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Sunflower Diseases in Some Growing Areas of Thailand

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ABSTRACT

Sunflower diseases found in Nakhon Ratchasima, Khon Kaen, Nakhon Pathom and Chon - Buri during May, 1987 - April, 1988 were leaf spot and leaf blight including lesion on stem, branch, head, sepal, petal and bract infected by *Alternaria* spp, while the rest of them were leaf spot caused by *Septoria* sp. " downy mildew by *Plasmopara* sp., rust by *Ureds* sp., base and root rot by *sclerotium* sp. " and head and dry rot of seeds by *Cladosporium* sp. However, there were other different symptoms which causal agents have not yet been identified such as, yellow and leaf blight similar to a mineral deficiency, mosaic, yellow, and distortion by virus or mycoplasma, and root - knot by nematode, and the last symptom indicating here Phomopsis blight. Among these pathogens, *Alternaria* spp. and *Septoria* sp. were observed to be the most destructive one causing substantial loss to sunflower at Suwan Farm, Pakchong in Nakhon Ratchasima. It was also noticed that more than one species of the *Alternaria* spp. infected sunflower in the test plots at Suwan Farm such as, *A. zinnaie* and *A. helianthi.*

INTRODUCTION

Common sunflower (*Helianthus annuus* L.) is gaining its importance as an potentially economic crop of Thailand since it can be planted as an oilseed crop with relatively high nutritional quality. Chemical analysis of seed oil reveals 70% (by weight) of unsaturated fatty acids, including, linoleic, linolanic and arachinoleic acids. In addition, sunflower seed also contains 17% of protien and several valuable vitamins. Realizing its importance, the government therefore, has promoted sunflower production in Thailand during the last 3 years. However, sunflower seed production of high quality at a desirable quantity may be not a simple task since more than 30 diseases are known to attack the plant. Some of the major diseases could significantly decrease yield of sunflower to a great extent. Plant disease, hence, is one of the most important keys to the success or failure of sunflower production. These diseases reported from elsewhere except, Thailand include Sclerotinia stem and head rot, Rhizopus head rot, white blister, Alternaria leaf and stem rot, charcoal rot, Septoria leaf spot, Verticillium wilt, base and stem rot, noogoora bur rust, downy mildew, powdery mildew, Botrytis head and stem rot, crown gall, Cercospora leaf spot, root knot, Phymatotrichum root rot, bacterial wilt, damping - off, violet root rot and viral diseases were reported from all over the world (Annonymous, 1960; Carson, 1985 b; Fick and Zimmer, 1975; Hoes and Putt, 1964; Henry and Gilbert, 1924; Sackston, 1960; Zimmer and Hoes, 1978; Zelle, 1932). Since there is no available information on the potential impact of these diseases on sunflower

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yield, it is necessary to carry out a disease survey in Thailand. The objective of this research is to obtain the quantitative information on the potential of some diseases on sunflower production and to determine their roles in the disease complex on this host.

MATERIALS AND METHODS

A disease survey was carried out in the sunflower growing areas of the northeast and central parts of Thailand in Nakhon Ratchasima, Khon Kaen, Nakhon Pathom and Chon Buri during May 1987 to April 1988 and specimens of different symptoms were collected. Isolations were made from each type of diseased tissues. Pure cultures were tested for their pathogenicity and were kept for further study.

Method of isolation.

Specimens which were suspicious as fungal infection were isolated by tissue transplanting method. Surface - disinfection of parts of diseased tissues was made by wetting them in 10% clorox for 3 - 5 min. followed by immersion in sterilized distilled water for 20 - 60 sec. The duration of wetting and immersion depended on the size of the infected pieces. Part of each specimen was transferred directly to petri dishes containing potato dextrose agar. Transfers of spores or mycelia from fungi growing from the diseased tissues were made to potato dextrose agar slants.

Pathogenicity test

The pathogenicity of each pathogens was investigated using sunflower plants at different ages (depending on each disease) by mean of Koch's Postulation. The plants were inoculated by spraying with a suspension prepared either from spores produced on the medium or from mycelia grown for a period of time (approximately 9 days) under favorable condition and in semi - selective medium.

