한국식물보호학회지 제21권 제 4 호
Korean J. Plant. Prot. 21(4) : 211~215 (1982)

Studies on Sesame Diseases in Korea I. Incidences of Phytophthora Blight

E.K. Cho,* N.Y. Heo,** S.H. Choi,* and S.C. Lee*

참깨 病害硏究 Ⅰ. 참깨 疫病의 發生에 對하여

趙義奎・許魯烈・崔聖浩・李升燦

ABSTRACT

Incidences of Phytophthora blight in plant of sesame (*Sesamum indicum* L.) were observed in southern sesame production areas, Gochang of Jeonbug, Yeonggwang of Jeonnam, Jinyang of Gyeongnam and Dalseong of Gyeongbug province where disease survy was conducted from July 29 to August 1, 1981. The rate of disease incidence ranged from none to 61% depending upon the field observed.

The causal species of the *Phytophthora* was identified as *P. nicotianae* var. *parasitica* (Dastur) Waterhouse based on specific pathogenicity to sesame and morphological characteristics of sporangia. Diseased plants of sesame generally showed dark discoloration on the stem leading to plant death.

INTRODUCTION

A sesame disease caused by *Phytophthora* species was reported as Phytophthora blight in India as early as in 1918[7] and in Japan in 1938[15]. The causal organism of the Phytophthora blight was first reported as *Phytophthora parasitica* Dastur, and Kale and Prasad[7] suggested the causal organism as *P. parasitica* var. *sesami* on the basis of specific pathogenicity to sesame, However, Waterhouse[19], and Waterhouse and Waterston[20] classified the *Phytophthora* species infecting sesame plants into *P. nicotianae* var. *parasitica.*

Eight sesame diseases were listed to occur in Korea in 1972[9]. Since then, several fungi were occasionally recognized from sesame seeds or diseased plants[2,16,17]. Among them, *Phytophthora* species was also identified from diseased sesame plants collected in Suweon[4]. During the course of study on sesame diseases, we found that a severe disease of sesame occurred in southern part of Korea in 1981 and that the disease was caused by *Phytophthora* species. Here we report the severe incidence of the Phytophthora blight and characteristics of the pathogen for identification of the causal organism.

MATERIALS AND METHODS

Isolation and Characterization of the Phytophthora isolate: Plants of sesame (*Sesamum indicum* cv. Suweon 9) showing dark discoloration approximately 10~20cm high on the stem from the ground level were collected from the field in Suweon.

*Dept. of Plant Pathology, Inst. of Agri. Sci., O.R.D., Suweon, Korea
**Dept. of Agr. Chem. and Biology, Agr. Chem. Res. Inst., O.R.D, Suweon, Korea

Tissues of diseased samples were cut into small pieces (generally 0.5cm² piece) with a sterilized knife and surface-sterilized by floating the pieces in 1% sodium hypochlorite solution for three minutes. Then several of each piece were blot-dried on flamed filter papers and placed on the water agar (15% agar, WA) media in Petri dishes.

When sporangia of *Phytophthora* sp. were observed on WA, small pieces of mycelia were transferred on potato dextrose agar (PDA) in a tube. Then the isolate was transferred on PDA, oat meal agar (OA), corn meal agar (CA) in Petri dishes for morphological studies. All cultures were incubated at 24±1°C. The length and breadth of 20 sporangia were measured with a micrometer placed inside eye piece lens. The length of 20 papilla was also measured with the micrometer.

Pathogenicity tests: Test plants of sesame cultivar Suweon 9 grown in the field were collected in August (seeded in May), and three plants were transplanted into each of three Wagner pots (15cm in diameter and 20cm in depth). Each plant showed no visual disease symptom when transplanted and inoculated three days after transplanting.

Inoculum of *P. nicotianae* var. *parasitica* was prepared by adding 10m*l* of sterilized water on potato dextrose agar in each of four Petri dishes in which the fungus was cultured for 10 days at 25°C, and scrubbing off the mycelia. Three plants were inoculated by making gashes on the stem and brushing into each gash with a nylon brush dipped into fungal suspension. Similarly, inoculum of *C. cassiicola* was prepared and applied into gashes on stems of three plants in a pot for comparison of symptom development in sesame with that caused by the *Phytophthora* isolate.

