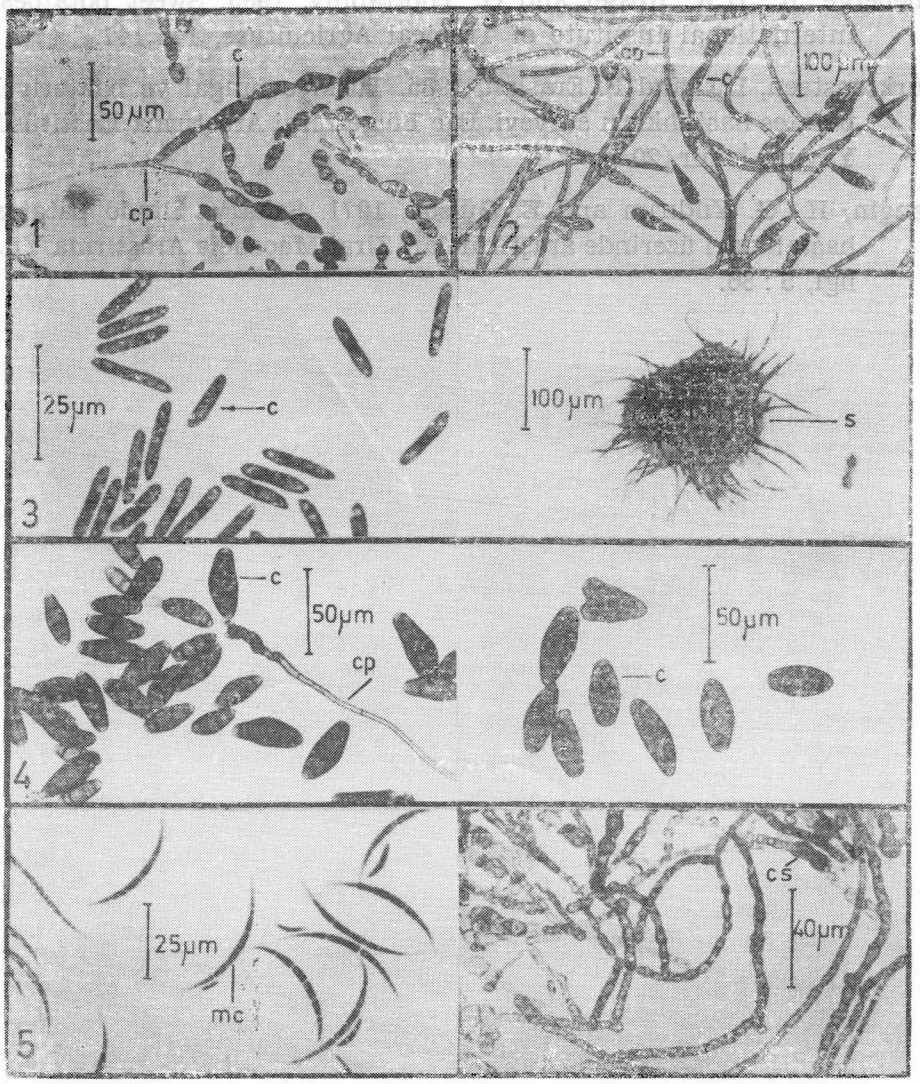

Fig.1. Conidia (c) and conidiophore (cp) of **Alternaria alternata.**

Fig.2. Conidia (c) and conidiophores (cp) **Alternaria solani.**

Fig.3. Conidia (c) and sclerotium (s) of **Colletotrichum atramentarium.**

Fig.4. Conidia (c) and conidiophore (cp) of **Curvularia fallax.**

Fig.5. Macroconidia (mc) and chlamydospores (cs) of **Fusarium acuminatum.**

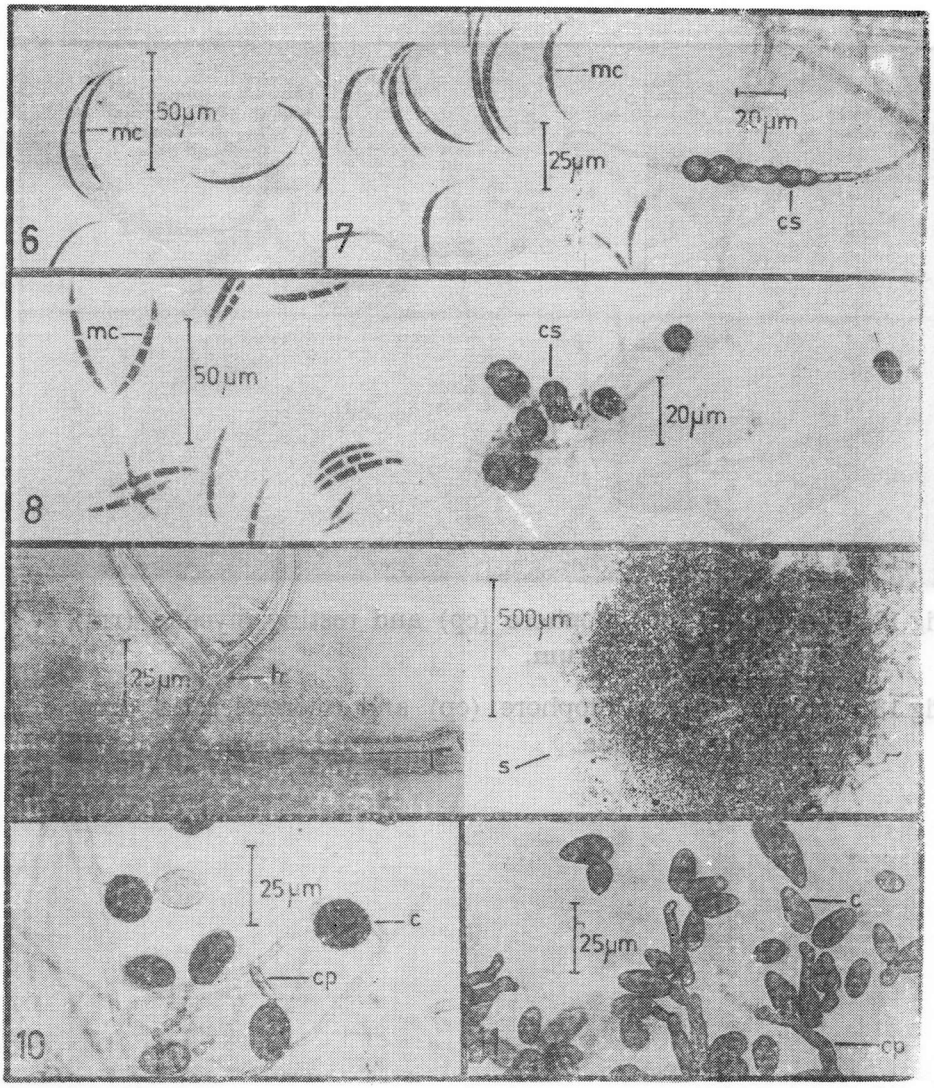

Fig.6. Macroconidia (mc) of **Fusarium avenaceum.**

Fig.7. Macroconidia (mc) and chlamydospores (cs) of **Fusarium equiseti.**

Fig.8. Macroconidia (mc) and chlamydospores (cs) of **Fusarium solani.**

Fig.9. Hypha (h) and sclerotium (s) of **Rhizoctonia solani.**

Fig.10. Conidia (c) and conidiophores (cp) of **Ulocladium atrum.**

Fig.11. Conidia (c) and conidiophores (cp) of **Ulocladium consortiale.**

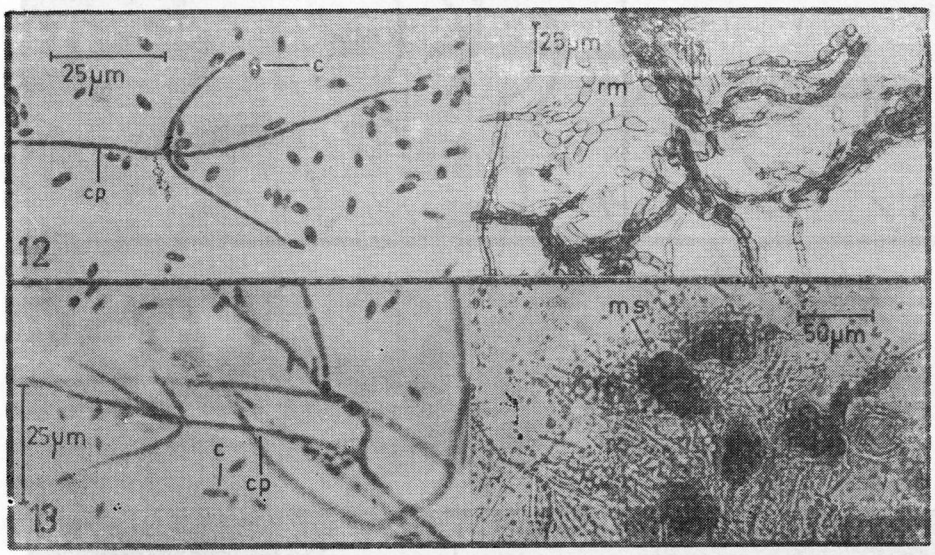

Fig.12. Conidia (c), conidiophore (cp) and resting mycelia (rm) of **Verticillium albo-atrum.**

Fig.13. Conidia (c), conidiophore (cp) and microsclerotia (ms) of Verticillium dahliae.

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Populationsschwankungen der Winterunkrautarten im Zitrusgarten Ökosystem

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ZUSAMMENFASSUNG

In den Zitrusgarten des Versuchsgutes der landwirtschaftlichen Fakültaet der Universitaet Çukurova wurden im Winter von Ende Oktober-1987, bis Anfang Juni-1988 waehrend der durchgeführten Untersuchungen insgesamt 61 Unkrautarten aus 22 Familien festgestellt. Von November bis Mai ergaben die Vegetationsaufnahmen, dass 12 Unkrautarten immer vorkommen, 16 Arten begannen ab Dezember, 5 Arten ab Januar, 5 Arten ab Februar, 7 Arten ab Maerz, 6 Arten ab April und 2 Arten ab Mai auszulaufen. Die höchste Unkrautdichte wurde im April (94.0 Pflanzen/m²) beobachtet. Aufgrund der Bodenbearbeitungen im Januar und Mai verrengerte sich die Unkrautdichte von 90.3 Pflanzen/m² auf 61.5 Pflanzen/m² bzw. 94.0 Pflanzen/m² auf 54.6 Pflanzen/m².