The pathogenicity of fungal leaf spot or leaf blight was made on 6 week - old sunflower plants. To obtain spores for inoculation, the mycelia and spores of pathogens were transferred into potato dextrose agar (PDA) and kept under fluorescent light alternated with dark condition for 12 hrs each. Spores formed on PDA after 10 - 14 day growth at room temperature were used to prepare spore suspension by adding 10 ml sterilized distilled water into stock culture to wash the spores from the surface and then filtrated the solution through filter cloth. These spores were diluted by sterilized distilled water to make up the required spore suspension of 2500 - 3500 spores/ml. The suspension was then transferred into knapsack sprayer for inoculation on sunflower in the test pot. The plants were predisposed for infection by water - spraying one day before inoculation and the humid condition maintained for another day after inoculation by covering the plants with plastic bags over the plant pots. Observation of the diseased symptom was made 10 days after inoculation by comparing with the healthy plants.

The pathogenicity of fungal root rot or root disease was investigated by starting inoculum preperation. Inoculum was cultured on wheat seed medium to increase spores. The medium was prepared by boiling wheat seeds and allowing it to dry in the air and then, pouring it into plastic bage of 4 $\times$ 6 inch. in size. Put the plastic bottom - neck closing with cotton wool plug on the top of the bag and fastened tightly with elastricity. The medium bag was autoclaved under 121°C at 15 lb/inch^2 for 15 min. A large amount of sclerotia and mycelia formed on the wheat seed medium after 14 - 15 day growth at room temperature were then mixed with sterilized soil in the ratio of inoculum: sterilized soil = 1 : 8. The infested soil was used for planting of sunflower in the clay pot. Seed germination, seedling symptom and other symptoms were observed at each growth stage of sunflower comparing with healthy plants.

Identification of causal agents,

The morphological and cultural characteristics of the causal agents especially of the fungus were studied both in pure cultures and in diseased tissues. Infected tissues were examined through steriocompound microscopy and also prepared by free hand sectioning as temporary slide to determine through light compound microscopy. Observation and record of the pathogens were made and identification made with the help of references concerning the taxonomy of fungi and sunflower diseases of Barnett (1969), Dingley and Brien (1956), Henry and Gilbert (1924), Neergaard (1945), Rossman, *et al.* (1988) and Zelle (1932).

RESULTS

Sunflower diseases found in some study sites such as the National Corn and Sorghum Research Center (Suwan Farm) at Pakchong, Nakhon Ratchasima, Khonkaen University, Kasetsart University at Kampaengsaen, Nakhon Pathom, and at the Field Crop Research Station, Chon Buri during the investigation period are as follows :

1. Alternaria leaf spot or leaf blight and stem blight and damage of other plant parts due to Alternaria.

The disease commonly occurred in all sunflower - producing areas and the pathogen could infect and caused damage to any plant parts of sunflower such as leaf, stem, branchs, petiole, head, sepal, petal and bract at any stages of growth starting at seedling (seedling blight) to reproductive stages (head rot), but severely damaging symptom was usually found at the later growth stages. Disease incidence was serious under warm and humid condition in the wet season when the relative humidity was high and the temperature rised before raining. When the plant was severely infected at the flowering stage, it resulted in die - back. If the plant was infected during anthesis, either incomplete seed setting or head blight followed by failure of seed setting would be resulted.

Symptom on leaves The occurrence of first symptom was small irregular dark brown to black spot on the lower leaves of the plant and then spreaded into the upper epidermis. *Alternaria* spp. infecting sunflower leaf was generally found at the 4 leafstage or a later stage of growth. Leaf lesions (as small as 0.2 - 0.5 cm to as large as 1 - 3 cm in diameter) depending on varieties of sunflower and races of pathogen began as dark flecks with indefinite margin surrounded by a distinct yellow halo. Each lesion could coalesce and enlarge into blakened area and resulted in leaf blight symptom causing premature defoliation. The pathogen could also damage leaf veins and cause water - soaked brown flecks and streaks along the vein length. When heavy infection occurred, the leaves began to fall down or the branchs attached to the stem dropped down resulting in the die - back standing (Figure 1 and 2)

