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Acer Virus Diseases In Turkey

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ABSTRACT

Regular epidemiological observations for over the last decade have shown that the disease on maple (**Acer** spp.) trees is rather widespread in Turkey. Transmission experiments, serological tests, electronmicroscopy and ISEM tests have revealed that the trees were infected by viruses.

Mechanical inoculations resulted in symptom formation on **Chenopodium amaranticolor, C. quinoa, C. murale, Cucumis sativus, Datura stramonium, Nicotiana tabacum, N. glutinosa, Vinca minor** and **Zinnia elegans** tests plants. Particle structure of viruses were isometric and in diameter from 26 to 30 nm. ISEM tests were reacted with German SMV, CMV, AMV antiserums.

All the three viruses in **Acer** spp. are new for the world literature.

INTRODUCTION

Virus like symptoms were detected on maple trees in Keçiören-Kalaba campus of University of Ankara, Faculty of Agriculture since 1971. Those symptoms were increased recently and same type of symptoms were also detected in the gardens and parks in the towns and city centrum of Ankara. Similar symptoms were observed in Afyon, Eskişehir, Denizli and Izmir.

There is not much detailed information on the virus diseases of maple trees. The only known data is based on the symptom expression of the diseases. The first report about this kind of symptoms on maple trees was reported at the end of the previous century. Reuter (1870), Syme (1877) and Carriére (1887) were determined that the virus infection of maple trees can be transmitted by bud and stem grafting. Atanasoff (1935), described the symptoms of **Acer negundo** leaves in Boris Park of Sofia as plenty of small circular light green lesions. In some of the trees, the diameter of the lesions were 1.5 mm, but some of them had been reached to 3 mm and caused yellowish apperance of the leaves. He, reffering to Syme and Carriére, is named the cause of the disease as «Maple Mosaic».

Schmelzer et al. (1966), had detected vein banding and ringspot symptoms on the maple trees of Harz mountain of Germany especially on the **Acer pseudoplatanus** and **A. platanoides**. But, he couldn't be able to transfer infection on to the herbaceaus host plants. So, he mentioned that he couldn't differentiate whether these symptoms were caused by virus or by genetic leaf mottle.

Szirmai (1972), reported the disease causing light green mottling which later becomes yellowish mottling on the leaves of **Acer negundo** and **Acer pseudoplatanus** trees in Hungary during last 20 years. He mentioned that later on the leaves are malformed. Because of the randomly braching and increasing in shorting the top of the tree takes witches broom like apperance.

He has succeded the transmitting of the virus by bark grafting method. The first symptoms are noticed on the lower leaves of the plants, later, they have spread to the upper ones. After one month, mosaic type mottling is detected on the whole of the foliage uniformly. The virus is mechanically transmitted to **N. tabacum** L. and **N. rustica L.**

In the transmission studies done with **Trialeurodes vaporariorum** (Westw.), the characteristic symptoms are developed after one month, later they developed as mosaics (Duffus, 1965).

In the transmission studies, the white-flies which are collected from nature are more effective comparing to those that are raised on diseased plants, but in seed transmission studies, different results were obtained. This part of research is going on.

MATERIALS and METHODS

As research material, maple trees **Acer negundo L.**, **Acer pseudoplatanus** L. and **Acer campestre** L. showing the symptoms of little mosaic lesions, leaf deformation, mottle and increase in shooting and randomly branching were chosen.

Diseased plants were mechanically inoculated to perennial plants with 0.05 M phosphate buffer solution pH:7.0 and carborundum.

In inoculation test, those plant species are used: **Beta vulgaris L.**, **Chenopodium amaranticolor, Chenopodium murale L., Chenopodium quinoa L., Cucumis sativus L., Datura stramonium L., Gomphrena globosa L., Nicotiana glutinosa L., N. tabacum L., Phaseolus vulgaris L., Vinca minor L., Zinnia elegans** Jacq.

As test material, leaves showing symptoms of disease and the shoots 2-3 cm. long are used.

In serological tests, microprecipitation (Erdiller, 1980), agar-gel (Erdiller, 1982 b), immunosorbent electron microscopy (Erdiller, 1982 a) techniques were used. As antisera, Sharka 467, TOSR 256, AMV-275, SMV-648, FV-213, BMV-I 487, Teschm (X), TMV 131, Bean yellow, CFMV 601, Squash mosaic virus, WMV_1, WMV_2, CMV-365, CMV-Holland str. carnation, Zucchini yellow, Tobacco necrosis are used. The antisera were supplied from Germany, Netherlands, Italy and USA. ISEM tests are done in Braunschweig by Dr. Lesemann. Purification of virus are done by using the method of TOMLINSON et al. (1973).

Electron microscopy investigations are done in Electron Microscopy Unit of Medical School of Ankara University. The preparations are shadowed with uranyl acetate 2 %, pH.4.2.

RESULTS and DISCUSSION

The symptoms of maple trees in Turkey increased and spread during the last 10-15 years. In april, because of abnormally branching of the newly developing shoots, the trees shows witches broom like apperance. The distances between the nodiums are shortened (Figure 1) and the leaves are gathered at the end of the shoot. In months of May and June, the severity of symptoms are increased.

The major leaf symptoms is leaf deformation. The bottom leaves are light and dark green mottled (Figure 2). The leaf is narrowed, and also from light green to bright yellow colored mosaic symptoms are detected (Figure 3). The veins are visible and very little light-dark green lesions resembling to acarina damage were also detected on the leaves (Figure 4).

After the mechanical inoculation tests typical symptoms are developed on some of the host plants as follows:

Beta vulgaris: Slightly sistemic mosaic infection is observed.

Chenopodium amaranticolor: Some of them, showed chlorotic local lesions, but the others developed systemic chlorotic vein banding and mottle infection.

C. quinoa and C. murale: 3-4 days after the inoculation, circular chlorotic local lesions are developed, systemic vein clearing, mottling and chlorose followed them 5-7 days later (Figure 6).

On some of the plants, only vein clearing and chlorotic dost are developed.

Cucumis sativus: Sistemic mosaic and stunting in various severity are observed.

The progress of the infested plants is stopped.

Datura stramonium: in 5-7 days following the inoculation, local lesions and mosaic symptoms were detected on infected plants. The infection caused severe systemic mosaic, the narrowing of leaf, blistering and leaf deformation.

Nicotiana tabacum «White Burley»: 10-15 days after the inoculation, local lesions are developed. Depending on the increase of the temperature, the symptoms are masked.

Nicotiana glutinosa: The symptoms differ from light to severe mosaic infection. Some strains caused yellow vein and mosaic infection (Figure 8).

P. vulgaris cv. French Bean: Chlorotic local lesions developed which later turns to systemic necrose (Figure 9).

Vinca minor: Leaves are folded to downward, internodia are shortened, flowers are smaller and white color breakings are observed.

Zinnia elegans: 6-8 days after, vein clearing is observed, systemic symptoms are developed in the form mosaic but masked 10-12 days after the inoculation.

Cucumis sativus: Systemic mosaic and stunting.

Datura stramonium: Local lesions and systemic mosaic. Mosaic infection on **N. glutinosa**, color breaking on the flowers of **Vinca minor**, vein banding of **Z. elegans** showed that Cucumber mosaic virus is one of the viruses which cause infection on maple trees.

Slight mosaic on **Beta vulgaris**, chlorotic local lesions, systemic mottle and chlorose on **C. murale**, chlorotic local lesions on **C. amaranticolor** showed that Sowbane mosaic virus also infects the maple trees.

Vein banding and mottling of **C. amaranticolor**, vein clearing on **C. quinoa**, chlorotic local lesions, vein banding on **C. sativus**, local lesions which developed 10-21 days after the inoculation on **N. tabacum** W.B. (masking of the symptoms according to the temperature), chlorotic local lesions, systemic necrose and folding of leaves of **P. vulgaris** also showed that Arabis mosaic virus is one of the viruses which causes infections of maple trees.

As the result of mechanical inoculations, Cucumber mosaic virus (CMV), Sowbane mosaic virus (SMV), Arabis mosaic virus (AMV) reactions are detected.

In microprecipitation, agar-gel and immune electron microscopy tests, diseased plant sap gave positive reactions with Cucumber mosaic

virus-Carnation str., Sowbane mosaic virus (SMV-648), Arabis mosaic virus-grape isolate (AMV-295) antisera.

The microprecpitation and 0.8 % agar-gel diffusion tests, that are conducted with AMV antiserum were successful. Virus showed only one precipitation line in agar-gel tests (Figure 10).

Because of the immunogenic weakness of the CMV, in the tests done with CMV antiserum, the virus is fixed with formaldehit as suggested by Francki and Habili (1972). When the virus is slightly heated or in physiological saline solution, it precipitates. Because of this fact, in serological test, by using water or low molar buffer solutions as proposed by Francki et al. (1966) and Scott (1968) succesfull results were achieved. The virus which is once stabilised gives one or two precipitation lines.

One of them is very close to antigen well. This is caused by crude virus particles. The other one is close to antiserum well. This is caused by separated virus particles (Scott, 1968; Devergne and Cardin, 1970).

SMV is highly antigenic virus. In double diffusion test, it contributes one precipitation line (Figure 11).

In ISEM tests which are done by Dr. Lesemann-Virus Research Institute-Braunschweig, Virus gave positive reactions with AMV, CMV, SMV antisera.

In electron microscopy studies, circular particles in 26-30 nm. diameter are detected (Figure 12).

If the CMV particles are not fixed, they diffuse during the contrasting with phosphotungustic acid. But they exhibit very good contrast with uranyl acetate pH:4.5 (Francki and et al. 1966). Particle mesuares of all those 3 viruses are very close to each other. The diameter of AMV is 30 nm (Murant 1970), CMV is 28 nm (Francki et al. 1979) and SMV is 26 nm (Kado, 1971).