Die Unkrautartenzahl zeigte im Zitrus eine zunehmende Tendenz von November bis April (19-49 Arten). Danach nahm sie wieder wegen der Bodenbearbeitung im Mai ab.

EINLEITUNG

Um den Zeitpunkt der Unkrautbekaempfung optimal zu bestimmen ist es notwendig die Unkratdichte im Jahresverlauf zu hemmen. Dazu wurden in dieser Arbeit die Populationsschwankungen der einzelne Unkrautarten gemessen.

Der Unkraut-Deckungsgrad lag Zitrus im Sommer bei 56 %, mit insgesamten 26 Arten (UYGUR, 1985). Um die Sommerarten mit den Winterarten zu vergleichen, wurde diese Arbeit unter normalen Bewirtschaftungsmassnahmen im Zitrusanbau durchgeführt.

MATERIAL und METHODEN

Die Versuche wurden in den Zitrusgarten des Versuchsgutes der landwirtschaftlichen Fakültaet der Universitaet Çukurova im Winter

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von Ende Oktober-1987 bis Anfang Juni-1988 unter normalen Bewirtschaftungssmassnahmen durchgeführt. Die Zitrusbaeumen waren ca. 2 Jahre alt und die Versuchsflaeche 20 da gross.

Grösse der Aufnahmeflaeche wurde nach BRAUNBLANQUET (1964) und KNAPP (1971) in m² alle 15 Tagen festgestellt. Alle 15 Tage wurden die Unkrautarten und-individuelzahl in 7 ± 1 m² grossen Parzellen auf der Versuchsflaeche gezaehlt.

Die unbekannten Arten wurden herbariert und diese Muster von der Abteilung Biologie der naturwissenschaftlichen-philologischen Fakültaet der Universitaet Çukurova identifiziert.

Entsprechend der normalen Bewirtschaftungsmassnahmen wurde die Versuchsflaeche im Januar und im Mai mit dem Grubber bearbeitet. Die klimatische Daten des Versuchsgutes wurden gemessen.

ERGEBNISSE

1. Witterung des Ortes waehrend der Versuchszeit

Die Daten wurden in der Tab. 1 dargestellt.