Symptom on stem and branch. The pathogens produced stem lesions as dark brown flecks or small darken spots 0.1 cm. in diameter with indefinite margin. Under favorable conditions, stem lesions enlarged rapidly to form elliptic shape and sometime scattered over to the stalk. Stem symptoms could coalesce as long lesions or streaks 0.2 - 10 cm long, freqrently blackened the stem and caused the plant to wither. Because a drop of water was usually kept around the node area of the plant, the pathogens could easily infect areas causing a rough and black lesion. Severe node and petiole infections resulted in premature defoliation or leaf blight they dropped down and died, but remain attached to the withering stem. (Figure 3 and 6)

Symptom on petal Petal damage usually first developed as water - soaked and greasy dark brown spots 0.1 cm in diameter. The lesions then enlarged to elliptical shape and the petals started to rot. When the rotten petals were severely

infected, the disk flowers turned brown, and the causal agents spreaded to the flower resulting in premature defoliation of the petals (Figure 4).

Symptom on head and receptacle. The first symptom of head rot usually started with small darken spots on the receptacles. The spots could be 0.2 cm or greater in diameter. Receptacle lesions or spots at the back of the head enlarged to produce large elliptic shaped sunken dark - brown lesion (depressions). The lesions could coalesce to form large blackened areas resulting in head rot and decayed seeds. In some cases, secondary infections were encountered on the face of sunflower causing the entire head to be severely rotten (Figure 5).

Distribution. The disease was found in all study sites, namely, Nakhon Ratchasima, Khon Kaen, Nakhon Pathom and Chon Buri.

Causal organism. The laboratory studies revealed two species of *Alternaria* pathogens which were easily distinguished microscopically. *A. helianthi* produced pigmented or dark conidia with no beak which were rounded at both ends. The conidia could have both longitudinal and transverse septa (muriform conidia) in younger stage while the longitudinal septate could disappear in the later stage (Figure 7 and 8 A). *A. zinniae* also produced pigmented and muriform conidia like *A. helianthi,* but *A. zinniae* was characterized by an elongated apical beak (Figure 8 B). In general, *A. zinniae* produced a symptom similar to a common target spot whose conidia were produced in concentric ring around the lesions, yet, it was rarely founded in the tested plots.

Dissemination. *Alternaria* spp. were airborne, seed borne and soilborne (Baker and Davis, 1950; Baker, 1980). Since *Alternaria* spp. produced abundantly dry spores without any slime mass, such spores, could be very well disseminated through the wind. Once the pathogens found their host plants with favorable conditions, the spores would germinate and infected plants as previously mentioned. In addition, it was noted that *A. zinnaie* was a soil invader thus reducing the pathogen to survive for a certain period in the soil as a saprophyte without any host plant. As a result, crop rotation in the infected area over 2 - 3 consecutive years could not completely eliminate the pathogen (Baker, 1980). In case of being seedborne, it was found that once the head was infected during the high humidity the pathogen might further penetrate into the fruit coat resulting in infected seeds. When the seeds were propagated, these fungi were then transmitted to the new seedling plants (Baker, 1980).

Factors influencing infection. The favorable conditions for sunflower disease caused by *Alternaria* spp. were high humidity with warm to hot temperature. During the wet season with continuous rain for a period of time, the environment was very suitable for the development of disease or when fogs or dew drops occurred the disease could be observed to be very severe at this stage.

2. Septoria leaf spot.

The disease was commonly found at the National Corn and Sorghum Research Center. Two diseases accompanied with the same infected tissue, Septoria leaf spot and Alternaria leaf sopt were usually observed. During the investigation it seemed that Alternaria was more severe than Septoria leaf spot, and the latter was mostly found to cause injury to the leaves while *Alternaria* spp. was found to cause damage to all parts of the plants.

Symptom. Septoria leaf spot first appeared on the lower leaves and gradually spreads to the upper leaves. It was charactrized by water soaked spots that became roughly circular (0.2 - 1.0 cm in diameter) with light color or gray centers and indefinite darker margins due to the abundant dark spores produced around the margin. The lesions could later coalesce and formed diamond - shaped necrotic areas on the leaves. If the environment were favored to the disease development,

