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SCREENING PHYLLODY INFECTED SESAME VARIETIES FOR SEED TRANSMISSION OF DISEASE UNDER NATURAL CONDITIONS IN TURKEY

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***ABSTRACT**: Sesame (**Sesamum indicum** L.) is one of the major and valuable oilseed crops in the world because of its high oil quality. Phyllody incited by mycoplasma-like organisms (MLO) is one of the considerable diseases of sesame. This pathogen is present most of the sesame production area in the world and causes important yield losses. The objective of this study was to identify whether or not disease is transmitted by seed. In this study, seed transmission for Phyllody (MLO) were estimated in plants grown from seeds obtained from symptomatic sesame plants naturally infected with the Phyllody disease. Phyllody infected and severely damaged 30 single plants of eleven variety were selected from eight registered and three candidate sesame varieties at Aegean Agricultural Research Institute (AARI), Menemen, Izmir-Turkey in 2001. The seed samples of pods were collected from the different part of Phyllody infected plants. In order to prevent vectors Phyllody infected single plant seed were planted in the screenhouse and evaluated under field conditions during first and second crop production seasons in 2002. None of the plants from 11 variety showed disease symptom and all of plants were found to be Phyllody disease free in both seasons. Phyllody disease transmission was observed 0% from infected plants of seed. The results suggested that this disease is not seed-born and seed transmission from Phyllody infected plants virtually nonexistent.*

***Keywords:** Sesame, phyllody, **Sesamum indicum** L., seed-borne disease.*

PHYLLODY ENFEKTELİ SUSAM ÇEŞİTLERİNDE TÜRKİYE'DE HASTALIĞIN TOHUMLA YAYILMA DURUMUNUN DOĞAL KOŞULLAR ALTINDA SAPTANMASI

***ÖZ**: Yüksek kaliteli yağı ile susam (**Sesamum indicum** L.) dünyada başta gelen yağ bitkilerinden birisidir. Mikoplazma benzeri organizma (MLO) olan Phyllody susam bitkisinin önemli hastalıklarından birisidir. Patojen, dünyada susam üretimi yapılan birçok bölgede görülmekte olup, önemli verim azalışlarına neden olabilmektedir. Bu çalışma ile infekte olan bitkilerden elde edilen tohumlardan yetişen bitkilerde hastalık görülüp görülmeyeceği, diğer bir ifadeyle hastalığın tohumla yayılıp yayılmadığını ortaya koymak amaçlanmıştır. Bu çalışmada, doğal koşullar altında Phyllody (MLO) ile*

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enfekte olmuş susam bitkilerinden elde edilen tohumlardan yetiştirilen bitkilerde Phyllody hastalığının tohumla yayılma durumu değerlendirilmiştir.Ege Tarımsal Araştırma Enstitüsü, Menemen, Izmir'de doğal koşullarda Phyllody ile önemli oranda enfekte olan ve zarar gören 11 çeşit /çeşit adayına ait 30 tek bitki 2001 yılında seçilmiştir. Tohum örnekleri hastalıklı bitkilerin farklı yerlerinden toplanan kapsüllerden elde edilmiştir. Phyllody ile infekte olan bitkilerden elde edilen tohumlardan gelişen bitkiler, vektörlerden etkilenmemesi için izolasyon kabinlerinde birinci ve ikinci ürün koşullarında 2002 yılında yetiştirilmiştir. Bitki gelişme devresinde periyodik olarak haftada bir yapılan gözlemlerde; hastalıklı 11 çeşit/çeşit adayından seçilen tohumlardan yetişen bitkilerin Phyllody hastalığından ari olduğunu, her iki yetişme sezonunda da bitkilerin normal ve sağlıklı olarak geliştiği ve herhangi bir Phyllody hastalık belirtisi göstermediği belirlenmiştir. Araştırma sonuçları hastalığın tohumla yayılmadığını ortaya koymuştur.