Plants of sesame collected from fields were also transplanted into a Wagner pot filled with inoculum of vermiculite infested with *Phytophthora*. Similarly, tobacco plants (*Nicotiana tabacum* cv. K*Y*), tomato plants (*Lycopersicon esculentum* Mill. cv. Mansujosaeng) and pepper plants (*Capsicum annum* L. cv. Saemaeulgeumjang) were transplanted into each of Wagner pots. Tomato fruits were inoculated with *Phytophthora* and incubated in plastic bags. All test plants were grown more than two months in the greenhouse before transplanting.

Disease survey: Five, five, six, and six fields were observed for incidence of Phytophthora blight at Jinyang in Gyeongnam, at Dalseoung in Gyeongbug, at Yeonggwang in Jeonnam and at Gochang in Jeonbug province, respectively. Thirty to 100 plants were observed to determine severity of the Phytophthora blight of sesame in the fields where the disease was found. The survey was conducted from each location for diagnosis of the disease.

RESULTS

Pathogenicity tests: Sesame plants produced dark black discoloration on the stem just above the ground leading to collapse of the plants in three days (Fig. A), when the soil was inoculated with *Phytophthora*, whereas plants without inoculation remained symptomless. Plants inoculated with *C. cassiicola* for comparison produced a partial brown stripe from the inoculated spot on the stem without causing plant wilting. Tomato, tobacco and pepper plants did not produce symptoms (Table 1). However, tomato fruits inoculated with the isolate produced soft rot in three days after inoculation.

Characteristics of the Phytophthora isolate: The sporangia of the *Phytophthora* isolate from sesame plants were pyriform or spherical and golden in color with a distinguishable papilla on the apex (Fig. B). The length of sporangium was 38.2μ and the breadth was 28.1μ in average. The average ratio of the length and breadth of the sporangium was 1.36 : 1. The length of papilla was 3.38μ in average.

The Phytophthora isolate grew well around 30°C on PDA, OA, and CA. Mycelium in PDA was whitish rough surface. Mycelia were relatively short and branched showing swelling when grown on PDA whereas mycelia were smooth, narrow, and long on CA. Abundant sporangia were produced when culture solution, prepared by brushing off mycelium after adding a small amount of water into Petri dished, was placed under continuous fluorescent light around 25°C for a few days.

Incidence of Phytophthora blight: At Gochang in Jeonbug province, 34 plants out of 280 plants

observed were diseased. At Yeonggwang in Jeonnam province, 138 plants out of 339 plants observed were diseased. At Jinyang in Gyeongnam province, 16 plants out of 160 plants observed were diseased. At Dalseong in Gyeongbug province, 28 plants out of 48 palnts observed were diseased. Therefore, percentage of the Phytophthora blight incidence ranged from 10 to 60.9% depending upon locations surveyed(Table 2). From diseased sesame plants collected from each location, typical sporangia of *Phythophthora* sp. were frequently detected as shown in Fig. B.

Table 1. Results of pathogenicity tests with an isolate of *Phytophthora* species from sesame (*Sesamum indicum* L. cv. Suweon 9) plants showing blight symptoms

Test host plant	Reactions of test hosts inoculated[a].
Sesamum indicum L. cv. Suweon 9	Stem rotting followed by plant death
Lycopersicon esculentum L. cv. Mansujosaeng	No symptoms were produced
Nicotiana tabacum L. cv. Kentucky	No symptoms were produced
Capsicum annum L. cv. Saemaeulgeumjang	No symptoms were produced

[a]. Inoculations were made by transplanting a few plants of test host into a Wagner pot filled with soil mixture with suspension of *Phytophthora* culture grown on PDA for about 10 days at 24± 1°C.

Table 2. Average percentage of Phytophthora blight incidence in sesame, number of fields observed and number of fields where the disease was found in four provinces.

Province and district surveyed for disease incidence	Number of sesame fields observed	Number of sesame fields disease found	% of the disease incidence
Jeonbug-Gochang	6	4	12.1
Jeonnam-Yeonggwang	6	5	31.7
Gyeongnam-Jinyang	5	3	10.0
Gyeongbug-Dalseong	5	1	60.9

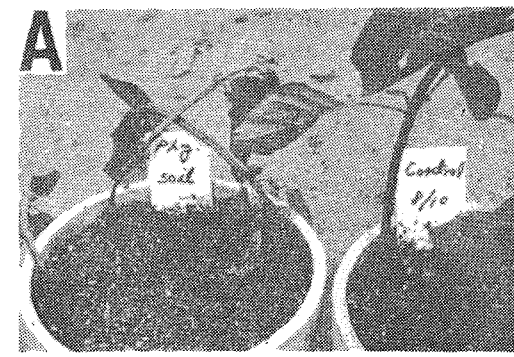

Fig. A. Symptoms of stem rot in sesame (*Sesamum indicum* L. cv. Suweon 9) plants transplanted into a Wagner pot filled with soil mixture with *Phytophthora nicotianae* var. *parasitica* (left) and control (right).