Tab. 1. Klimatiche Daten von Adana

	Lufttemperatur (°C)			Niederschlag	Luftfeuchtigkeit
	Max.	Min.	X	(mm)	(%)
NOVEMBER	22.9*	10.6	15.7	66.6	63.0
	27.4**	6.0	15.0	70.7	65.0
DEZEMBER	16.8	6.7	11.1	121.6	67.0
	24.6	—2.3	11.7	201.3	63.0
JANUAR	14.2	4.8	9.2	112.4	67.0
	21.0	1.6	10.5	46.6	57.0
FEBRUAR	15.8	5.7	10.4	96.3	68.0
	19.8	2.4	11.3	130.6	64.0
MAERZ	19.0	7.8	13.1	68.6	66.0
	17.2	7.8	12.2	164.3	68.1
APRIL	23.4	11.2	16.0	53.9	68.0
	24.0	12.3	17.6	27.0	64.3
MAI	28.2	15.0	21.3	52.5	67.0
	28.7	16.8	22.3	62.9	66.2

* Durchschnitt von 47 ± 5 Jahren
** Daten waehrend der Versuchzeit

2. Populationsschwankungen der Winterarten im Zitrus

Unkrautarten, die von Oktober bis Juni in Adana wachsen, bezeichnet man als Winterarten. In dieser Zeit wurden insgesamt 61 Arten aus 22 Familien beobachtet. 19 Arten aus dieser Unkrautflora keimten vor November und im Boden aufgelaufen. 16 Artan begannen ab Dezember, 5 Arten ab Januar, 5 Arten ab Februar, 7 Arten ab Maerz, 6 Arten ab April und 2 Arten ab Mai im Boden aufzulafen. Die Artenzahl zeigte eine zunehmende Tendenz von November bis April (19-49 Arten). Die maximale Artenzahl wurde im April mit 49 Arten festgestellt. Die erste Bodenbearbeitung in der normalen Bewirtschaftung im Januar wirkte nicht auf die Artenvielfalt der Unkrautflora. Aber nach der zweiten Bearbeitung im Mai sank die Unkrautartzahl in einem Monat von 49 auf 27 Arten (s. Abb. 1).

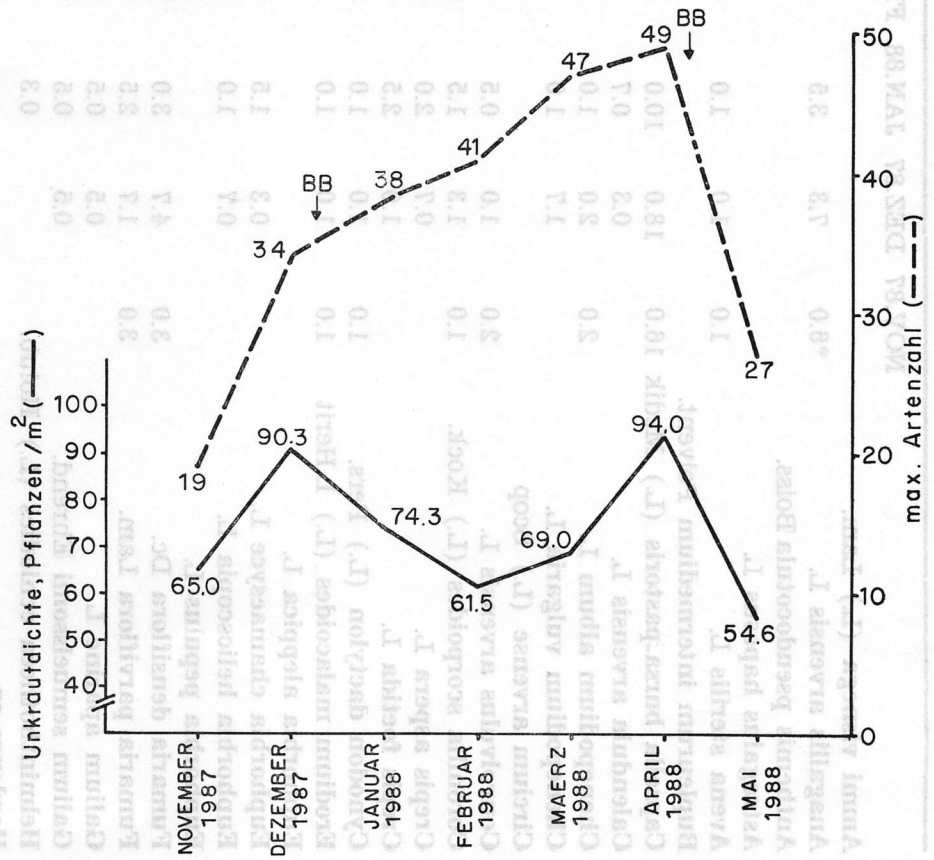

Abb.1. Unkrautdichte und maximale Artenzahl im Zitrus
(BB=Bodenbearbeitung)

Die Unkrautindividuelzahl schwankte im Zitrusanbau in Adana zwischen 54.6 und 94.0 Pflanzen pro m² im Winter. Im Dezember und

Tab. 2. Populationsschwankungen der Winterunkrutarten im Zitrus

	NOV.87	DEZ.87	JAN.88	FEB.88	MÄRZ.88	APR.88	MAI.88
Ammi visnega (L.) Lam.							1.0
Anagallis arvensis L.	*6.0	7.3	3.5	2.5	2.5	3.0	
Anthemis pseudocotula Boiss.					0.5	0.5	2.0
Astragalus haposus L.						0.5	2.0
Avena sterilis L.	1.0	1.0	1.0	0.5	0.5	3.5	6.0
Bupleurum intermedium Poivent.						0.5	
Capsella bursa-pastoris (L.) Medik	16.0	18.0	10.0	9.5	7.5	7.0	
Calendula arvensis L.		0.3	0.7	0.5	0.5	1.5	
Chenepodium album L.	2.0	2.0	1.0	1.0	0.5	0.5	0.3
Chenepodium vulgaria L.		1.7	1.0	1.0	1.0	0.5	3.0
Circium arvense (L.) Scop					0.5	0.5	0.5
Convolvulus arvensis L.	2.0	1.0	0.5	1.5	4.0	7.5	12.0
Coronilla scorpoides (L.) Kock.	1.0	1.3	1.5	0.5	1.0	1.0	0.3
Crepis aspera L.		0.7	2.0	0.5	0.5	1.0	1.0
Crepis foetida L.		1.0	2.5	0.5	0.5	1.0	
Cynodon dactylon (L.) Pers.	1.0	1.0	1.0	0.5	0.5	3.5	6.0
Erodium malacoides (L.) L.Herit	1.0	1.0	1.0	1.0	1.0	1.0	
Euphorbia aleppica L.					0.5		
Euphorbia chamaesyce L.		0.3	1.5	0.5	0.5	1.0	
Euphorbia helioscopia L.		0.7	1.0	1.0	1.0	1.0	
Euphorbia pepulus L.				0.5	0.5		
Fumaria densiflora Dc.	3.0	4.7	3.0	3.0	2.0	5.0	1.0
Fumaria parviflora Lam.	3.0	1.7	2.5	2.0	0.5	3.0	2.0
Galium aparine L.		0.5	0.5	0.5	0.5	0.5	0.5
Galium semuelssonii Ehrend.		0.5	0.5	0.5	0.5	0.5	
Helminthotheca echiodies (L.) Holub.			0.3				
Hordeum sp.				0.5	0.5	0.5	0.5
Hypericum triquetrifolium Turn.	1.0	1.0					