According to the results of mechanical inoculation, serological and electron microscopy studies, the viruses that are infecting the maple trees in Turkey are determined as AMV, CMV and SMV. They can all exist on the same tree. The symptoms of maple trees look like the ones which are described as «Maple mosaic virus» by different investigators.

Atanasoff (1935) in Sophia, Sorauer (1954) in Chezkoslovakia, Schmelzer et al. (1966) in Germany, Szirmai (1972) in Hungary described virus disease of maple trees as «Maple mosaic virus» (Ahorn mosaic) but none of them gave the physical, antigenic and electron mic-

roscopy characteristics. The conviction is evaluated according to the symptoms expressed by perennial and woody test plants. On the other hand, some of the cucumoviruses shows some difficulties during the determination of their physical, antigenic and biological characteristics. Such as, some of CMV strains induce systemic infections on cowpea plants and because of this, they resemble to CMV-Q strain, some of the CMV strains induce symptoms on **N. glutinosa** resembling to the ones characteristic for Tomato aspermy virus (Francki et al. 1979). Alfalfa mosaic virus also induces symptoms on some of the host plants resembling to CMV. But because of the morphology of its particles and systemic infections on **C. amaranticolor** and **C. quinoa**, it differs from other cucumovirus.

Although Arabis mosaic virus look likes to some of the Nepoviruses such as Strawberry latent virus, Tobacco ringspot virus, Tomato black ring, Tomato ringspot virus, it is not serologically related to none of them. It is distantly related to Grapevine fanleaf virus (Murant, 1970).

Sowbane mosaic virus is not serologically related with Arabis mosaic and Cucumber mosaic virus (Kado, 1971). Arabis mosaic virus and Strawberry latent ringspot virus is transmitted by **Xiphinema diversicaudatum** (Micol.).

All the three viruses in Acer spp. are new for the world literature.

ACKNOWLEDMENT

I wish to thank D. Lesemann of the B.B.A. Institut für Viruskrankheiten der Pflanzen, Germany for ISEM tests and Huriye Sencer of the A.Ü. Tıp Fakültesi, Turkey for electronmicroscopy.

Ö Z E T

AKÇAAĞAÇLARDA GÖRÜLEN VİRUS HASTALIKLARI

İlk kez 1971 yılında Ankara'nın Keçiören-Kalaba yolu üzerindeki akçaağaçlarda görülen hastalık etmeni giderek yaygınlaşmış, Ankara ili ve çevresinden başka Afyon, Eskişehir, Denizli, İzmir illerindeki park ve bulvarlardaki akçaağaçlarda görülmüştür. Hastalıklı ağaçlardan konukçu bitkilere yapılan mekanik nakil denemeleri, serolojik testler ve immunelektronmikroskopi (ISEM) testleri sonucunda akçaağaçlarda epidemik durum alan hastalığa neden olan etmenin virus olduğu saptanmıştır.

Mekanik aşılamalar sonucu **Chenopodium amaranticolor, C. quinoa, C. murale, Nicotiana tabacum, N. glutinosa** ve **Cucumis sativus** gibi bitkilerde simptomlar meydana gelmiştir.

Serolojik test ve ISEM testleri sonucu Hıyar mozaik virus (Cucumber mosaic virus-CMV), Kazayağı mozaik virus (Sowbane mosaic virus-SMV) ve Kazteresi mozaik virus (Arabis mosaic virus-AMV) antiserumları ile pozitif reaksiyon görülmüştür.

Elektron mikroskop ile yapılan çalışmalar sonucu izometrik 26-30 nm çapında partiküllere rastlanmıştır. Bulunan her üç virus, akçaağaçlarda dünya literatürü için yenidir.

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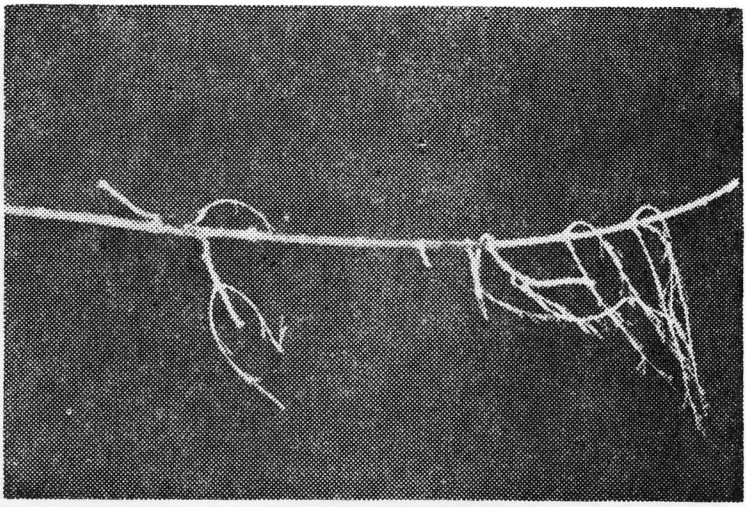

Figure 1. Shortening of the internodia on the shoots of maple trees.

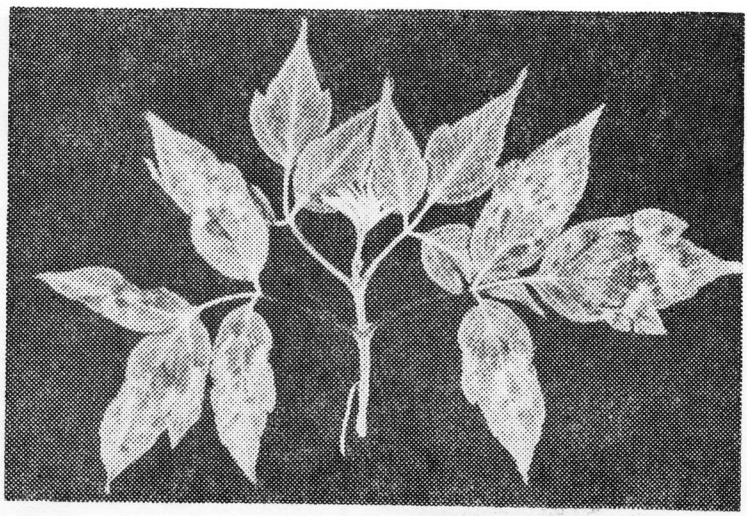

Figure 2. Mosaic lesions on **Acer negundo** leaves.

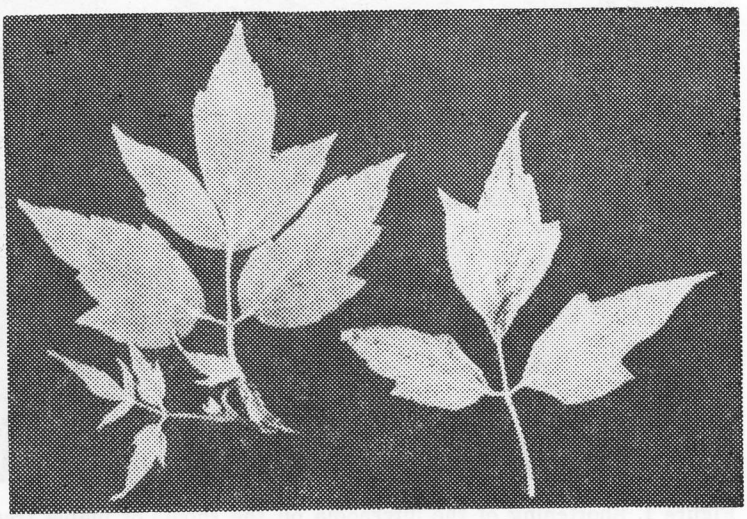

Figure 3. Light green point like symptoms. (Later they become bright yellow)

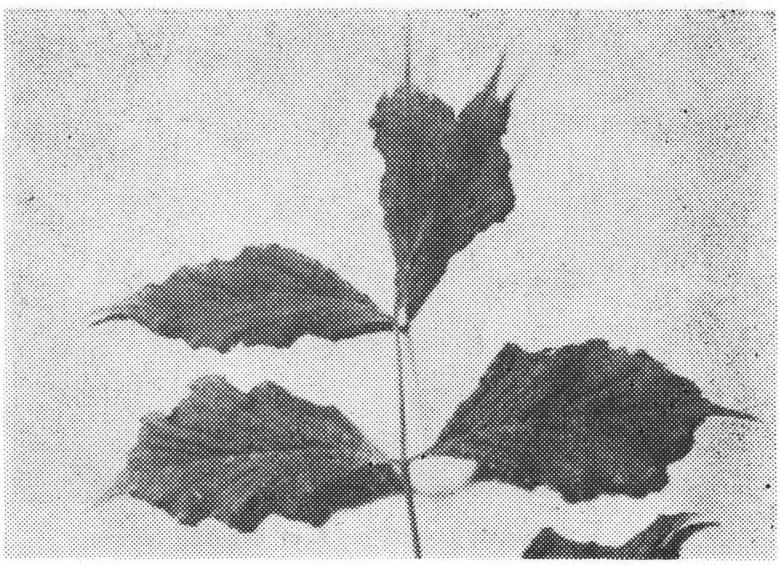

Figure 4. Leaf deformation and mosaic symptom resembling to acarina damage.