Anahtar Sözcükler: *Susam, phyllody,* ***Sesamum indicum*** *L., tohum kaynaklı hastalık.*

INTRODUCTION

Among the other oilseed field crops, sesame (*Sesamum indicum* L.) is known one of the important crops in the world for edible oil production, and it is produced mainly in India, Myanmar, China, Sudan, Ethiopia, Uganda, Nigeria, Paraguay, Niger, Tanzania, Thailand, Pakistan, and Turkey (Anonymous, 2010).

Sesame is one of the important crops for Turkey. Because Turkey is secondary centre of diversity for this crop. Having great amount of diversity, the genetic resources of sesame used as source of breeding (Tan and Tan, 1996).

Many diseases attack sesame, but only a few of them such as *Fusarium* wilt (*Fusarium oxysporum* f. sp. *sesame*), charcoal rot (*Macrophomina phaseolina*), Phyllody, *Phytophthora parasitica* var. *sesami*, *Pseudomonas syringae* pv. *sesami*, *Xanthomonas campestris* pv. *sesami*, *Pseudomonas solanacearum*, *Alternaria sesamicola*, *Rhizoctonia solani*, *Sclerotinia rolfsii*, *Alternaria* sp., *Cercospora* sp., *Erysiphe cichoracearum*, *Pythium* sp., Leaf curl, is considered to be important diseases of sesame in the world and it occurs wherever sesame is cultivated (Beech, 1981; Sataur, 1981; Serry and Sataur, 1981; Tan and Tan, 1996; Tan, 2003; Tan, 2006; Tan, 2009a; Tan, 2009b).

Phyllody or "Gren Flowers" is one of the most important and destructive diseases of sesame (*Sesamum indicum.* L) in Turkey. The disease caused by a mycoplasma-like organism (phytoplasma) is present in the world where sesame is grown. The indicence of this disease varying year to year and its incidence is minor most of the growing area in the world. The indicence of this disease was reported as high as 100% in India and 90% in Burma (Beech, 1981).

Türkmenoğlu and Ari (1959) observed Phyllody symptoms on native sesame varieties in Aegean Region of Turkey and they have never seen an economical damage of this disease on native sesame varieties. However, the foreign sesame varieties showed as high as 50 % symptoms and damage whereas native varieties which were growing near the foreign varieties did not show so much symptoms as the others. They indicated that the native varieties were almost resistant against this disease.

There was damage of Phyllody in sesame cultivars and yield losses observed at different level; however, there were also uninfected plants among the germplasm and registered varieties in the national sesame breeding nursery in 2001 in Izmir, Turkey (Tan, 2001).

Among the major constraints in the production of sesame, Phyllody is a very serious disease caused by mycoplasma-like organisms (MLO) capable of inflicting up to 33.9 per cent loss in yield (Abraham *et al*., 1977a).

Phyllody is associated with a mycoplasma-like organism (MLO) in the phloem of affected plants (Vasudeva and Sahambi, 1955; Gowanlock *et al.* 1976; Klein 1977; Beech, 1981). It is transmit by leaf hopper (Vasudeva and Sahambi, 1955). Pal and Pushkarnath (1935) reported that the systemic nature of the disease was caused by a virüs. However, it was showed that disease to be transmitted by two species of cicadellid leafhopper, *Orosius albicinctus* and *O. argentatus* (Vasudeva 1955, Vasudeva and Sahambi 1955, Gowanlock et *al.* 1976). Beech (1981), reported that Phyllody in sesame is transmitted in India and Australia by cicadellid leafhoppers in the genus *Orosius.* In common with most other MLO, the sesame MLO can be transmitted to a range of other crops.

Selvanarayanan and Selvamuthukumaran (2000) reported that the insect vector, leafhopper *Orosius albicinctus* population was minimal and could not be significantly correlated to the disease incidence among the cultivars. However, Murugaesan *et al*. (1973) and Abraham *et al*. (1977a) reported that the leafhopper population within the field had no significant influence on Phyllody disease incidence. Abraham *et al*. (1977a) was also reported that the leafhopper population was minimal during the early phases of the crop development . They indicated that the reason may be attributed to the fact that even a single leafhopper coming from the source of inoculums outside the field would have inoculated a number of plants. The causal organism (MLO) is transmitted by the leafhopper, *Orosius albicinctus* Distant (Cicadellidae: Hemiptera) (Vasudeva and Sahambi, 1955; Ghauri, 1966). Abraham *et al*. (1977a) reported that dodders (*Cuscuta campestris*) are play role for transmission and donor as well as reservoir of phytoplasma.