Lamium aplexicaule L.	3.0	4.7	2.5	1.5	2.0	2.0	
Lathyrus annus L.				0.5	1.5		
Lineris chalepensis (L.) Mill.				0.5	0.5	0.5	
Lotus peregrinus L.			0.5	0.5	0.5		
Malabaila secacul Banks.	1.0	2.7	3.5	2.0	1.5	1.5	2.0
Malva parviflora L.	3.0	2.3	1.5	2.0	1.5	2.5	2.0
Malvella sherardiana (L.) Jub.			0.5	0.5	0.5		
Medicago scutellata (L.) Mill.					0.5	1.5	1.0
Melilotus indica (L.) All.						0.5	
Mercuarialis annua L.		2.3	2.0	1.0	0.5	0.5	1.0
Muscari neglectum Guss.		1.3	2.0	1.0	1.0	1.0	
Ornithogalum narbonensel						0.5	
Papaver rhoeas L.				0.5	0.5	1.5	1.0
Phleum exeratum Hochst.						2.5	
Polygonum aviculare L.					1.0	0.5	
Prosopis farcta Macbride						0.5	
Sonchus asper (L.) Hill.			1.0	0.5			
Sonchus oleraceus L.	3.0	3.3	2.0	2.0	2.5	3.5	2.0
Raphanus raphanistrum L.		4.7	3.0	1.0	1.0	1.5	
Rumex conglomeratus L.			2.0	1.0	0.5	1.0	
Senecio vernalis Waldst. Kit.	3.0	3.7	4.0	3.5	4.0	5.5	1.0
Sinapis arvensis L.					1.5	1.5	3.0
Solanum elatum Moendh.							1.0
Stachys sparsipilosa			0.5	0.5	0.5	0.5	0.5
Stelleria media (L.) Cyr.	1.0	0.3	0.3	1.5	10.0	4.0	2.0
Tribulus terrestris L.	1.0						
Trifolium spumosum L.		1.0	1.0	0.5	0.5	1.0	
Urtica urens L.	10.0	12.7	4.0	4.5	4.0	6.5	
Veronica cymalaria Bodard	4.0	4.3	7.0	7.0	3.5	5.0	
Vicia narbonensis L.		0.7	1.0	0.5	0.5	0.5	1.0
Vicia sativa L.		0.3					

* Individueuzahl in m²

im April zeigten die Unkrautarten pro m² die höchsten Werte mit 90.3 und 94.0 Pflanzen pro m². Nach der zweiten Bodenbearbeitung im Mai wurde mit 54.6 Pflanzen/m², die geringste Unkrautdichte festgestellt (s. Abb 1).

Arten wie **Avena sterilis** L., **Chenepodium album** L., **Convolvulus arvensis** L., **Cynodon dactylon** (L.) Pers., **Coronilla scorpoides** (L.) Kock., **Fumaria densiflora** De., **Fumaria parviflora** Lam., **Malva parviflora** L., **Malabaila secacul** Banks., **Senecia vernalis** Waldst a. Kit., **Sonchus oleraceus** L., **Stelleria media** (L.) Cyr. kamen im Winter von November bis Mai bei jeden Aufnahmen vährend dieser Monate vor. Aber Arten wie **Bupleurum intermedium** Poivent., **Euphorbia alleppica** L., **Helminthotheca echioides** (L.), Holub., **Melilotus indica** (L.) ALL., **Ornithogalum narbonense** L., **Prosopis farcta** Macride, **Phleum exeratum** Hochst., konnten unter normalen Bewirtschaftungsbedingungen nur einen Monat lang beobachtet werden. Die höchste Indivuduelzahl pro m² wurde bei **Capsella bursa-pastoris** (L.) Medik. und **Urtica urens** L. festgestellt (S. Tab. 2).

DISKUSSION

Die in Adana in den Monaten November 1987 bis Mai 1988 im Zitrus durchgeführten Unkrautpopulationsmessungen geben einen Überblick über die hier auftretenden Winterarten. Dabei ist nicht auszuschliessen, dass die eine oder andere Unkrautart aufgrund ihres seltenen Vorkommens nicht erfasst wurde, eine vollstandige Erfassung der Flora war auch nicht Ziel der Arbeit. Mit 61 verschiedenen Arten wurden im Winter bedeutend mehr unkrautarten festgestellt als im Sommer mit nur 26 Arten (UYGUR, 1985).

Arten wie **Convolvulus arvensis** L. und **Cynodon dactylon** L.), Pers. gehören nach HOLM et al. (1977) zu den 10 weltweit wichtigsten Arten. Diese zwei Arten konnten auch in Zitrus wahrend des Winters fesgestellt werden. Im Sommer gehören diese beiden Arten zu den schwer bekaempfbaren und problematischen Unkrautarten. Somit könnte eine Bekämpfung dieser Arten schon im Winter von Nutzen sein. Andere wichtige Sommer unkrautarten konnten kaum gefunden werden.

Waehrend des Winterhalbjahres mit der höchsten Unkrautdichte aufgelaufene Unkrautarten, **Capsella bursa-pastoris** (L.) Medic. und **Urtica urens** L. sind im eigenen Sinn diese Unkrautarten, so dass auch ihre Bekaempfung keine Schwerigkeiten bereitet.

Ö Z E T

TURUNÇGİL EKOSİSTEMİ İÇERİSİNDE KIŞLIK YABANCI OT TÜRLERİNİN POPULASYON DALGALANMALARI

Çukurova Üniversitesi Ziraat Fakültesi Deneme Çiftliğindeki turunçgillerde Ekim sonu-1987 ve Haziran başı-1988 tarihleri arasında yapılan çalışmada 22 familyaya ait toplam 61 tür saptanmıştır. Bu tarihler arasında 12 yabancı ot türüne devamlı olarak her ölçümde rastlanmış olup 16 tür Aralık, 5 tür Ocak, 5 tür Şubat, 7 tür Mart, 6 tür Nisan ve 2 türde Mayıs aylarında çimlenip toprak yüzeyine ilk defa çıkmıştır.