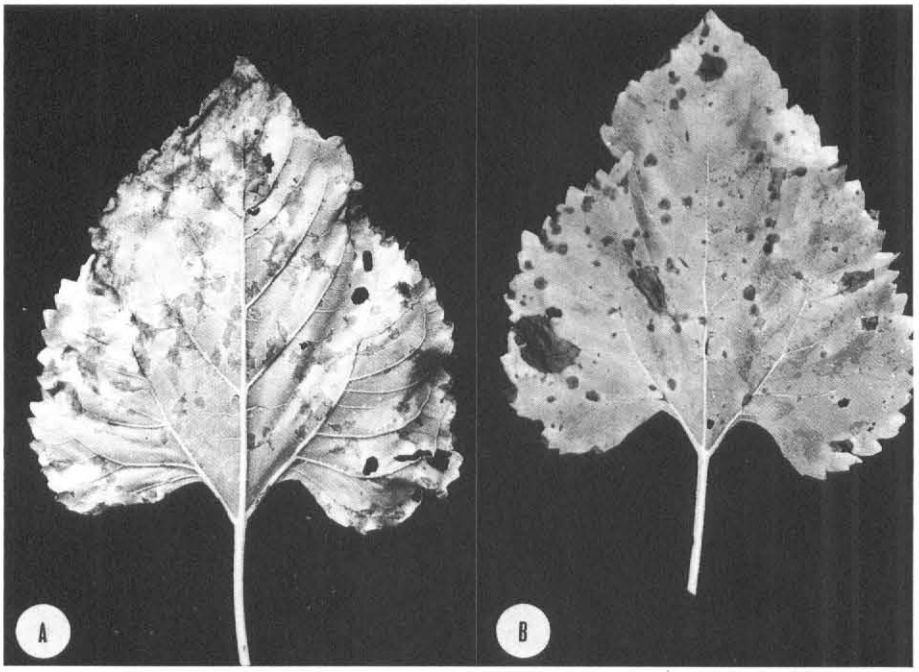

Figure 1. Leaf spot caused by *Alternaria* spp. A. The small irregular dark brown spots on the lower leaf. B. The spots spreading into the upper epidermis. A. and B. sometime shot - hole leaf spots were also noticed.

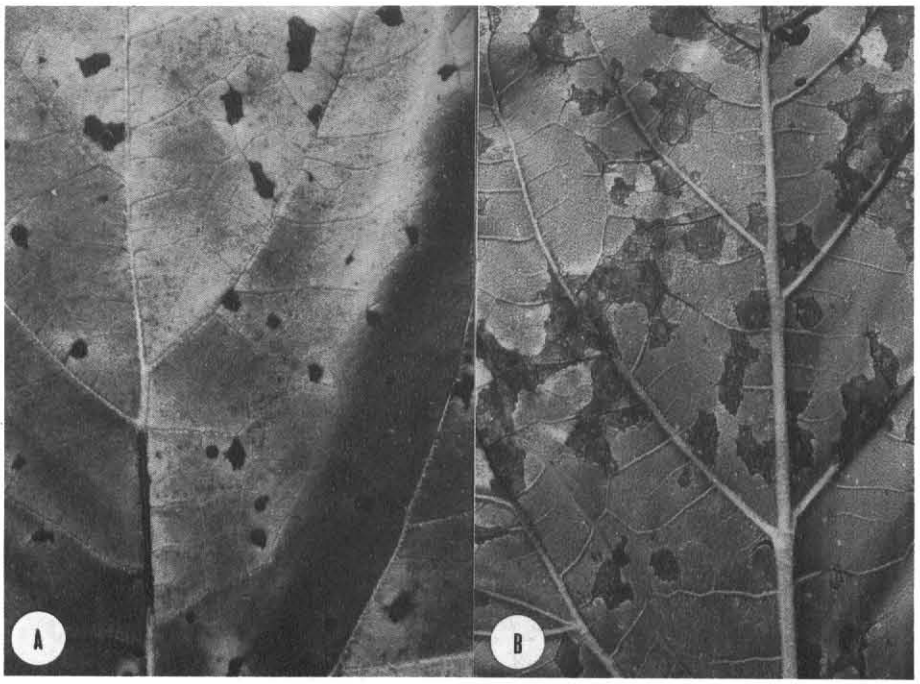

Figure 2. Focuses of Alternaria leaf spot showing A. irregular dark brown to black spots on the lower leaf, B. Each lesion coalesced and enlarged into blackened area, A. + B. The pathogens damaging the leaf veins and causing blackened flecks or streaks along the vein length.