There is often confusion between resistance of the sesame plants to the phytoplasma and resistance to the insect vector. The use of resistant varieties provides an efficient and sustainable approach to control susceptibility of phytoplasmas. Genetic resistance to phytoplasma diseases is achieved.

Sing, *et al*., (2007), evaluated 150 germplasm, 32 released varieties, and 4 wild spp. of sesame under field conditions. Genetic study resulted in that allelic test on intraspecific crosses revealed recessive resistance to be governed by two independent non-allelic genes exhibiting duplicate dominance in cultivated varieties whereas, interspecific crosses of wild species showed the dominance nature of resistance with the involvement of one dominant and one recessive gene.

Phyllody is accompanied by abundant vegetative growth. The internodes are very much shortened and there is abundant abnormal branching due to the stimulation of axillary buds, and the plants bear small-sized leaves. The disease symptoms become evident in the flowering stage and floral organs are transformed into green leafy structures. Inside the ovary, petiole-like outgrowths are produced instead of ovules (Beech, 1981). Affected plants may be partially or completely Phylloid depending on the stage of growth at infection. In partially affected plants the disease expresses itself only at the ends of branches or on new shoots produced on the stem due to stimulation of the axillary buds. The lower portions of the branches may bear capsules just like a normal plant. These capsules, however, contain shriveled non-viable seeds (Beech, 1981).

The affected plants are stunted (Abraham *et al*., 1977a; Selvanarayanan and Selvamuthukumaran, 2000) with the floral parts being modified into leafy structures. The capsules abort and open exposing the developing seeds. The crown region become bushy, with shortened internodes, tiny reduced leaves, phylloid flowers and flower buds and aborted capsules (Selvanarayanan and Selvamuthukumaran, 2000).

In India Phyllody disease of sesame infects a large number of agricultural crops and other plant species. Investigations have shown that it can be transmitted to sunn-hemp (*Crotolaria juncea*), chickpea (*Cicer arietinum*), berseem clover (*Trifolium alexandrinum*), *Medicago scutellata, Brassica campestris* var. *toria* and *sarson* and the garden flowers *Phlox drummondii* and *Petunia violacea.* All these species were affected with Phyllody under natural conditions and have been used to infect sesame and sunn-hemp through the vector, *Orosius* spp. (Vasudeva and Sahambi 1957, 1958; Sahambi 1958).

Controlling the vector using chemical insecticides has been successful (Tandon and Banerjee 1968; Rosy *et al*., 1996), the complete elimination of the disease is not possible because small areas are subject to re-infection with jassids migrating from adjacent natural or cultivated hosts.

Number of crop hygiene practices which may help reduce Phyllody incidence in sesame, e.g. early rouging of diseased plants from the crop, restrictions on growing sensitive crops, and control of host plants of the leafhopper vectors.

The control or to avoid Phyllody disease some of the cultural methods could be practiced, particularly rotation management, sowing dates, etc. Cotton, maize, millet, sorghum, and groundnuts are hosts and they can harbor the vector which transmits the Phyllody to the following sesame crop (Beech, 1981). It has been noted that the severity of Phyllody is influenced by the time of sowing (Rhind 1935). This has led to recommendations for early sowing in Madras and late sowing as in Uttar Pradesh (Joshi 1961). Early sowings of sesame tend to produce excessive vegetative growth which makes the plants very attractive to jassids, thereby increasing the likelihood of incidence of Phyllody. However, in later sowing which produce smaller plants, the incidence of Phyllody will still be high due co migration of the vector from adjacent host crops approaching maturity. It could be expected that the longer the life cycle, the greater the potential for infection observed in Orissa, India by Satpathy *et al.* (1963).