En yüksek yabancı ot bitki sıklığı Nisan ayında (94.0 bitki/m²) gözlenmiş olup, yabancı ot florasında ilk toprak işleme ile Ocak'ta 90.3 bitki/m²'den 61.5 bitki/m²'ye, ikinci toprak işlemeyle Mayıs ayında 94.0 bitki/m²'den 54.6 bitki/m²'ye bir azalış görülmüştür.

Yabancı ot tür sayısı ise turunçgillerde Kasım ve Nisan ayları arasında artış (19-49 Tür sayısı) gösterirken, ikinci toprak işleme ile Mayıs'ta azalmıştır.

LITERATURVERZEICHNIS

Braun-Blanquet, J., 1964. Pflanzensoziologie. 3. Aufl. XIV, 865 pp. Wien, New York.

Holm, Le Roy, G., J.V. Pancho, J.P. Herberger, D.L. Plucknett 1977. The world's worst weeds. The University Press of Havaii. Honolulu.

Knapp, R. 1971. Einführung in die Pflanzensosiologie. Eugen Ulmer. Stuttgart.

Uygur, F.N. 1985. Untersuchungen zur Art und Bedeutung der Verunkrautung in der Çukurova unter besonderer Berücksichtigung von **Cynodon dactylon** (L.) Pers. und **Sorghum halepense** (L.) Pers. PLITS. 1985/3 (5).

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Untersuchungen zur Wirkung von mechanischen Bekämpfungsmassnahmen auf die Verunkrautung mit den ausdauernden Unkrautarten wie **Convolvulus arvensis** L. und **Sorghum halepense** (L.) Pers.

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Ziel der Arbeit ist es, die Wirkung mechanischer Unkrautbekämpfungsmassnahmen und deren Anwendungshäufigkeit auf die Art der Verunkräutung mit ausdauernden Arten festzustellen. Diese Massnahmen werden seit Jahren im Çukurova-Gebiet als Unkrautbekämpfungsmassnahmen angewendet, wobei die Arten, wie **Convolvulus arvensis** L., **Sorghum halepense** (L.) Pers, einige erhebliche Probleme darstellen.

Das wichtigste Ungras des Çukurova-Gebietes **S. halepense** zeigte bei steigender Bearbeitungsintensität von Handhacke und Scheibenegge eine rasch abnehmende oberirdische Entwicklung. Bei einmaliger Behandlung jedoch wurde eine um 400-500 % steigende Entwicklung gegenüber der Kontrolle festgestellt. Die Behandlungen Mulchen, Kultivator und auch Handhacke konnten die Art **S. halepense** bei dreimaliger Anwendung unterdrücken. Die oberirdische Entwicklung war geringer als bei der Kontrolle.

Die andre wichtige Art, **C. arvensis**, hatte sich bei dreimaligen Mulchen, Handhacke, Kultivator und zweimaliger Scheibenegge im Vergleich zur Kontrolle 10-50 fach vermehrt.

Die Ergebnisse zeigten, dass auch die dreimalig hintereinander durchführte mechanische Massnahme problematische Arten wie **C. arvensis** und **S. halepense** nicht ausreichend bekämpfen konnte.

EINLEITUNG

Die Bekämpfung der ausdauernden Unkrautarten in den Kulturen wie Baumwolle und Zitrus wird im Çukurova-Gebeit seit Jahren zum Grossteil als mechanische Bodenbearbeitungsmassnahme durchgeführt. Die selektiven Herbizidanwendungen gagen ausdauernde Arten haben in den letzten Jahren eine zunehmende Bedeutung in diesem Gebiet gewonnen (Anonymus, 1970-1985). Die Arten **Convulvulus arvensis** L.

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und **Sorghum halepense** (L.) Pers. wie auch andere ausdauernde Arten zeigen zunehmende Probleme in diesem Gebiet. Eine ausschliessliche. Herbizidanwendungen ist aus verschiedenen Gründen nicht möglich. Daher sollte man die Herbizidanwendungen mit Bodenbearbeitungsmassnahmen kombinieren. Deswegen haben wir die Wirkung einzelner mechanischer Massnahmen auf diese Arten in einem kulturpflanzenfreien Feld unter der Konkurrenz der natürlichen Unkrautflora untersucht.

MATERIAL und METHODEN

Die Untersuchungen wurden in einem kulturpflanzenfreien Feld mit einer Parzellengrösse von 12.80 m^2 in 4 Wiederhdungen derchgeführt. Das Untersuchungsfeld wurde am 1.2.1986 gleichmässig umgepflügt.

Als Behandlungsvarianten wurden Mulchen, Handhacke, Scheibenegge und Kultivator (Grubber) gewählt. Jede Behandlung wurde 0, 1, 2 b.z.w. 3 mal an verschiedenen Terminen entsprechend der Unkrautentwicklung durchgeführt und die «null» Behandlung als Kontrolle beibehalten. Alle Varianten wurden am 15.5.1986 behandelt, die Varianten mit zweifacher Bearbeitung zugleich am 2.6.1986, die mit dreifacher Bearbeitung zudem am 25.6.1986.

Die Versuchsfläche wurde drei mal nach Bedarf beregnet. Bei Versuchsende am 25.7.1986 wurde die Frischmasse aller Arten aus 2 m^2 grossen Teilstücken der Parzellen gewogen und in Prozent in den Abbildungen dargestellt.

ERGEBNISSE

Während der Auswertung des Versuches wurden in insgesamt 15 Familien 25 Arten bestimmt (s. Anhang 1). Häufig vorkommende Arten waren **Amaranthus graecizans** L., **Convolvulus arvensis** L., **Chenepodium album** L., **Portulaca oleracea** L., **Prosopis stephaniana** Kunth ex Spreng. und **Sorghum halepense** (L.) Pers.

1. Wirkung der Massnahmen auf die Art der Verunkrautung

Die Konkurrenz zwischen einjährigen und ausdauenden Arten ist je nach Behandlungsart unterschiedlich. Je nach dem, ob ein, zwei- oder dreimal behandelt wurde, die gesamte oberirdische Entwicklung der ausdaurnden Arten bei allen Varianten jedes Mal mehr oder weniger besser als die Kontrolle (s. Abb. 1-4).

1.1. Wirkung von Mulchen

Bei der dreimaligen Mulchbehandlung wurde eine grössere Frischmassenbildung von **C. arvensis** gegenüber geringerer Behandlungen festgestelt. **S. halepense** zeigte bei zweimaligem Mulchen eine höhere Frischmasseproduktion als die anderen Arten (s. Abb. 1).