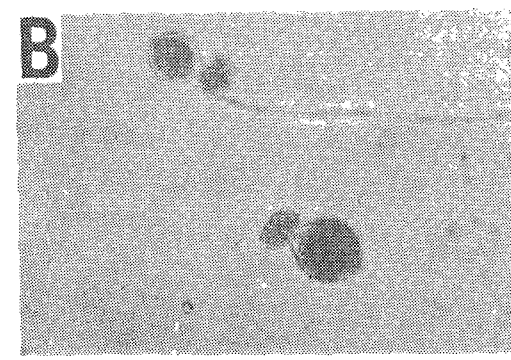

Fig. B. Sporangiospores coming out from the pyriform sporangium of *Phytophthora nicotianae* var. *parasitica* obtained from diseased sesame plants.

DISCUSSION

Our data suggested that the *Phytophthora* species from sesame was *P. nicotianae* var. *parasitica*. The pathogenicity of the *Phytophthora* isolate specifically pathogenic to sesame plants also supports our conclusion as indicated by previous workers[7,13,19,20] in addition to characteristics of sporangia in cultures similar to those described by Waterhouse[19] and Katsura[8]. However, conclusive taxonomic determination of the *Phytophthora* species from sesame awaits for more information on mycological characteristics of the pathogen.

The *P. nicotianae* var. *parasitica* was reported to

infect as many plants as 72 genera in 58 families such as sesame, tomato, strawberry, eggplant, melon and tobacco[13,20]. In our results, however, the isolate from sesame plants appeared to be specifically pathogenic to sesame. These results are similar to those obtained by Kale and Prasad[7]. This might be possible due to parasitic speciaiization of the sesame[7,20].

In our preliminary tests, we observed differences of sesame cultivars or lines in susceptibility to *P. nicotianae* var. *parasitica* when tested at the seedling stage in the greenhouse[2]. Varietal resistance of sesame to Phytophthora blight were also reported by previous workers[6,14]. The results indicated that use of resistant sesame lines or tolerant lines might help control of the disease. On the other hand, the Bordeaux mixture was reported to be relatively effective for the control of the Phytophthora blight of sesame[5]. Thus, several aspects of control measures have to be taken into consideration and have to be investigated.

Sesame diseases known to occur in Korea include a virus disease caused by watermelon mosaic virus[1], bacterial leaf spot caused by *Pseudomonas sesami* Malkoff, and bacterial wilt caused by *P. solanacearum* Smith[9]. Fungal pathogens in sesame reportd in Korae are *Alternaria sesamicola* Zimmerman, *Cercospora sesami* Zimmerman, *Corynespora cassiicola* (Berk and Curt) Wei, *Corticium rolfsii* Surzi, *Fusarium oxysporum* f. sp. *vasinfectum* (Atk.) Snyder et Hansen, *Macrophoma sesami* Sawada, *Macrosporium sesami* Nawanura, *Oidium* sp., *Phoma sesami* and *Sclerotinia sclerotiorum* (Lib.) de Bary[3,9,11,12,15].

Seedborne pathogens might play an important role in poor germination and damping-off at the seedling stage which appeared to be serious disease problems at early stages of sesame growth. Recently, various seedborne organisms were reported from sesame seeds[16,17]. During the growing season, root and stem rots, Alternaria and Corynespora blights[18] appeared to be major diseases in sesame. Among root and stem diseases[9], our data indicated that Phytophthora blight was one of serious diseases in the southern part of Korea. The disease was also known to cause severe yield losses up to 66% in sesame[7].

Although several diseases of sesame were reported in Korea, disease severity, epidemiology, and yield losses, and relative importance of each disease have rarely been investigated. Therefore, we are going to pursue to determine the importance of each disease for establishment of control measure for sesame diseases as cultivation of sesame is expanded[10] as well as screening of newly developed sesame cultivars or lines to major diseases.