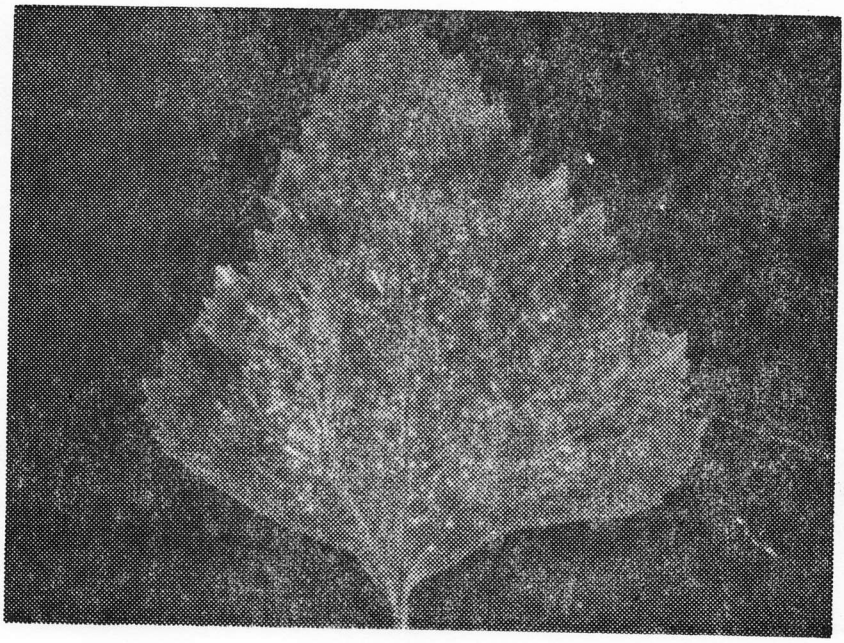

Figure 5. Chlorotic local lesions on **C. amaranticolor.**

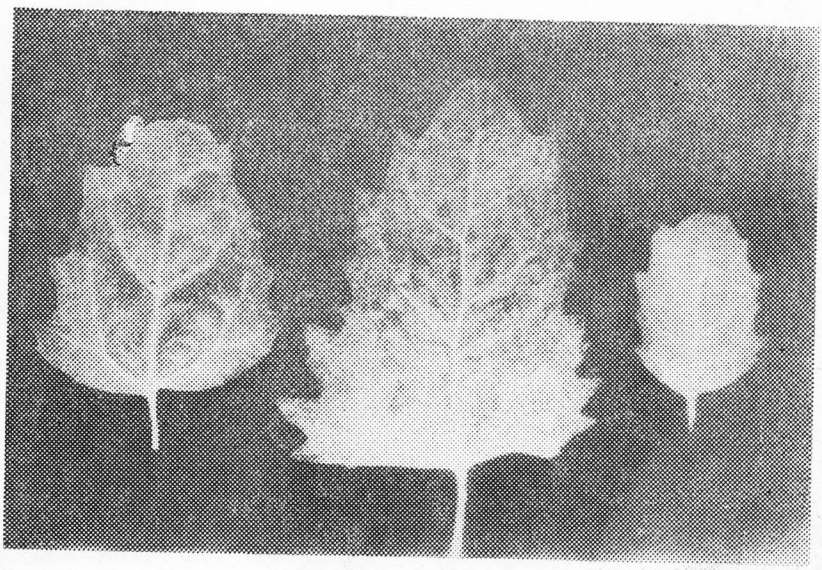

Figure 6. Chlorotic and systemic lesions on **C. quinoa.**

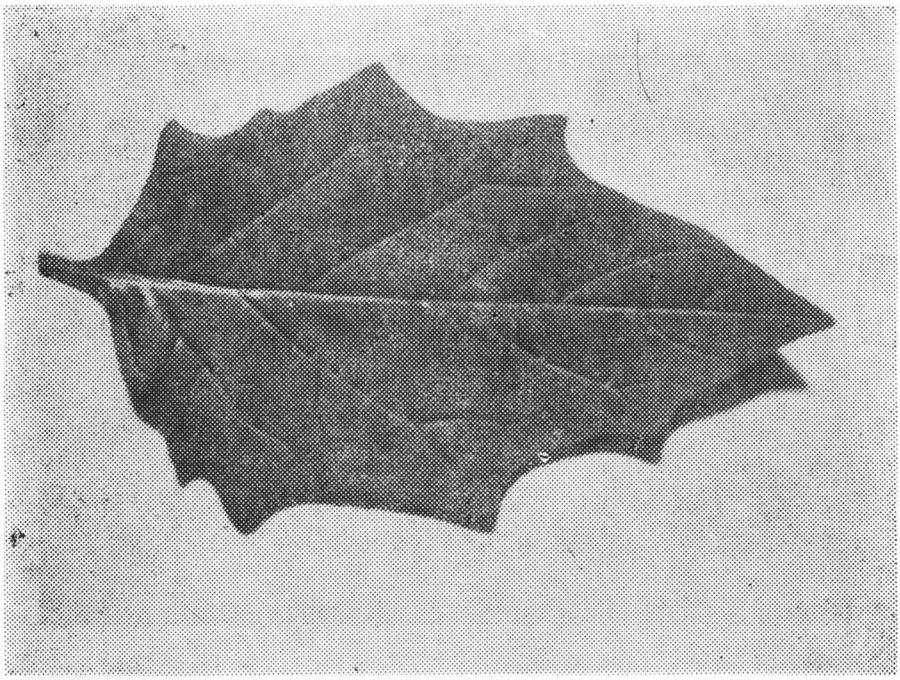

Figure 7. Local lesions on **Datura stramonium.**

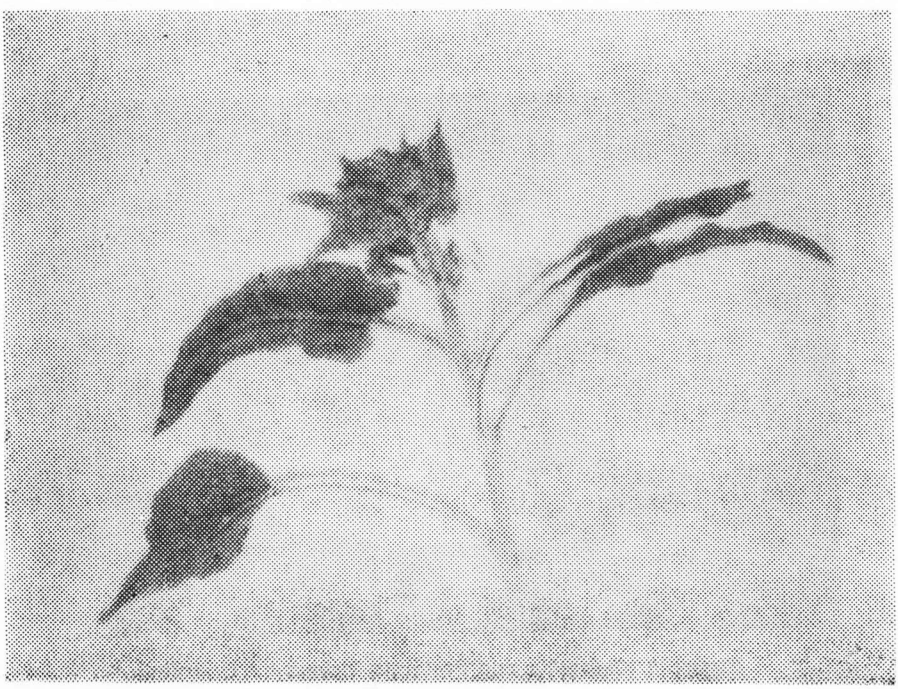

Figure 8. Severe mosaic and deformation of **N. glutinosa.**

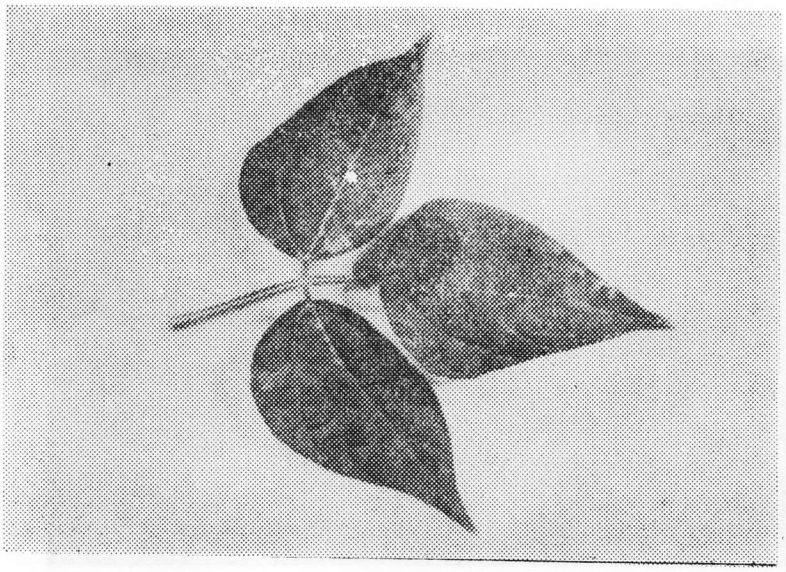

Figure 9. Local lesions on **P. vulgaris.**

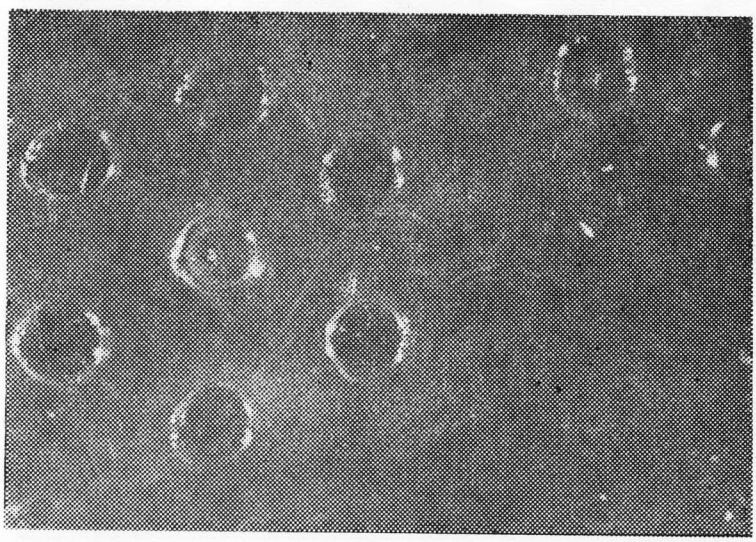

Figure 10. Serological reaction of AMV antiserum in agar-gel.