1.2. Wirkung von der Hacke

Eine positive Wirkung wurde bei dreimaliger Handhackebehandlung auf die Frischmasseproduktion von **C. arvensis** beobachtet, während die Wirkung auf **S. halepense** unter den gleichen Bedingungen umgekehrt war (Abb. 2). Bei Handhacke zeigten die Arten **C. arvensis** und **S. halepense** zusammen eine ausreichende Konkurrenzkraft gegenüber einjährigen Arten. **P. oleracea** reagierte auf intensivere Handhackenbehandlung mit gesteigender Frischmassenproduktion.

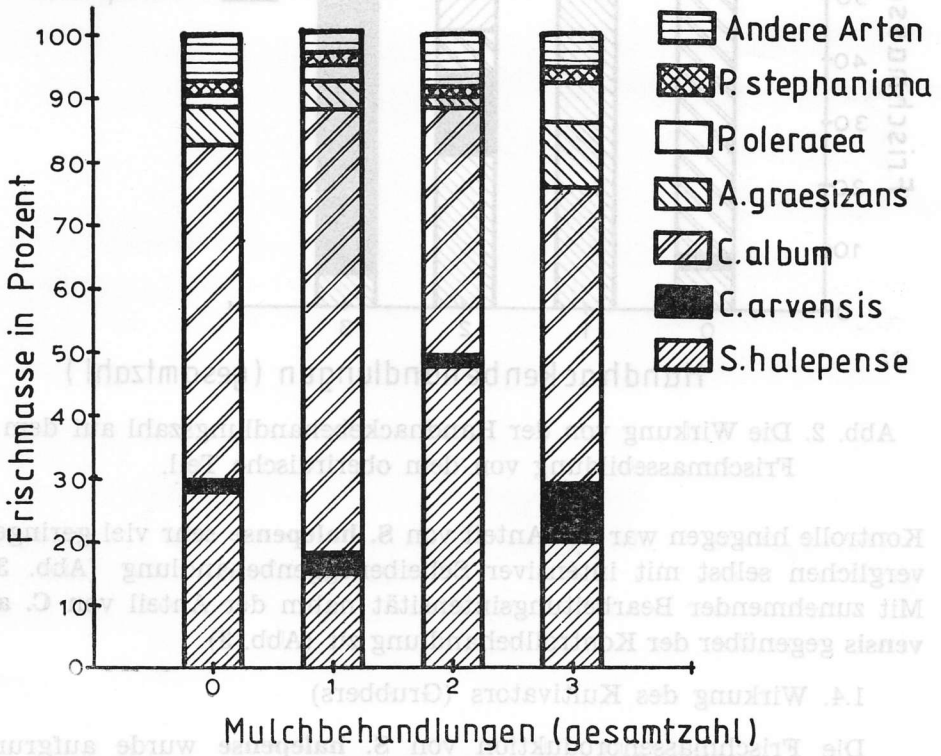

Abb. 1. Die Wirkung der Mulchbehandlungszahl auf die Frischmassebildung von dem oberirdische Teil

1.3. Wirkung von Scheibenegge

Die prozentuale Frischmassenproduktion von **S. halepense** nahm mit zunehmender Bearbeitungsintensität ab. Sie sank von 55 % bei einmaliger Behandlung auf 35 %, bei dreimaliger Behandlung. Bei der

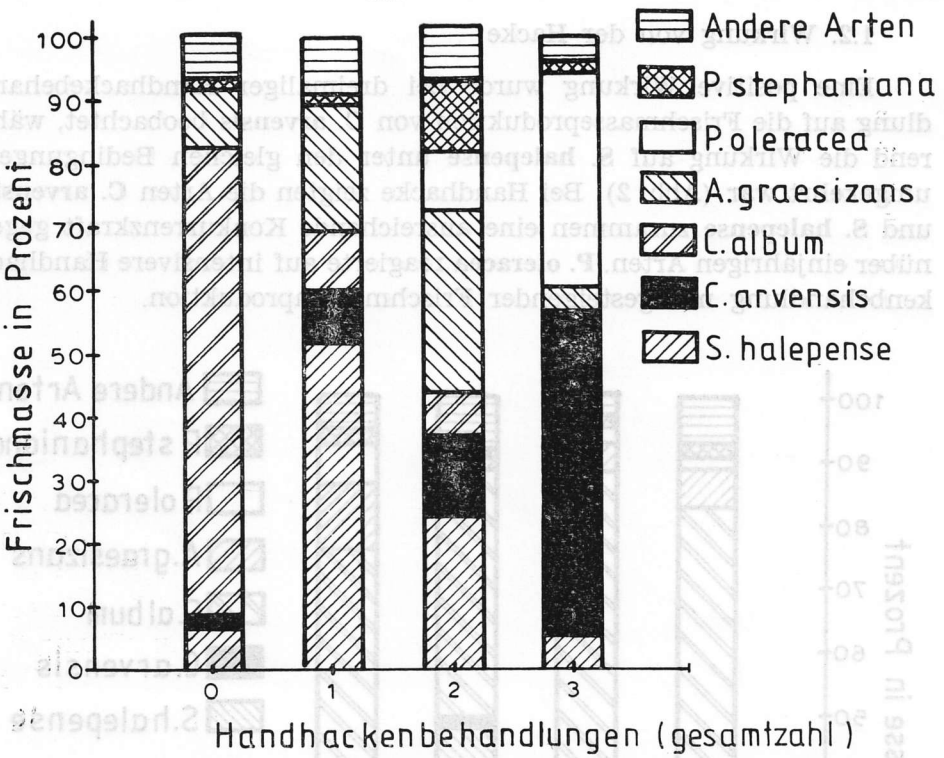

Abb. 2. Die Wirkung von der Handhackebehandlungszahl auf dem Frischmassebildung von dem oberirdische Teil.

Kontrolle hingegen war der Anteil von **S. halepense** sehr viel geringer, verglichen selbst mit intensiver Scheibeneggenbehandlung (Abb. 3). Mit zunehmender Bearbeitungsintensität nahm der Anteil von **C. arvensis** gegenüber der Kontrollbehandlung zu (Abb. 3).

1.4. Wirkung des Kultivators (Grubbers)

Die Frischmassenproduktion von **S. halepense** wurde aufgrund zweimaliger Kultuvatorbehandlungen gegenüber der Kontrolle nahezu verdoppelt. Hingegen führte eine dreimalige Behandlung zu einer starken Vermehrung von **C. arvensis** und **P. oleracae**, wodurch **S. halepense** unterdrückt wurde und sogar eine geringere Frischmassenproduktion als die Kontrolle aufwies (Abb. 4).