Figure 3. **Alternaria stem rot showing A. Elliptic shaped lesion on stem and scattered over the stalk. B. The pathogens causing black lesions on nodes and petioles resulting in drop down and die of leaves but still attached to the stem.**

Figure 4. **Symptoms on head and receptacle caused by *Alternaria* spp. A. Showing water - soaked and greasy pale to brown spot on petals, the flower resulting in distortion and premature defoliation, B. Showing the elleptic shaped, sunken dark - brown lesions at the back of the head.**

Figure 5. **A. Symptom on bracts and petals caused by *Alternaria* spp. B. The pathogens infected the entire head and stalk to be severely rotten.**

Figure 6. Plants are severely infected by *Alternaria* spp. resulting in the die - back standing in all growing areas at Suwan Farm.

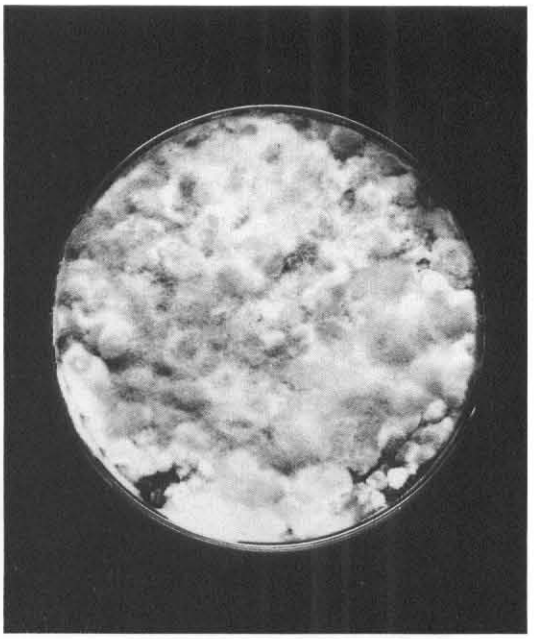

Figure 7. Culture of *Alternaria helianthi* at 10 day old on wheat seed medium.

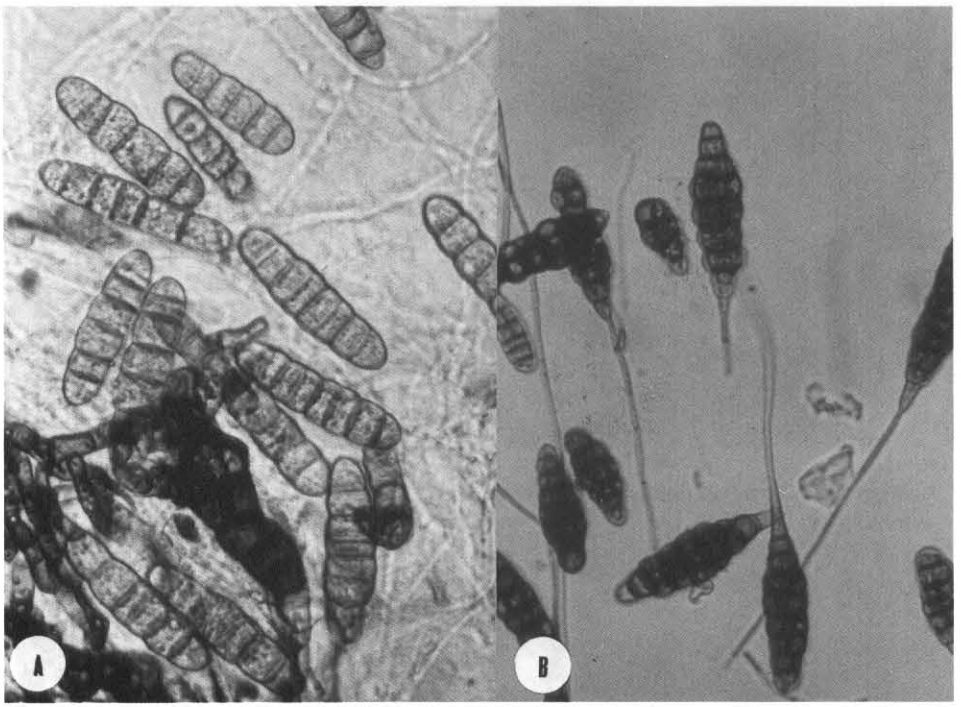

Figure 8. Conidia of *Alternaria helianthi* (A) and *A. zinniae* (B).

the lesions expanded rapidly, the leaves turned blight and finally the plant became wither which were similar to those symptoms caused by *Alternaria* spp.