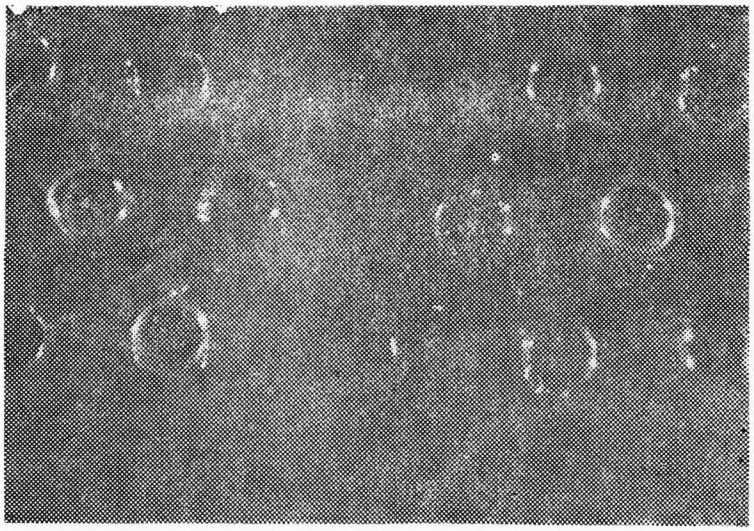

Figure 11. a) Reaction with SMV and b) Reaction with CMV.

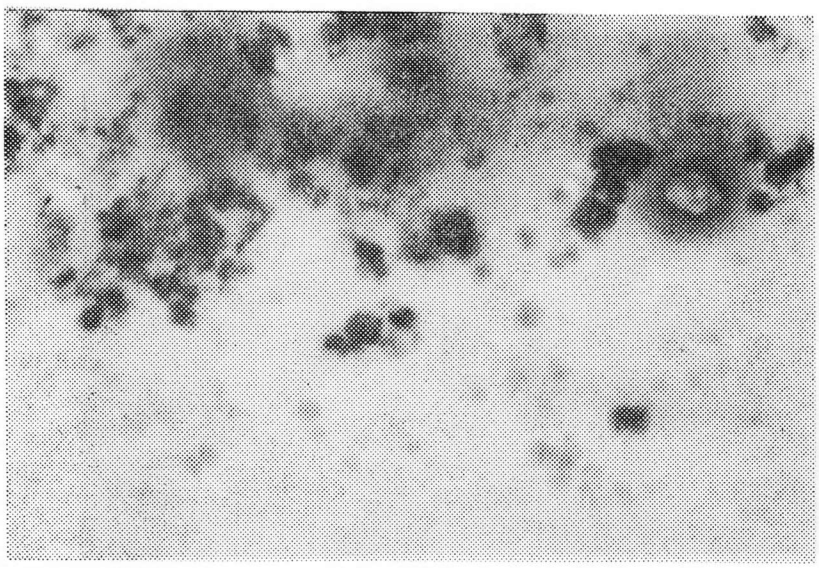

Figure 12. Particles in 26-30 nm. diameter (x80000).

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Incidence, Epidemiology And Identification Of Viruses On **Phaseolus vulgaris** L. in Erzincan Plain In Turkey[1]

Serap AÇIKGÖZ (2) **Ahmet ÇITIR** (3)

ABSTRACT

In Erzincan Plain some mosaic infections have been noticed on bean crop recently which has a rate of incidence of 30 % in average. Two dry-bean cultivars namely Dermason and Selanik have been affected equally. Because of this prevailing mosaic infection, significant reduction of the average pod number per plant and the average seed number per pod have occurred. So the average yield of per 30-plant was reduced significantly. As the results of the further investigations two bean virus pathogens were isolated by employing seed transmission and mechanical inoculation methods from infected plant sap to a differential host of broad bean (**Vicia faba** major L.). By determining their symptoms, host ranges, physical properties in sap, serological and electron microscopical properties of those virus isolates, they were identified as bean common mosaic (BCMV) and bean yellow mosaic (BYMV) viruses. The results of field and greenhouse experiments revealed that three breeding lines among the 317 been cultivars tested, were immune to infections of each of the two virus isolates alone and in mixture.

INTRODUCTION

Eastern Anatolian Region of Turkey has unfavorable climatic conditions for the most field crops. Because of the extreme weather conditions, raising livestock, mostly cattle and sheep is the primary agricultural occupation of the growers. But in some small microclimatic areas like Iğdır, Malatya and Erzincan Plains, the weather conditions permit to grow some field crops like cereals, sugar beet, dry-bean and even cotton. For instance in Erzincan Plain, beside the orchards of apricot and apple, sugar beet and dry-bean have been major field crops the growers usually prefer to produce. 2130 hectares of land has been allocated for the dry-bean production in Erzincan

(1) Portion of a dissertation submitted by first author.

(2) Research specialist in Eastern Anatolian Regional Agricultural Research Institute, Erzurum, Turkey.

(3) Faculty member in Plant Pathology, Department of Plant Protection, Atatürk University, Erzurum, Turkey.

Plain, which is second in place after Plain of Malatya in Eastern Anatolia (Anonymous, 1980). Dry-bean yield was 3400 tons during the same year which indicates 1600 Kg/hectare in average. Because of this low yield of dry-bean crop in Erzincan Plain the growers complained about some mosaic infections to responsible government officials. So, a research project was initiated in cooperation with the Department of Plant Protection at Atatürk University and The Eastern Anatolian Regional Agricultural Research Institute in Erzurum. The aims of this project were to determine incidence, epidemiology of those mosaic infections and to identify their causal agents. If it is possible to find out some immune cultivars for the control of this mosaic infections.

As a field crop, bean (**Phaseolus vulgaris** L.) has been susceptible to a number of pathogenic infections (Anonymous, 1960). The mosaic symptoms are, however, caused mostly by a number of viruses of bean. Thornberry (1966) listed 64 plant viruses to which at least one bean cultivar was susceptible. On the other hand, Smith (1972) explained that only 17 plant viruses cause natural infections on beans. As the primary causal agents of bean mosaic diseases two bean viruses namely bean common mosaic (BCMV) and bean yellow mosaic (BYMV) viruses have been reported as widespread in the World. Single or mixed infections of BCMV and BYMV were reported in Italy by Lisa (1977), in Yugoslavia by Alecsic (1967), in Czechoslavakia by Kvicala **et al** (1975), in Japan by Murayama **et al** (1975), in Israel by Nitzany (1975) and in Soviet Union by Stanyulis (1976). Disease incidence of mosaic infections on bean were also reported in some parts of Turkey by Tekinel **et al** (1969), Özalp (1971) and Erdiller (1979). Hampton (1975) reported that mutual infections of BCMV and BYMV usually act synergistically and reduce the number of pods per plant, and the number of seed per pod. So, the seed yield could be reduced as much as 64 % to 68 %. When dealing with bean mosaic infections in an area, the causal viruses have to be identified first. Bos **et al** (1960) suggested international rules for the identification of legume viruses. All the diagnostic features of BCMV and BYMV were summarized by Bos (1971) and Bos (1970) respectively. He reported that BYMV is not a seed transmissible virus and has a wide host range in contrast to the narrow host range of the seed-borne BCMV.

MATERIAL AND METHOD

1. Determination of Rate of Mosaic Infection:

According to collected data about the dry-bean production in Erzincan Plain, six villages were selected randomly in the area Fig. 1. In every location three randomly selected bean fields with a size of