LITERATURE CITED

1. Chang, M.U., and C.U. Lee. 1980. A virus disease of sesame (*Sesamum indicum* L.) caused by watermelon moasic virus. Korean J. Plant Prot. 19 : 193-198.
2. Cho, E.K., N.Y. Heo, S.H. Choi, and S.C. Lee. 1981. 참깨 病害의 發生生態와 防除에 關한 試驗. 農技研試驗研究報告書. 352-359.
3. Choi, C.Y. 1962. Effects of culture filtrates of *Fusarium oxysporum* f. sp. *vasinfectum* upon the germination of seed of host plants (sesame, cotton) and non-host (wheat and rice). Korean J. Plant Prot. 1 : 42-46.
4. Chung, B.J., and all staffs. 1978. 主要農作物의 病害分布 및 被害調査. 農技研試驗研究報告書, 290-303.
5. Gemawat, P.D., and N. Prasad. 1964. Further studies on *Phytophthora* blight of sesamum. Indian Phytopath. 17 : 273-283.
6. ———, and ———. 1965. Tests with different varieties of sesamum for resistance to Phytophthora blight of sesamum. Indian Phytopath. 18 : 128-132.
7. Kale, G.B., and N. Prasad. 1957. Phytophthora blight of sesamum. Indian Phytopath. 10 : 38-47.
8. Katsura, K.I. 1971. 植物の疫病, 理論と實際, 誠文堂, 新光社, 128pp.
9. Korean Soc. Plant Prot. 1972. A list of plant diseases, insect pests and weeds in Korea. 21pp.
10. Lee, J.I., S.G. Oh, S.T. Lee, C.H. Kang, H.S. Lee, and Y.S. Ham. 1980. New sesame variety Suweon 26. Res. Rep. ORD 22 : 134-137.
11. Nakada, K.G.R., and S.T. Takimoto. 1928. A list of crop disease in Korea. Korean Agr. Res. Rep. 15.

12. Park, J.S. 1965. Studies on the Fusarium wilt of sesame. Thesis Collection of Chungnam Univ. 4 : 1-47.
13. Ribeiro, O.K. 1978. A source book of the genus Phytophthora. Strauss and Cramer. 417pp.
14. Sehgal, S.P., and N. Prasad. 1972. Note on testing of different varieties, strains and species of sesamum for resistance to Phytophthora blight. Indian J. Agri. Sci. 42 : 122.
15. Takimoto, S.T. 1938. 疫病菌の寄生に因る作物の病害, Ann. of Japan Phytopathol. Soc. 7 : 240-248.
16. Yu. S.H. 1981. Significance of sesame seedborne fungi, with special reference to *Corynespora cassiicola*. Korean J. Plant Prot. 20 : 183-190.
17. Yu, S.H., and J.S. Park. 1980. *Macrophomina phaseolina* detected in seeds of *Sesamum indicum* and its pathogenicity. Korean J. Plant Prot. 19 : 135-140.
18. Yu, S.H., H.G. Kim, Y.G. Kang, and J.S. Park. 1981. Studies on Alternaria and Corynespora blights of sesame. Korean J. Mycol. 9 : 169-174.
19. Waterhouse, G.M. 1963. Key to species of *Phytophthora* de Bary. Commonw. Myc. Inst., Myco. Papers. 92 : 1-22.
20. Waterhouse, G.M., and J.M. Waterston. 1964. *Phytophthora nicotianae* var. *parasitica*. CMI Descriptions of pathogenic fungi and bacteria. No. 35.

摘 要

1981年 全北고창, 全南영광, 慶北달성, 慶南진양 地域에서 참깨病害의 發生과 被害를 調査한 結果 참깨疫病의 被害가 가장 甚하였다. 참깨疫病의 發生은 圃場에 따라 差異가 컸으며 發病이 甚한 圃場에서는 發病株率이 61%나 되었다.

참깨疫病을 일으키는 病原菌 *Phytophthora* spp.는 遊走子囊의 形態的特性과 참깨에 대한 特異的인 病原性에 依하여 *Phytophthora nicotianae* var. *parasitica* (Dastur) Waterhouse로 同定되었다. 참깨疫病의 病徵은 줄기가 暗黑色으로 變色, 腐敗되어 植物體가 倒伏, 枯死하는 特徵을 보였다.