Figure 9. Septoria leaf spot, showing A. Small roughly circular spots, B. The spots with gray centers and indefinite darker margin.

Distribution. The National Corn and Sorghum Research Center at Pakchong, Nakhon - Ratchasima.

Causal organism. *Septoria* sp. formed conidia in dark brown globose pycnidia with papillate ostioles at the end of those pyenidia. Conidia were hyaline and filiform with the base end a little bit wider than the top end and with 2 - 4 septa in each conidia.

Dissemination. *Septoria* sp. disperses in the same way as *Alternaria* spp. Infected seed was the principal source of inoculum. There were some evidences that the pathogen could survive in leaf debris for sevaral months but generally this was an unimportant source of inoculum compared to the infected seed.

Factors influencing infection. The favorable conditions for *Septoria* sp. to develop were similar to that of *Alternaria* spp. Generally, the disease was most severe on dry and dull days followed by cool, and very misty night. Under such conditions, the leaves remained moist for long period, which was ideal for infection.

3. Downy mildew

The causal fungus caused injury during all growth stages of sunflower with the most severe symptom or infection at seedling stage during seed germination and emergence.

Symptom. Chlorosis of leaves was typical to the disease. Discoloration began at the upper leaf veins near the petiole and spreaded towards the leaf margins. During the plant growth, the

Figure 10. Downy mildew, showing the chlorosis of leaves with localized infections on leaf appearing as random, small, yellow and angular spots.

causal organism spreaded to younger tissue, and chlorosis appeared on leaves successively up the stem. Opposite the chlorotic leaf areas (lower or underside of leaf), a white downy growth develops during periods of high humidity and cool temperature. The white growth was composed of fungus sporangiophores (conidiophores) and sporangia (conidia) growing through the stomata. The sporangia or conidia infected through stomatas and cause localized infections on leaves which appear as random, small, greenish yellow, angular spots. Infection during seed germination and emergence became systemic and was characterized by severe stunting, chlorotic leaves, and abnormally thick, brittle stems. However, during the surviellance at the study sites, only yellowing angular spots on the entire leaf blade was found (Figure 10).

Distribution. Downy mildew of sunflower was found at the National Corn and Sorghum Research Center, Packchong, Nakhon Ratchasima.

Causal organism. Downy mildew of sunflower was caused by *Plasmopara* sp. The disease was characterized as a white or grey bloom on the leaf lesions owing to the production of sporangiophore by the causal fungi. This fungus was an obligate parasite which typically penetrated the tissue of its host intercellularly with only limited intrusion into the host cell by specialized portion of the hyphae called haustoria. *Plasmopara* sp. was described as a typical of sporangiophore morphology whose branchs and subdivisions were right angles, irregularly spaced and with blunt tips on which the sporangia were borne.

Dissemination. Sporangia or motile spores usually dispersed through water, wind and senescent leaves. There were indicated that the downy mildew fungi could overseasoned on the alternate hosts and seeds.

Factors influencing infection. Humidity and temperature were the two most important factors influencing infection by downy mildew fungi. Most required high humidity for sporolation and spore germination and air temperature around 20 - 25°C was needed.

4. Rust

Rust diseases were caused by fungi belonging to the Uredinales which mostly parasitized Angiosperms or Gymnosperms. They colonized the host chiefly by intercellular mycelia with intracellular haustoria, as in the case of downy mildews.

Symptom. Sunflower rust was present as small reddish brown pustules which appeared on either side of the mature leaves, but predominated on the underside of the leaf. The pustules were initially yellow but later turned reddish brown and scattered chiefly over the upper surface of the leaves. Pustules were packed with enormous amount of spores which were ready to disperse. In addition, the halo around the pustule was also apparent. Sunflowers were susceptible to rust disease at all growth stages. In severe infections rust occurred on all aerial plant parts causing plants to ripen prematurely (Figure 11).

Distribution. The National Corn and Sorghum Research Center, Pakchong, Nakhon Ratchasima.