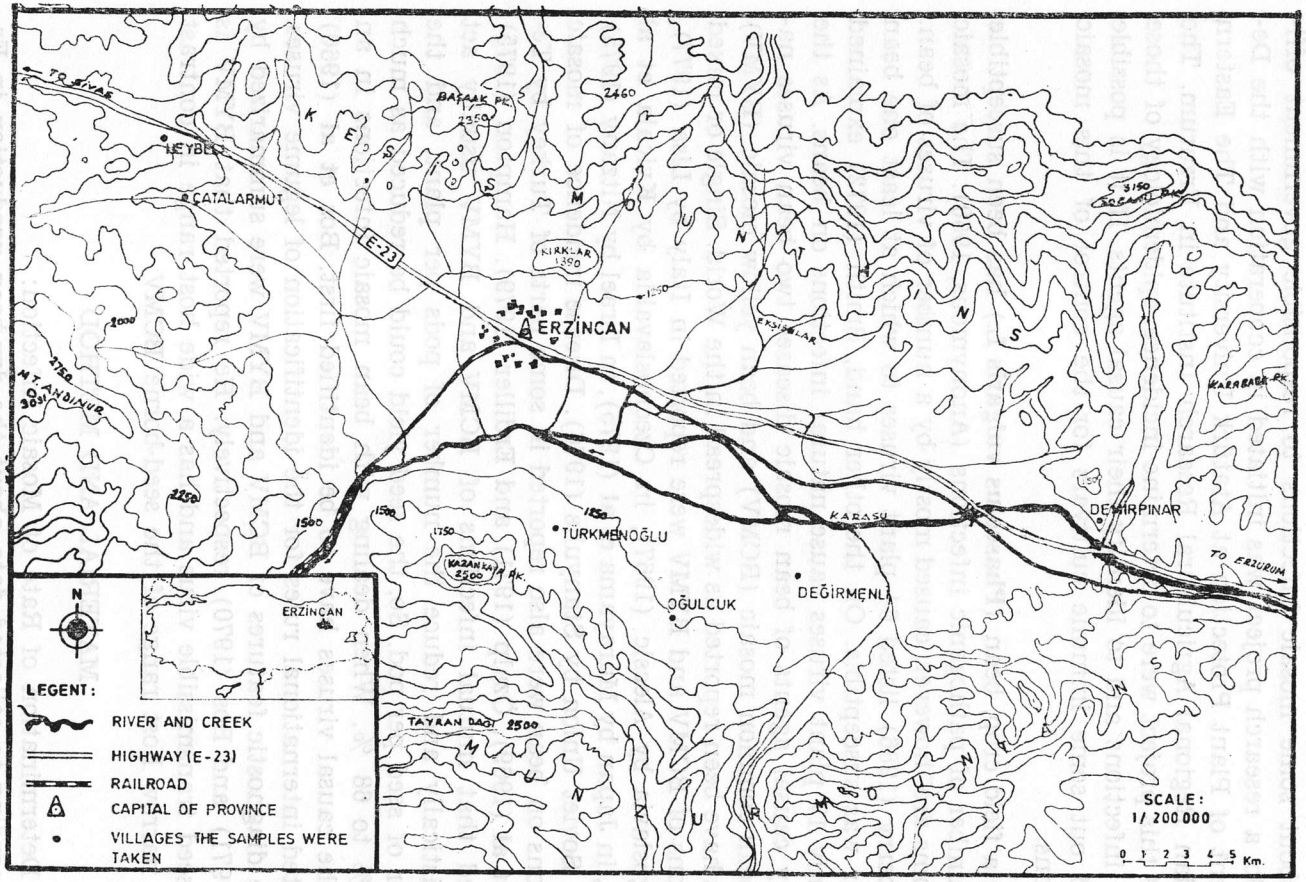

Figure 1. Topographical Features of Erzincan Plain and the Locations of Survey Studies about the Bean Mosaic Virus Infection were Made.

8-30 decares, were surveyed. These villages and fields were visited in June 1982. Three plots of 25 m X 25 m were selected in each field. One hundred bean plants were examined in each plot and the number of mosaic infected and healthy plants were counted and recorded.

2. Determination of Yield Reduction in Field Conditions:

Suggested method of Karman (1971) was employed for this purpose. Ten bean fields of Dermason and ten bean fields of Selanik cultivars were visited in August 1982 and 30 mosaic infected and 30 healthy bean plants were selected and sampled by gathering them separately from each field. The pods of ten mosaic infected and ten healthy randomly selected bean plants among the samples of each field were counted and recorded. The pods of samples were harvested separately and ten pods from infected, ten pods from healthy plants from each field were taken and the seed numbers of these pods were determined and recorded. The seeds of all the samples were let dry and harvested separately and the total weights of each 30-plant seed yield were obtained. This procedure was repeated for the samples of 20 fields.

3. Isolation of Bean Mosaic Viruses:

In order to isolate and determine the rate of seed transmission of those seed transmissible viruses of bean mosaic, Schade (1981)'s method was employed. Seed samples from mosaic infected and healthy plants were sampled from each cultivar. Three hundred seeds of infected plants were sown in pots containing sterilized soil. Fourty seeds of healthy plants were used as control. This was repeated for the samples of both cultivars. Those pots were kept in special growth chambers at 20-28°C, and 16 hour day length. Three weeks later the number of mosaic exhibiting plants were counted. Leaf samples were taken from these mosaic infected plants and were kept in a freezer for other studies.

Twelve leaf samples from mosaic infected Dermason and twelve leaf samples from mosaic infected Selanik plants in field conditions were collected and brought into laboratory during the field trips in 1982. Each sample was examined macroscopically and microscopically in the laboratory for the other pathogenic disease agents and was kept in deep-freeze until inoculations. Young plants of sixteen species belonging to Leguminosae family as listed in Table 1, were dusted with carborundum (grit number: 500) and inoculated with the sap obtained from infected bean leaves which were homogenized in 0.02 M phosphate buffer pH 7.2 containing 0.2 % 2-mercaptoethanol. Inoculated plants were washed gently with tap water, dried and kept in the greenhouse

Table 1. Plant Species and Cultivars Used for the İsolation and Identification of Mosaic Viruses in Erzincan Plain.

Family Name	Names of Plant Species	Name of Cultivars
Amaranthaceae	**Gomphrena globosa** L.	Mixed colors
Chenopodiaceae	**Chenopodium album** L.	—
	C. amaranticolor Coste + Reyn	—
	C. quinoa Willd.	—
Compositae	**Cirsium arvense** Soep	—
Iridaceae	**Gladiolus** sp.	—
	Freezia sp.	—
Legumenosae	**Phaseolus vulgaris** L.	Pinto III, Red Kidney, Great Northern, Ibyan-8, Small White 38, Sanilac, Black Turtle, Spain
	P. acutifolius Ariz.	Ladifolius
	Glycine max (L.) Davis	Lincoln, Grant
	Vigna sinensis (Turner) Savi	Black Eye
	Vicia faba L.	Major
	V. sativa L.	—
	Pisum sativum L.	Dark Skin Perfection
	Melilotus alba Desc.	—
	Trifolium incarnatum L.	—
	T. hybridium L.	Alsike
	T. repens L.	—
	Medicago lupulina L.	—
	M. sativa	Kayseri
	Lathyrus hirsitus L.	—
	Lupinus albus L.	Hung
	L. angustifolius L.	Frost
Papaveraceae	**Papaver somniferum** L.	Ssp Anatolicum
Solanaceae	**Lycopersicum esculentum**	Marglobe, Rutgers
	Nicotiana tabacum L.	Samsun, Samsun NN
	N. glutinosa L.	—
	N. sylvestris L.	—
	N. clevelandii Gray	—

at temperature ranging from 20 to 30°C. All inoculated plants were observed for the characteristic virus symptoms. Symptomless plants were indexed for the presence of virus four weeks after inoculations by using back inoculation method to the original host. The virus isolate caused severe mosaic on broad bean **(V. faba)** 'Major' was a different one and subjected to the further investigations for identification.

4. Identification of Viruses of Mosaic Infection:

Host Ranges of Virus Isolates:

Two isolates of bean mosaic viruses in Erzincan Plain were investigated by employing the methods of Bos **et al** (1960). For the host range studies 40 different plant species and cultivars in seven families as listed in Table 1 were used. Five pots of plants from each indicator plant were allocated and mechanically inoculated with the inoculum containing the virus isolate in subject as described before. The procedure was repeated for the other virus isolate.

Physical Properties of Virus Isolates in Sap:

Physical properties of both virus isolate were determined by investigating their dilution end points (DEP), thermal inactivation points (TIP) and the longevity **in vitro** (LIV) as described by Bos **et al** (1960). Relative infectivities of the treatments of DEP, TIP and LIV of broad bean isolate of bean mosaic virus were assayed by inoculating them carborundum dusted different sets of six **C. amaranticolor** plants, each containing six replicative leaves and arranged in a completely randomized block design. The local lesions were counted as soon as they appeared and analyzed statistically. Relative infectivities of the treatments of DEP, TIP and LIV of seed-transmissible virus isolate were assayed by using 'Red kidney' bean plants. 12 plants for each treatment were allocated and the number of infected plants out of 12 were obtained by counting them as soon as the systemic symptoms appeared and the results were analyzed.

Electron Microscopy:

The Leaf-dip method of Brandes and Paul (1957) was used as modified and rescribed by Horne (1967) for the electron microscopical studies of both bean mosaic virus isolates. Copper electron-microscopic grids (200 mesh/square inch) were covered with 0.5 % formvar. One drop of bidistilled water was put on each grid. Freshly cut triangular tips of infected leaves of broad bean by mosaic virus isolate were dipped three times into drops on grids. Excess liquid from grids was gently absorbed with filter paper. 2 % of sodium phosphotungistatic acid pH

7.0 was dropped on each grid for the negative staining. Other grids were prepared by using infected Red kidney bean leaves with seed-transmissible isolate. All the grids were examined under Zeiss EM 10 A electron microscope. Characteristic particles associated with virus infected plants were measured on electronmicrographs.

Serology:

In addition to normal sera of rabbit blood, the antisera against BCMV, BYMV and Alfalfa mosaic (AMV) viruses were otained from 'Laboratorium Voor Bloembollenderzoek, Lisse Holland'. Clarified sap of infected broad bean and Red kidney bean plants with virus isolates separately and clarified sap of their healthy individuals were prepared as antigens. They were diluted with saline containing 1:5 v:w 0.02 % sodium azide. The dilutions used were 1:4, 1:16 and 1:32 for both antisera and antigens. Tube precipitation and agglutination tests were used as given by Ball (1974). Precipitations were recorded two hours of incubation at 37°C and again 24 hours at room temperature.

5. Search for Immune Bean Cultivars

In order to search for immune bean cultivars against the mosaic virus isolates in Erzincan Plain, seeds of 317 cultivars and genetical stock materials were used. The field experiments were carry out in research farm of Eastern Anatolian Agricultural Research Institute in Pasinler, Erzurum in 1983. Twenty seeds from each cultivar were sown in six meter row on which bean plants were 30 cm apart from each other. There was at least one meter distance between two rows of different cultivars. So all the cultivars of bean were exposed to the mosaic infections in field conditions which were determined as abundant in the area. Bean plants were examined twice before and afterflowering and the infected cultivars and genetical stock materials were eliminated. Healthy looking cultivars were selected and their seeds were sown two for one pot in sterile soil. So sets of pots containing four plants from each cultivars were allocated to each inoculum prepared from two virus isolates and their mixture. So 12 plants from each cultivars were used. Carborundum dusted primary leaves of each cultivars were inoculated mechanically by their respective inoculums. İnoculated plants were kept in greenhouse conditions for the exhibition of characteristic virus symptoms for a period of four weeks. Symptomless cultivars and materials were rechecked by back-inoculations of sap obtained from such plants to the broad bean and Red kidney bean plants.