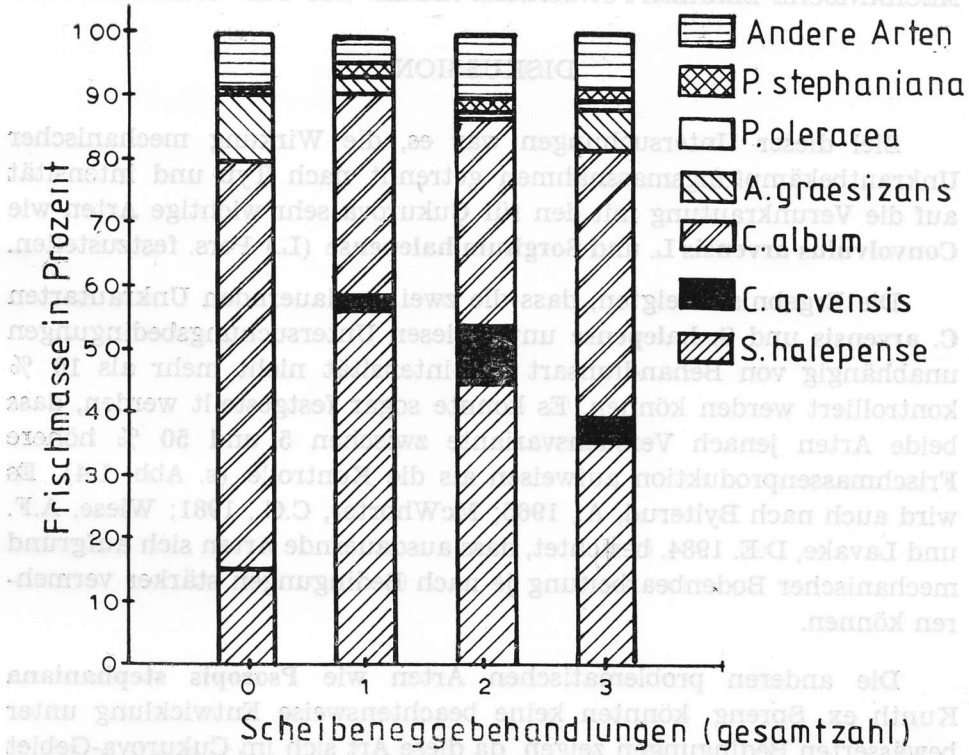

Abb. 3. Die Wirkung von der Scheibeneggebehandlunszahl auf die Frischmassebildung des oberirdischen Teils.

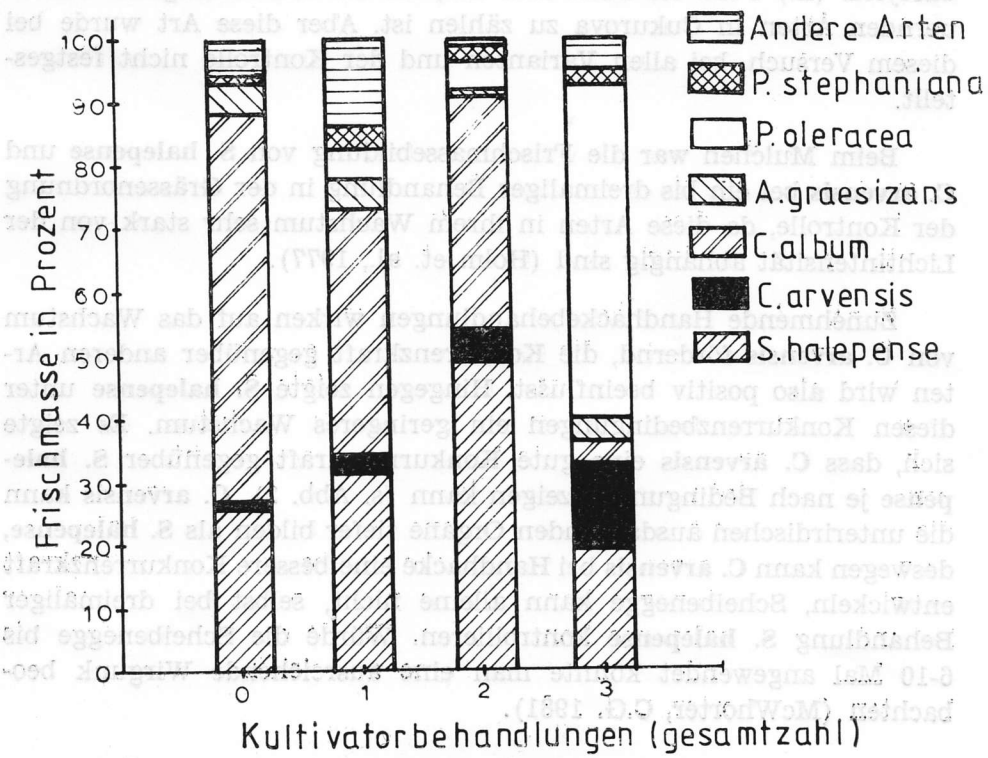

Abb. 4. Die Wirkung der Kultivatorbehandlunszahl auf die Frischmassebildung des oberirdische Teils.

DISKUSSION

Ziel dieser Untersuchungen war es, die Wirkung mechanischer Unkrautbekämpfungsmassnahmen getrennt nach Typ und intensität auf die Verunkrautung mit den für Çukurova sehr wichtige Arten wie **Convolvulus arvensis** L. und **Sorghum halepense** (L.) Pers. festzustellen.

Die Ergebnisse zeigten, dass die zwei ausdauernden Unkrautarten **C. arvensis** und **S. halepense** unter diesen Untersuchungsbedingungen unabhängig von Behandlunsart und-intensität nicht mehr als 10 % kontrolliert werden können. Es konnte sogar festgestellt werden, dass beide Arten jenach Versuchsvariante zwischen 5 und 50 % höhere Frischmassenproduktion aufweisen als die Kontrolle (s. Abb. 1-4). Es wird auch nach Bylterud, A., 1965; McWhorter, C.G., 1981; Wiese, A.F. und Lavake, D.E. 1984. berichtet, dass ausdauernde Arten sich aufgrund mechanischer Bodenbearbeitung je nach Bedingungen stärker vermehren können.

Die anderen problematischen Arten wie **Psoropis stephaniana** Kunth ex. Spreng. könnten keine beachtensweise Entwicklung unter bewässerten Bedingungen zeigen, da diese Art sich im Çukurova-Gebiet an unbewässerte Flächen angepasst hat (Uygur, F.N., 1985). **Cynodon dactylon** (L.) Pers. ist auch eine Art, die zu den wichtigsten ausdauernden Arten in Çukurova zu zählen ist. Aber diese Art wurde bei diesem Versuch, bei allen Varianten und der Kontrolle nicht festgestellt.