Causal organism. The disease is caused by *Uredo* sp. The pathogen was characterized by round, single cell and brownish yellow uredospore with spiny outer - wall. The teliospore, was not found in this study, therefore, there was an uncertainty whether *Puccinia* sp. or *Uromyces* sp. is responsible for the infection. As being reported in other countries, the two genera could severely infect sunflower.

Dissemination. Rust was wind borne spores for a distance and was also carried by other moving materials.

Factors influencing infection. Germination of uredospores were accelerated by high humidity especially during the cloudy days and water droplets were retained on leaf surface. Disease develop-

Figure 11. Symptom of rust on the leaf, showing small reddish brown pustules with yellow halo around the lesions.

ment was favored by moderately cool to cool weather.

5. Base and/or root rot disease

The disease was caused by a fungus with wide host plants and was more common and severe in regions within 38° latitude on either side of the equator. As a consequence, the disease was known under several generic names such as base rot, southern blight, southern wilt, dry rot, root rot and Sclerotium rot, etc.

Symptom. The pathogen produced a dark - brown lesion at the base of a stalk (at the soil level) resulting in yellowing of leaves, wilting and death of the plant (Figure 12). The margin between healthy and diseased tissues was often dark. The fungus grew rapidly and destroyed the root system. When the plant was pulled up, the lower stem and upper roots were apparently infected. The foot stalk was usually covered with white tufts of mycelia and several tiny white or dark brown to black sclerotia (Figure 13). The plant was susceptible to this disease at all growth stages.

Figure 12. Base rot caused by *Sclerotium* sp. The pathogen can infect at any growth stages of plant. A. Showing wilt at vegetative growth. B. The pathogen produces a dark - brown lesion at the base of a stalk.

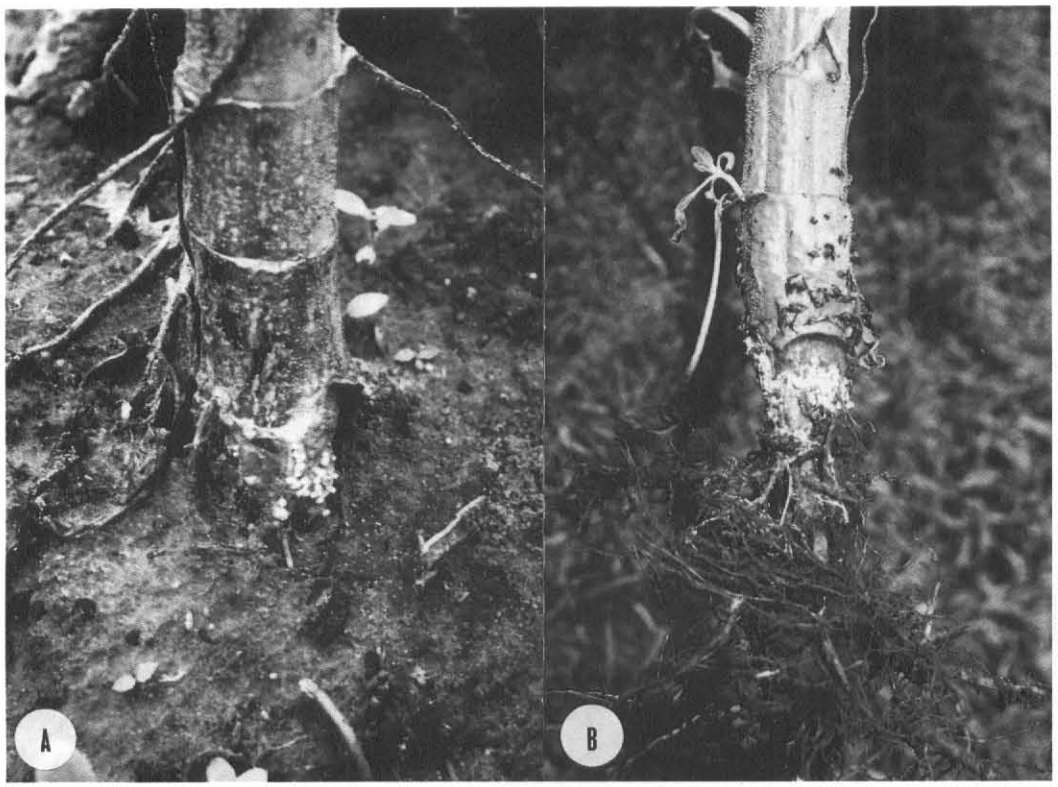

Figure 13. Base or root rot caused by *Sclerotium* spp. A. The foot stalk is covered with white tufts of mycelium and several tiny white to brown sclerotia. B. The pathogen caused damage to the root system.