RESULTS

1. Determination of Rate of Mosaic Infection:

The results of the rate of mosaic infection in Erzincan Plain is shown as in Table 2. In 1982 season the bean crop was infected about 29.90 % in whole Plain. As a results of those counts dry-bean cultivar of Selanik revealed average 32.58 % which was slightly higher than Dermason's 28.86 % average rate of mosaic infection. There was, however, no significant differences on the rate of infection between two cultivars.

Table 2. The Rate of Mosaic Infection on Bean Crop in Erzincan Plain in 1982 Growing Season.

Name of Village	Examined Field Area (Decare)		Infection Rate (%)
Çatalarmut	27		28.20
Heybeli	30		36.69
Türkmenoğlu	34		51.00
Oğulcuk	32		45.96
Değirmenli	36		6.63
Demirpınar	45		31.05
Total surveyed area	204	Average rate	29.90

2. Determination of Yield Reduction of Dry-bean:

As a result of mosaic infection on bean crop in Erzincan Plain the number of pod on per plant was reduced significantly in both Selanik and Dermason cultivars. The differences in pod number of both cultivars was insignificant. Mosaic infection caused significantly important reduction in the number of seed for per pod. There was also significant differences between the numbers of seed for per pod of Selanik and Dermason cultivars at the level of 0.05 possibility. Healthy Dermason plants showed higher number of seed in per pod than Selanik.

Survey studies revealed that there were significant differences between the seed yields of per 30-plant of healthy and infected groups of both cultivars. So, mosaic infection reduced the yield almost 73 % and affected both cultivars equally as indicated Figure 2.

3. Isolation of Mosaic Viruses:

As a result of seed transmission experiments, single bean mosaic virus isolate was obtained. The rate of seed transmission of this virus

isolate was 61.82 % in Selanik and 62.10 % in Dermason cultivars. As the result of mechanical sap inoculations from infected bean samples to a number of virus indicator plants provided another bean mosaic virus on broad bean plants. There was no other pathogenic agent responsible for the mosaic infection on bean samples collected from Erzincan Plain.

4. Identifications of Mosaic Virus Isolates:

Host Ranges of Bean Mosaic Virus Isolates:

As a result of mechanical sap inoculations seed-transmissible virus isolate was infectious on just a few plants. **C. quinoa** exhibited chlorotic local lesions seven days after inoculations. All the inoculated bean cultivars like Red kidney, Black turtle, Small White 38 and Spain indicated mosaic symptoms in three weeks. **Phaseolus acutifolius** Var. Ladi-

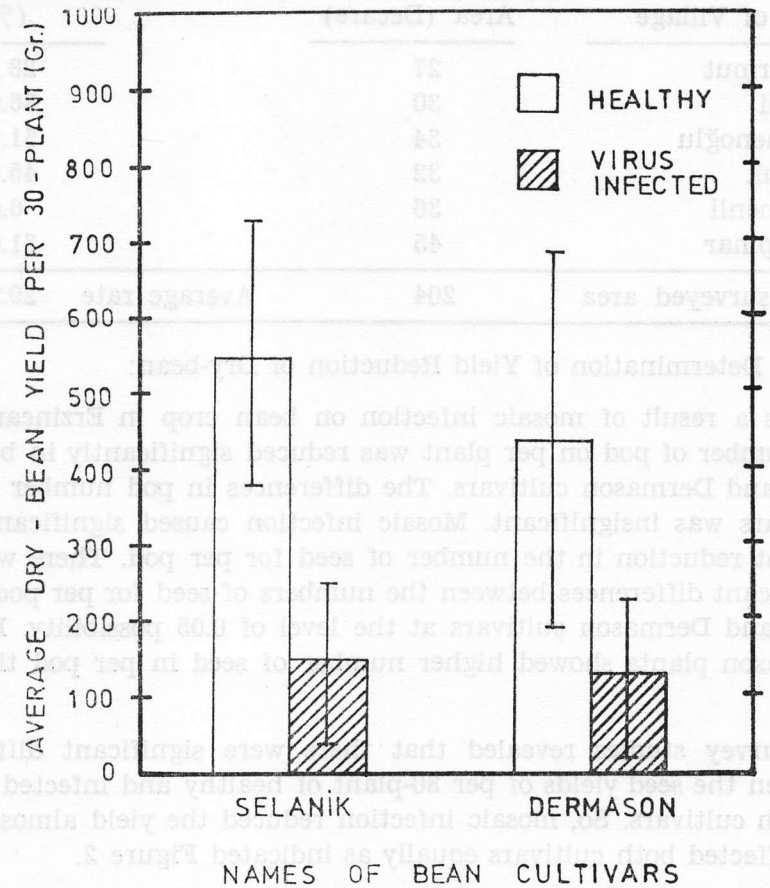

Figure 2. Comparison of Dry-bean Yields of Healthy and Mosaic Virus Infected Plants of two Bean Cultivars during the Growing Season of 1982 in Erzincan Plain, Turkey.

folius exhibited severe mosaic, leaf deformation and stunting. All the other tested species and cultivars were found immune to this isolate.

On the other hand mechanical sap inoculations of broad bean isolate of mosaic virus revealed pretty wide host range. As listed in Table 3, total 27 out of 40 tested plant species and cultivars were found to be susceptible to this bean virus.

Physical Properties in Sap:

Seed transmissible isolate of bean virus indicated a (DEP) dilution end point between $1:10^3$ and $1:10^4$, but thermal inactivation point (TIP) was between 55° and 60°C and the isolate was still infectious 24 hours after aging **in vitro** (LIV) at room temperature, but not infectious 48 hours later.

Broad bean isolate of bean mosaic virus revealed a (DEP) dilution end point between $1:10^3$ and $1:10^4$ and a (TIP) thermal inactivation point was between 60 and 65°C. The isolate was still infectious six days after aging **in vitro** at room temperature but was not seven days later.

Electron Microscopy:

Electron microscopical studies revealed that, both mosaic virus isolates of bean contained flexible rod shape particles having an average length of 750 nm and almost 14 nm in diameter.

Serology:

Serological studies indicated only one spesific serological reaction between antigen prepared from broad bean isolate of mosaic virus and the antiserum against bean yellow mosaic virus (BYMV) as aresult of the agglutination tests.

5. Search for Immune Variety:

The results of investigations for immune variety against the separate and mutual infections of two bean mosaic viruses in Erzincan Plain revealed that all the tested bean cultivars were susceptible to them except two hybrid and one genetical stock material as listed in Table 4. Among the 317 bean cultivars and breeding lines 'Ibyan 8' indicated hypersensitive reactions by exhibiting local lesions. But at the end of the experiments this cultivar also systemically infected by broad bean isolate and revealed chlorosis and stunting.

Table 3. List of Susceptible Plants to the Broad bean Isolate of Bean Mosaic Virus and their symptoms three Weeks after Inoculations.

Name of Plant Species and Cultivars	Types of Symptoms
Chenopodium album L.	LLc
C. amaranticolor Coste+Reyn.	LLc, VC, SI
C. quinoa Willd.	LLc
Gladiolus sp.	Mo, CoB
Freezia sp.	CoB
Phaseolus vulgaris L. (Pinto III, Red kidney, Small white 38, Black turtle, 3Lb Sanilac, Ibyan 8, Spain)	Cl, Mo, St
P. acutifolius Var. Ladifolius (Ariz)	Mo
Vigna sinensis (Torner) Savi	SlessC
Vicia faba L. (Major)	SeMo
Melilotus alba Desc.	Cl, Mo
Trifolium incarnatum L.	VC, Mo
T. hybridium L. (Alsike)	Mo
T. repens L.	Mo
Medicago lupulina L.	Mo
M sativa L. (Kayseri)	Mo, St
Lathyrus hirsitus L.	Mo
Lupinus albus L. (Hung)	Cl, W, D
L. angustifolius L. (Frost)	Cl, W, D
Papaver somniferum L. (Anatolicum)	SlessC
Nicotiana sylvestris L.	VC, SI
N. clevelandii L.	Cl, St

Symptom Key; Cl: Chlorosis, CoB: Color breaking on flowers, D: Death, LLc: Chlorotic local lesion, Mo: Mosaic, SeMo: Severe mosaic, VC: Vein clearing, W: Wilting, SlessC: Syptomless carrier, St: Stunting, SI: Systemic infection.

Table 4. List of Bean Cultivars Immune to two Bean Mosaic Virus Isolate from Erzincan Plain in Turkey.

Type of Cultivar	Number of Registration	Hybrid of	Pedigri or Source
Hybrids	11 B-2	983/1-599/3	ESF-11ES-2ES-0ES
	11 B-4	983/1-569/5	ESF-11ES-4ES-0ES
Genetical stock Material	4 F-683	681/1-681/3	Yalova/Turkey

Erzincan Plain as one of the important microclimatic agricultural areas in Eastern Anatolia shows characteristic features for dry-bean cultivation. Farmers grow just two cultivars, namely Dermason and Selanik which are infected with a mosaic disease. As indicated in Table 2 almost 30 % rate of mosaic infection may cause considerable amount of reduction in the yield. Because of this disease pod number of per bean plant and seed number of per pod reduced significantly and the yield of 30-plant of both cultivars dropped significantly as shown in Figure 2. This means almost 73 % of yield lost for infected beans.