Beim Mulchen war die Frischmassebildung von **S. halepense** und **C. arvensis** bei ein bis dreimaliger Behandlung in der Grässenordnung der Kontrolle, da diese Arten in ihrem Wachstum sehr stark von der Lichtintensität abhängig sind (Holm et. al., 1977).

Zunehmende Handhackebehandlungen wirken auf das Wachstum von **C. arvensis** fördernd, die Konkurenzkraft gegenüber anderen Arten wird also positiv beeinflusst. Hingegen zeigte **S. halepense** unter diesen Konkurrenzbedingungen ein geringeres Wachstum. Es zeigte sich, dass **C. arvensis** eine gute Konkurrenzkraft gegenüber **S. halepense** je nach Bedingungen zeigen kann (s. Abb. 2). **C. arvensis** kann die unterirdischen ausdauernden Organe tiefer bilden als **S. halepense**, deswegen kann **C. arvensis** bei Handhacke eine bessere Konkurrenzkraft entwickeln, Scheibenegge kann alleine nicht, selbst bei dreimaliger Behandlung **S. halepense** kontrollieren. Würde die Scheibenegge bis 6-10 Mal angewendet könnte man eine ausreichende Wirgunk beobachten (McWhorter, C.G. 1981).

Kultivatorbehandlungen reichen ab der dritten Behandlung zur Kontrolle von **S. halepense** aus. Hingegen wurde durch die wiederholte Kultivatorbehandlung das leichter zu bekämpfende **P. oleracea** stark gefördet. Es kann für Kontrolle von **S. halepense** ein Nachteil sein. Bei viermaliger Anwendung des Kultivators wurde die unterirdische Knospenbildung von **S. halepense** gegenüber der Scheibenegge um 50 % verringert (Uygur, F.N., 1988).

Diese Ergebnisse zeigen, dass ausschliesslich mechanische Unkrautbekämpfungsmassnahmen nicht ausreichen, die problematischen Unkrautarten wie **C. arvensis** und **S. halepense** zu bekämpfen.

Ö Z E T

MEKANİK YABANCI OT SAVAŞ YÖNTEMLERİNİN **Convolvulus arvensis** L. ve **Sorghum halepense** (L.) Pers. KONTROLÜNDEKİ ETKİLERİNİN ARAŞTIRILMASI

Bu çalışmanın amacı, mekanik yabancı ot savaş yöntemlerinin ve bunların kullanılma sıklıklarının, çok yıllık yabancı otların gelişmesine olan etkileri ile bu türlerin toplam yabancı otlanmadaki oranlarının saptanmasıdır. Bu yöntemler yıllardır Çukurova bölgesinde **Convolvulus arvensis** L. ve **Sorghum halepense** (L) Pers in kontrolunda kullanılmakta isede bugün sorun henüz çözülmüş değildir.

Çukurova bölgesinin en önemli yabancı otlarından **S. halepense** bir kez el çapası veya diskaro uygulamasında % 400-500 toprak üstü aksamında gelişme görülürken, uygulama sayısı arttıkça bu türün toprak üstü gelişmesinde bir kez uygulamaya göre gerilemeler saptanmıştır. Malçlama, kultivatör ve hatta el çapası üç kez uygulandığında, **S. halepense**'nin toprak üstü gelişimi kontrole göre daha az olmuştur.

Diğer önemli tür **C. arvensis** ise üç kez malçlama, el çapası ve kultivatör ile iki kez diskaro uygulandığında kontrole göre 10 ile 50 kez daha fazla toprak üstü aksamı oluşturmuşlardır.

Sonuçlar göstermiştirki uygulanan mekanik toprak işleme aletleri bölgede problem olan **C. arvensis** ve **S. halepense** gibi türlerin kontrollerinde yeterli değildir.

LITERATURVERZEICHNIS

1. Anonymus, 1970-1985. T.C. Gıda Tarım ve Hayvancılık Bakanlığı Bölge Zirai Mücadele ve Karantina Başkanlığı Çalışma Raporları, Adana.

2. Bylterud, A., 1965. Mechanical and chemical control of **Agropyron repens** in Norway, Weed Research 5, 169-180.

3. Holm, Le Roy G., J.V. Pancho, J.P., Herberger, J P., Plucknett, D.L. 1977. The world's morst weeds. The University Press of Havaii, Honolulu.

4. McWhorter, C.G. 1981. Johsongrass as a Weed. United States Deportment of Agriculture, Farmers Bulletin, Number 1537.

5. Uygur, F.N., 1985. Untersuchungen zu Art und Bedeutung der Verunkrautung in der Çukurova unter besonderer Berücksichtigung von **Cynadon dactylon** (L.) Pers. und **Sorghum halepense** (L.) Pers., PLITS 1985/3 (5).

6. Uygur, F.N., Tunar, S., Çınar, Ö., Koch, W., 1988. Bazı Yabancı ot Kontrol Uygulamalarının **Cynodon dactylon** (L.) Pers., **Cyperus rotundus** L. ve **Sorghum halepense** (L.) Pers. Türlerinde Rizom Gelişmesine Etkisi, 5. Fitopatoloji Kongresi, Antalya, 1988.

7. Wiese, A.F. and Lavake, D.E. 1984. Herbicides in no-tillage systems involving wheat. The Texas Agricultural Experiment Station., MP 1547

ANHANG 1.

Artenliste nach Familien:

Amaranthaceae

Amaronthus graecizans L.
Amaranthus retroflexus L.

Asteraceae (Compositae)

Erigeron sp.
Erigeron canadensis L.
Sonchus sp.

Chenopodiaceae

Chenepodium album L.

Convolvulaceae

Convolvulus arvensis L.

Cucurbitaceae

Cucurbitya sp.

Euphorbiaceae

Chrozophora tinktoria (L.) A. Juss.
Euphorbia sp.

Fabaceae

Trifolium repens L.

Heliotropiaceae

Heliotropium haussknechtii Bunge.
Heliotropium hirsutissimum Grauer

Malvaceae

Malva sylvestris L.

Mimosaceae

Prosopis stephaniana Kunth ex Spreng.

Poaceae (Gramineae)

Cynadon dactylon (L.) Pers.
Digitaria sanguinalis (L.) Scop.
Echinochloa colonum (L.) Link
Paspalum paspaloides (Michx) Serbu
Sorghum halepense (L.) Pers

Polygonaceae

Polygonum aviculare L.

Portulacaceae

Portulaca oleracea L.

Tilliaceae

Corhorus olitorus L.

Zygophyllaceae

Tribulus terrestris L.

All Correspondance Should Be Made To
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