Phyllody disease is not restricted to the cultivated species of *Sesamum;* it has been observed in *S. alatıun, S. indicatum* (Ramanujam 1944), *S. occidentale* and *S. radiatum* (Mazzani and Malaguti 1952). The success achieved in breeding for resistance to jassids in cotton (Prentice 1972), rice (Bhaskaro *et al.***,** 1980; Yoshihara 1979), and dry beans (Eskafi and Schoonhoven 1978). Tandon and Banerjee (1968) found moderate resistance to Phyllody in several Indian sesame cultivars. Varietals resistance and/or tolerance, both to the vector and the disease is the best way for controlling this disease (Beech, 1981). Abraham *et al.* (1977b) recorded minimal damage on the cultivar TMV 4. branches, Selvanarayanan and Selvamuthukumaran (2000) concluded that to manage the sesame Phyllody, the use of resistant / tolerant varieties like TMV 4 can be recommended instead of chemical measures.

MATERIALS AND METHODS

This study was carried out to determine whether or not sesame Phyllody, the causal organism (MLO) is transmitted by the infected plants of seed.

In the study, seed samples of Phyllody infected plants were collected from the registered varieties Kepsut 99, Osmanlı 99, Cumhuriyet 99, Tan 99, Orhangazi 99, Gölmarmara, Muganlı, Özberk and the candidate varieties which were TUR-S-80, TUR-S-172, TUR-S-181. Disease severity was considerable and plants were either partially or totally infected (Table 1).

The seed samples of pods were collected from the different parts which where main stem or its branches with or without disease symptom of Phyllody infected plants in order to figure out whether disease transmits by seed or not (Table 1).

Seed of infected varieties were grown subsequent year at first and second crop production times. The field experiment was conducted in a disease observation nursery with two replication at Aegean Agricultural Research Institute in Menemen, Izmir – Turkey in 2002. Each plot consisted of a single row, and row length was 5 m with 70 cm apart, and plant spacing on the row was 15 - 20 cm. This nursery was conducted under screenhouse conditions in order to prevent disease transmission by vector population. The vector population was monitored after sowing onwards. The disease occurrence on each variety plants per replication at random was observed weekly and the percentage of branches and capsules damaged was also recorded.

Figure 1. Symptoms of sesame Phyllody in the field (Photo, A. Ş. Tan, 2001).

Figure 2. Partially infected sesame plants show damaged and non-damaged branches (Photo, A. Ş. Tan, 2001).

Figure 3. Sesame inflorescence showing floral symptom (Phyllody) without pod or abnormal pod formation (Photo, A. Ş. Tan, 2001).

Figure 4. Sesame symptoms due to the result of flower proliferation (Photo, A. Ş. Tan, 2001).

Table 1. Seed samples collected from Phyllody infected sesame varieties (AARI, Menemen, Izmir-Turkey. 2001).