Only plant viruses cause mosaic infections on beans as accounted by Smith (1972). It could be suggested that only more than one virus could cause such a drastic yield reduction as reported by Hampton (1975). Such a low yield due to virus infections may remind the involvement of more than one virus which cause synergistic effects in the same host. In order to identify such viruses their isolation is an out most importance. Ross (1964) suggested that different transmission characteristics of viruses could help isolation or separation of those viruses in a mixture in one host to different susceptible plants. It is a good practice to use seeds of infected plants to isolate seed transmissible viruses. Mechanical sap inoculations from infected plant parts to a number of virus indicator plants is another way of isolation. Bean is susceptible to a more than one seed transmissible and mechanical transmissible viruses, but they could be separated one by using differential host plants as listed by Smith (1972) for each of them. So, two kinds of mosaic virus were isolated by using mosaic infected bean seeds and mechanical sap inoculations from samples of Erzincan beans to differential host of broad bean.

Bos **et al** (1960) formulated a procedure for the identification of unkown legume viruses which include determination of host range, physical properties of them in sap, serological and electron microscopical properties. Sometimes determination of only one feature of an

unknown virus isolate could be enought for a definite identification as suggested by Ross (1964). Just as, Çıtır (1975) identified an endive mosaic agent as a turnip mosaic virus (TuMV) by using a crisp head lettuce cultivar 'Calmar' which is a dependible differential host of turnip mosaic virus with mildew resistance.

Seed transmissible bean mosaic virus isolate of Erzincan Plain was identified as bean common mosaic virus (BCMV). Beside the seed transmissible feature of this isolate it is also mechanically sap transmissible to a few species of host plants, causing similar symptoms as described for bean common mosaic virus by Bos (1971), Klinkowski (1972) and Erdiller (1979). Other seed transmissible viruses of bean infect cowpea (**V. sinensis**) but Erzincan isolate similar to common mosaic virus never infects it. Physical properties of isolate in sap showed results of; TIP: 55-60°C, DEP: $1:10^3$ - $1:10^4$ and LIV: 34-48 hours which are similar to the results of bean common mosaic virus obtained by Zaumeyer and Goth (1964), Ordosgoitty (1972), Erdiller (1979) and Omar **et al** (1979). In spite of absence of a positive serological reactions between the antigens prepared from Erzincan isolate of seed transmissible mosaic virus and the antiserum against the bean common mosaic virus, electron microscobic studies revealed identical flexible rod shape particles with the average dimension of 750 x 14 nm. According to Bos (1971) it is hard to obtain necessary particle concentrations of bean common mosaic virus in most of the cases for serological studies. So, most of serological tests could not show a specific positive reactions for identification of the isolates of bean common mosaic virus. Probably this was happen during the serological studies of Erzincan isolate of bean common mosaic virus too.

The other bean mosaic isolate obtained on broad bean plants in Erzincan Plain was identified as bean yellow mosaic virus. It is mechanically sap transmissible to 27 out of 40 plant species and cultivars in seven families as listed in Table 3 which exhibit characteristic symptoms similar to bean yellow virus as described by Bos (1970) and Kovachevsky (1973). The isolate caused local chlorotic lesions on inoculated leaves of **C. amaranticolor** and caused systemic vein clearing in young leaves which is the most remarkable feature of bean yellow mosaic as described by Bos (1970) and Yılmaz (1981). Physical properties of this virus isolate in sap were found as; TIP: 60-65°C, DEP: $1:10^3$ - $1:10^4$ and LIV: 6-7 days which are confirmed by the results of Bos (1970), Kovachevski (1973) and Tu (1980) whom they determine similar figures of the other bean yellow mosaic virus isolates. Only one positive serological reaction was obtained between the antigen prepared from the broad bean isolate of Erzincan bean mosaic virus and the antiserum against the bean yellow mosaic virus, as a results of

agglutination tests. Because of the improper handling of antigens for the tube precipitation tests there was no specific reactions. The electron microscobic studies revealed that the isolate has flexible rod shape particles having dimensions of 750 x 14 nm which are like bean yellow mosaic virus as reported by Kaiser and Eskandari (1970), Bos (1970) and Kovachevsky (1973).

Three out of 317 bean cultivars showed immune reaction to both virus isolate as listed in Table 4. To use immune cultivars is considered to be the best way of control of those virus infections. Therefore Hubbeling (1973), Shamy **et al** (1972), Innes and Walkey (1980) and Hampton **et al** (1983) searched some bean cultivars immune to bean common mosaic virus. On the otherhand Dickson and Natti (1968). Provvidenti and Schroeder (1973), Kowalska **et al** (1979) and Tu (1980) tested many cultivars against the infections of bean yellow mosaic virus isolates, and found some immune cultivars. In this study at least three genetical stock material which are far from being a commercial dry-bean cultivars at this point shoved immunity to both mosaic virus isolates of bean common mosaic and bean yellow mosaic viruses isolated from the infected beans in Erzincan Plain in Turkey.

Ö Z E T

TÜRKİYE'DE ERZİNCAN OVASI'NDAKİ FASULYE (**Phaseolus vulgaris** L)'LERDE GÖRÜLEN VİRÜSLERİN YAYILIŞI, EPİDEMİSİ VE TANILANMASI

Son zamanlarda Erzincan Ovası'nda fasulye ürününde ortalama % 30 oranında yaygınlık gösteren bazı mozayık enfeksiyonları dikkati çekmeye başlamıştır. Hastalıktan, bölgede yetiştirilmekte olan iki kuru fasulye çeşidi Dermason ve Selanik aynı derecede etkilenmektedir. Bu mozayık hastalığından dolayı bitki başına bakla adedinde ve bakla başına tohum adedinde önemli düşüşler belirlenmiştir. Böylece 30-bitki başına ortalama verim büyük ölçüde azalmıştır. Yapılan diğer çalışmalar, hastalıklı bitkilerden tohumla taşınma suretiyle ve bakla (**Vicia faba** major L.)'ya yapılan mekaniksel inokulasyonlar sonucu mozayık etmeni olarak iki ayrı virüs izolatının bulunduğunu göstermiştir. Bu virüs izolatlarının neden oldukları belirtiler, konukçu çevreleri, bitki özsuyu içerisindeki fiziksel özellikleri, serolojik ve elektron mikroskobik nitelikleri belirlenerek bunların fasulye adi (BCMV) ve fasulye sarı mozayık (BYMV) virüsleri oldukları saptanmıştır. Yapılan tarla ve sera denemeleri ile bu iki virüsün tek tek ve birlikte enfeksiyonlarına tabi tutulan 317 fasulye çeşidinden ancak üç ıslah hattının virüs izolatlarına immün oldukları belirlenmiştir.

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An Investigation On The Ability Of The Monosporidia Of Long Smut Agent (**Tolyposporium ehrenbergii** (Kühn) Pat.) To Cause Infection On Sorghum

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ABSTRACT

The monosporidial isolates obtained from chlamydospores of **T. ehrenbergii** were inoculated into the inflorescence sheats of sorghum with the purpose of determining their degrees of ability to cause infection.

The monosporidial isolates obtained from certain chlamydospores did not cause the disease at all, whereas a certain number of the isolates obtained from other chlamydospores were found to have the ability to cause infection. Upon mixing and inoculating the non-infectious monosporidial isolates together, the resulting mixture was found to possess the abiliity to infect.

Our results also imply that the majority of the sporidia are haploids, and that the remainings are diploid or dikaryotic.

INTRODUCTION

There are different reports from various parts of the world in the literature covering the mode of infection of long smut (**T. ehrenbergii**) which was determined by the author for the first time in Turkey only in 1964. According to some investigators, only the sporidia which actually enter the sheats enclosing the young inflorescences, cause infection (Prasad, 1945; Ramarkrishnan and Reddy, 1949; Vasudeva and Iyegar, 1950; Kamal and Moghal, 1968; Doshimow, 1969). Hafız (1958) referring to Burler that the chlamydospores of **T. ehrenbergii** germinate and produce sporidia like those of **Ustilago maydis**. These sporidia infect the young inflorescences. According to Hafız (1958)'s research, there are seedling and inflorescences infections and if the sporidial suspension poured inside the sheats, the disease occur rather at a high rate. Ragap and Mahdi (1966) also determined similar results in their investigations. Parlak (1979) shoved that chlamydospores transmitted from previous year's crop through the soil or ones adhered to the surface of the grain, germinate and produce sporidia in the soil during

the spring under favorable canditions. The sporidia are carried by air. When the inflorescence sheats start to open, some of the sporidia may settle in drops of water which is present between the heads and the sheats. The sporidia germinate in these drops and penetrate into the young ovaries. There was no infection when the inoculation was made after the heads entirely emerged from sheats. In addition, there was no seedling and stem infection.

The sporidia or only one sporidium may anter between the heads and sheats in groups or individually. These sporidia may be haploid or diploid (Christensen, 1963). Some investigators mentioned above carried out the inoculation by pouring the sporidia inside the sheats. However, there is no monosporidial culture inoculation. In this work, we try to learn whether the monosporidial inoculation can cause a disease or not.

MATERIALS AND METHODS

The chlamydospores of **T. ehrenbergii** and the seeds of **Sorghum vulgare** Pers. collected from Ergani, Diyarbakır in 1976 were used in this research.

Isolation of single spores and production of monosporidial cultures: Under the microscope, a chlamydospore was picked up by aid of a sterile glass needle from a sterile glass slide previously dusted with dry chlamydospores. Then, each spore was transfered to the potato-dextrose agar in a petri plate, and incubated at about 28°C for germination. After the chlamydospore germination, the sporidia were isolated directly from the promycelium or an individual sporidium was drawn away from the promycelium and then isolated by aid of a needle under the microscope. Each sporidium was sown on one of the potato-dextrose agar plate, and incubated at about 28°C for monosporidial cultures.

Inoculum and inoculation: After abundant growth appeared, adequate distilled water was added until it covered the surface of the culture. Each monosporidial suspension was added to 100 cm^3 of distilled water, and inoculated by a hypodermic syringe into the 10 inflorescence sheats before emergence of the young inflorescences of sorghum plants which were grown in the green house in Diyarbakır. In order to avoid air-borne infection, ears were bagged before the inflorescence sheats start to open. 10 plants were inoculated with mixture of sporidial suspensions. The percentages of smut infection were determined by smutted and unsmutted head counts. If there was no infection on some groups of plants which were inoculated monosporidial suspensions, the same suspensions were mixed with each other, and the other 10 plants were inoculated with this inoculum.

RESULTS AND DISCUSSION

The experimental results are shown in Table 1. As it is seen from this table, some of the monosporidial cultures which were isolated from some chlamydospores caused the long smut. While some of the monosporidial cultures isolated from the other chlamydospores were causing the disease the others did not. Monosporidial cultures which did not cause long smut individually, gave rise the disease when applied in combination.

Table 1. Monosporidial infection on **Sorghum vulgare**

The characters of monosporidial isolates	The number of monosporidial isolates	Percentage of smutted head
The isolates obtained from a chlamydospore which gave only sporidia but not promycelim	1	—
	2	90
	—	—
	—	—
»	1	100
	2	80
	3	—
	4	—
»	1	—
	2	—
	3	—
	4	—
The isolates obtained from a chlamydospore which gave promycelium and sporidia	1	60
	2	90
	3	70
	4	—
»	1	—
	2	—
	3	—
	4	—
»	1	—
	2	—
	3	—
	4	—
The population of sporidia	1	100
Combination of monosporidial isolates which did not cause the disease individually	1	90

We could not come across with any information about the monosporidial inoculation and sexual reproduction of **T. ehrenbergii** in literature. The spore germination process of this fungus resembles that of **Ustilago maydis** (D.C.) Corda (Parlak and Karaca, 1976).

Some monosporidial isolates which were nonpathogenic may be haploid; whereas the others which were virulent may be diploid. The combination of monosporidial cultures which were induvidually avirulent caused infection and galls developed. In this case, these monosporidial cultures separately may have opposite sex and the sporidial fusion perhaps occured in the host. As a matter of fact, **U. maydis** shows the same characteristics (Wolf, 1949; Walker, 1950; Christensen, 1963; Karaca, 1965).

Ö Z E T

KOCADARI UZUN RASTIĞI ETMENİ (**Tolyposporium ehrenbergii** (Kühn) Pat.) MONOSPORİDİLERİNİN İNFEKSİYON YAPABİLME GÜÇLERİNİN ARAŞTIRILMASI

Tolyposporium ehrenbergii (Kühn) Pat. klamidosporlarından elde edilen monosporidi izolatları kocadarının başak kını içerisine inokule edilerek enfeksiyon yapıp yapmadıkları tespit edilmeye çalışılmıştır.

Cetvel 1'in tetkikinden de görülebileceği gibi, bazı klamidosporlardan elde edilen monosporidi izolatlarından bir kısmı hastalık meydana getirdiği halde diğer kısmı hastalık meydana getirmemişlerdir. Bazı klamidosporlardan elde edilen monosporidi izolatlarının ise hiç biri hastalık meydana getirmemiştir. Hastalık meydana getirmiyen monosporidi izolatları biribiriyle karıştırılıp inokulasyon yapıldığında bu karışımın hastalığı oluşturduğu görülmüştür.

Elde edilen veriler, sporidilerin çoğunluğunun haploid, bir kısmının da diploid veya dikaryotik olabileceği kanısını vermektedir.

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Effectiveness Of Some Chemicals Against To Downy Mildew (**Pseudoperonospora cubensis** (Berk .and Curt) Rostow) On Muskmelon

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ABSTRACT

The effectivities of a protective fungicide (Dithane M-45) and two protective-systemic mixture formulations (Mikal and Ridomil MZ-72) against to **Pseudoperonospora cubensis** on muskmelon were tested. It was found that the effectivities of Dithane M-45, Ridomil MZ-72 and Mikal were 68.1 %, 86.4 % and 96.4 % respectively.

INTRODUCTION

The downy mildew disease of cucurbits (**Pseudoperonospora cubensis** (Berk. and Curt.) Rostow) is the most important disease on muskmelon and cucumber in the South Anatolian Region. It may have been an epidemical disease and caused great losses in the product in some years.

The protective fungicides with mancozeb, propineb, zineb and maneb active ingredients have been used against this disease in the region by cucurbit growers. But it has not been possible to control the disease effectively even with two applications per week during all vegetation period.

This study was made to determine the comparative effectivities of Dithane M-45 as a protective fungicide, and Ridomil MZ-72 and Mikal as protective-systemic mixture fungicides on downy mildew on muskmelon.

MATERIALS AND METHODS

The experiment was made in a field of Agricultural Faculty of Çukurova University. Ananas muskmelon variety (**Cucumis melo** cv. **ananas**) was used. Fungicide applications were made with a knapsack pulverizer. The trade names, active ingredients and doses of the fungicides used have been shown in table 1.

Table 1. The trade names, active ingredients and doses of the fungicides used

	Fungicides'	
Trade name	Active ingredients and rate.	Dose as preparate per 100 liter water
Dithane M-45	Mancozeb, 80 %	250 g
Ridomil MZ-72	Mancozeb, 64 % Metalaxyl, 8 %	250 g
Mikal	Phosetyl-Al, 50 % Folpet, 25 %	300 g

The experiment was carried out according to randomized block design with 4 characters and 4 replicates. Each plot was 18 m^2 and had 24 plants. Muskmelon seeds were directly sown in the field soil at March 16, 1984.

First fungicide applications were made at May 17, 1984 when first disease simptoms began to be seen in the experiment field and the plants were in flowering period. Aplications were continued 10 days interval, and three applications were made totally.

The countings were made according to 0-5 scala below taken from plant protection technical directions against to downy mildew disease of cucurbits on 100 leaves taken at random from each plot at 10 days after the last applications at June 18, 1984.

The disease scala used

Scala number	Disease severity
0	No symptom on leaves
1	0-5% of the leaves is spotted
2	6-10 % of the leaves is spotted
3	11-25 % of the leaves is spotted
4	26-50 % of the leaves is spotted
5	51-100 % of the leaves is spotted

Index values were obtained using index formula, and the effectiveness of the fungicides were calculated by applying Abbott formula on the index values. Variance analysis and Duncan Test were made.

RESULTS AND DISCUSSION

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

Table 2. The results obtained from the experiment

Characters	Rep.	Disease index	Effectiveness (%)	Mean effectiveness (%)	Duncan result
Dithane M-45	I	0.82	69.9	68.1	b
	II	1.18	52.4		
	III	0.26	91.4		
	IV	0.68	58.5		
Ridomil MZ-72	I	0.26	90.4	86.4	a'b
	II	0.40	83.9		
	III	0.76	75.0		
	IV	0.06	96.3		
Mikal	I	0.10	96.3	96.4	a
	II	0.04	98.4		
	III	0.06	98.0		
	IV	0.12	92.7		
Control	I	2.72	—	—	c
	II	2.48	—		
	III	3.08	—		
	I V	1.64	—		

As shown in table 2, the effectiveness of Mikal, Ridomil MZ-72 and Dithane M-45 fungicides against to **P. cubensis** were 96.4 %, 86.4 % and 68.1 %, respectively. According to Duncan test, while Mikal was in first group, Ridomil MZ-72 and Dithane M-45 were in second and third groups, respectively.

All fungicides used were not phytotoxic on muskmelon plants.

Bertrand et al. (1978) found that aluminiumethylphosphite (Phosethyl-Al) was effective against a number of diseases including **P. cubensis** on cucumber. Chazalet et al. (1978), in a field trial, found that the best results against to grapevine mildew were obtained with aluminiumethylphosphite and folpet mixture at low doses. Lafon et al. (1978), in two field trials, indicated that aluminiumethylphosphite and folpet mixture reduced grapevine mildew disease incidence to 4.35 % and 0.12 %. Boubals (1979) indicated that three applications with aluminiumethylphosphite in a growing season controlled downy mildew of vineyards completely. Lafon et al. (1979), in field trials, showed that

the treatments with aluminiumethylphosphite and folpet mixture were effective and better than mancozeb. Marais and Van Der Walt (1979) indicated that 50 % aluminiumethylphosphite and 25 % folpet, and 50 % aluminiumethylphosphite and 25 % mancozeb mixtures gave better control than mancozeb did alone against to downy mildew of vineyards. Mur (1979) found that Aliette (Aluminiumethylphosphite), Curzate and Acylon (Metalaxyl) fungicides stopped the mildew of grapevine and protected young leaves formed after treatments.

The results obtained from this study have agreed with the results obtained by Bertrand et al. (1978) for **P. cubensis** and with those obtained by other investigators for grapevine mildew disease. The downy mildew of cucurbits is a serious problem and have caused the great losses in the South Anatolian Region. It has not been possible to control the disease with the protective fungicides such as Dithane M-45 used in this study. It has been necessary to use systemic and systemic-protective mixture fungicides. The results obtained from this study were promising to control the downy mildew of cucurbits more effectively. But it is necessary to know if there will be the residue and resistance problems before using these fungicides. There are many reports on resistance to the fungicides containing metalaxyl.

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Ö Z E T

KAVUNDA YALANCI MİLDİYÖ HASTALIĞI (**Pseudoperonospora cubensis** (Berk. and Curt.) Rostow)'NA KARŞI BAZI İLAÇLARIN ETKİNLİKLERİ

Kavunda yalancı mildiyö hastalığına karşı bir koruyucu fungisit (Dithane M-45) ve koruyucu-sistemik karışımı formülasyonlu iki fungisit (Ridomil MZ-72 ve Mikal)'in biyolojik etkinlikleri denendi. Dithane M-45, Ridomil MZ-72 ve Mikal'in hastalığı önlemede etkinliklerinin sırasıyla % 68.1, % 86.4 ve % 96.4 olduğu saptandı.

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