Sample no	Disease condition of selected plant*	Seed sample collected plant part	Seed collected part of plant	Disease condition of seed collected plant part**	Variety
1	P-I	Main stem	Whole part	Uneffected by disease	TUR - S – 80
2	P-I	Branches	Whole part	Effected by disease	TUR - S – 80
3	P-I	Branches	Whole part	Uneffected by disease	TUR - S – 80
4	P-I	Main stem	Upper part	Effected by disease	TUR - S - 172
5	P-I	Main stem	Lower part	Effected by disease	TUR - S - 172
6	P-I	Branches	Whole part	Uneffected by disease	TUR - S - 172
7	P-I	Main stem	Upper part	Effected by disease	Kepsut 99
8	P-I	Main stem	Middle part	Effected by disease	Kepsut 99
9	P-I	Main stem	Lower part	Effected by disease	Kepsut 99
10	P-I	Main stem	Upper part	Effected by disease	Gölmarmara
11	P-I	Main stem	Lower part	Effected by disease	Gölmarmara
12	P-I	Branches	Whole part	Effected by disease	Gölmarmara
13	P-I	Branches	Whole part	Uneffected by disease	Gölmarmara
14	P-I	Main stem	Whole part	Effected by disease	Cumhuriyet 99
15	P-I	Branches	Whole part	Uneffected by disease	Cumhuriyet 99
16	P-I	Branches	Upper part	Uneffected by disease	Muganlı-57
17	P-I	Branches	Whole part	Effected by disease	Muganlı-57
18	P-I	Main stem	Whole part	Uneffected by disease	Muganlı-57
19	P-I	Branches	Lower part	Partly effected (lower part uneffected, upper part effected)	Muganlı-57
20	P-I	Branches	Whole part	Uneffected by disease	Tan 99
21	P-I	Main stem	Middle part	Effected by disease	Orhangazi 99
22	P-I	Main stem	Lower part	Effected by disease	Orhangazi 99
23	P-I	Branches	Whole part	Uneffected by disease	Orhangazi 99
24	P-I	Branches	Whole part	Effected by disease	Orhangazi 99
25	P-I	Main stem	Whole part	Effected by disease	TUR - S - 181
26	P-I	Main stem	Upper part	Modarately effected	Özberk-82
27	P-I	Main stem	Lower part	Partly effected (lower part uneffected, upper part effected)	Özberk-82
28	P-I	Branches	Whole part	Effected by disease	Özberk-82
29	P-I	Branches	Whole part	Uneffected by disease	Özberk-82
30	T-I	Branches	Whole part	Uneffected by disease	Osmanlı 99

* P-I: Partly infected plant with phyllody; T-I: Totally infected plant with phyllody.
** Uneffected by disease: shows no disease symptom; Effected by disease: shows disease symptom

RESULTS AND DISCUSSION

The seed samples were collected from Phyllody infected plants. Seed of infected varieties were grown and produced normal and healthy plants under first and second crop production times in Menemen, Izmir-Turkey.

All seed samples were collected from the infected plants in the sesame breeding nursery at Aegean Agricultural Research Institute in Menemen, Izmir-Turkey. 2001. However, there were also healthy plants adjacent to infected plants in the nursery. The infected plants show totally or partially Phyllody disease symptoms. Infected plants may become stunted and the floral parts being modified in to leafy structures bearing no pod or abnormal pods without seeds causing considerable yield loss (Figure 1, 2, 3, and 4) (Tan, 1996; Tan, 2009a; Tan, 2009b).

Seed transmission for Phyllody (MLO) were estimated in plants grown from seeds obtained from symptomatic sesame plants naturally infected with the Phyllody disease. Seed samples from 30 sesame (*Sesamum indicum* L.) single plant selected from 11 variety were tested under field conditions in the screenhouse for Phyllody. In order to prevent vectors Phyllody infected single plant seed were planted in the screenhouse.

Phyllody symptoms were not observed on subsequent generation of eleven varieties observed weekly. Seed transmission of Phyllody was evaluated by more than 600 plants from 11 variety in screenhouse conditions. These seed of infected plants were produced normal and healthy plants and the percentage of branches and capsules damaged was 0% under first and second crop production times in Menemen, Izmir-Turkey in 2002.

Phyllody symptoms were not observed on subsequent generation of eleven varieties and all plants were Phyllody disease free in both seasons.

None of the plants from 11 variety were infected through seed with Phyllody and disease transmission was observed to be 0% from infected plants of seed. The seed transmission from Phyllody infected plants virtually nonexistent; thus, the results indicated that sesame Phyllody, the causal organism (MLO) is not transmitted through the infected plants of seed or it is not soil-born disease.

Since sampled plants were partly infected, some of them might be resistant/tolerant to this disease; however, in order to manage Phyllody and other destructive disease of sesame further studies are need to be exploring the vast gene pool of *Sesamum* spp., therefore, a greater collection will need to be tested and evaluated against Phyllody and other diseases.

As a result, besides the use of resistant/tolerant varieties several crop cultural practices may help to reduce sesame Phyllody incidence in the field e.g. early rouging of Phyllody diseased plants or Phyllody diseased plants part from the crop, and control of the leafhopper vectors and their host plants.

This is the first study on disease transmission of sesame Phyllody in Turkey.

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