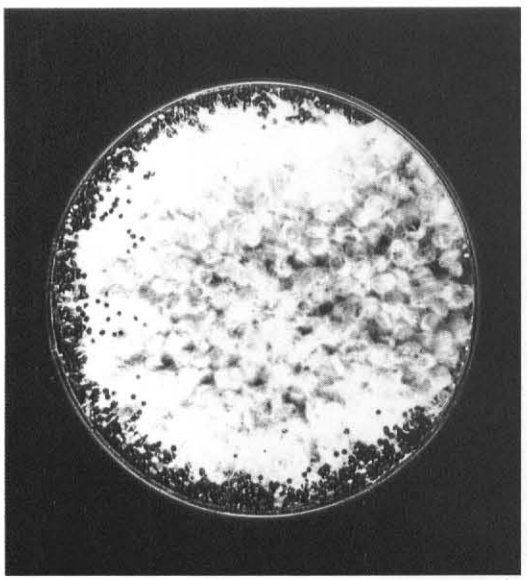

Figure 14. Culture of *Sclerotium* sp. at 23 day old on wheat seed medium, showing white fufts of mycelium and white to dark brown sclerotia.

Distribution. All study sites.

Causal organism. Only sclerotia was found in this study, hence, the pathogen was tentatively identified as *Sclerotium* sp. The fungus produced small, uniform sclerotia which were white when immature and became darker with age. Mature selerotia were the size, shape and color of mustard seeds (about 2 mm in diameter) and very resistant to various extreme conditions. The selerotia began to form in culture after about a week (Figure 14).

Dissemination. The fungus was soil borne and could be spreaded by water and planting materials.

Factors influencing infection. Warm to high temperature, wet weather and aeration were conductive to the pathogen. The disease was most severe when such conditions favored the growth of the fungus but not the host. The

optimum temperature for growth of the pathogen was about 85 - 99°F. The outbreaks were usually more severe following excessive hilling or bedding of plants by cultivation or when there was an accumulation of fallen leaves around the base of the plants. Mycelia of the pathogen would be destroyed at freezing point while the sclerotium still survives even when the temperature was as low as 14°C (Hoes and Putt, 1964).

Figure 15. Cladosporium head rot showing the pathogen infected the seeds only but never penetrated to damage the receptacle.

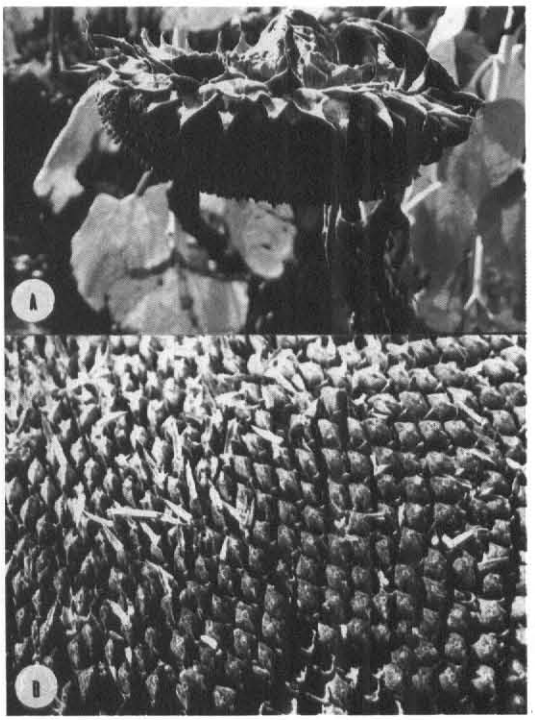

Figure 16. Cladosporium head rot showing. A. The infected head became dark brown and died. B. Seeds were shrunken, distorted and ungerminated.

6. Cladosporium head rot

Cladosporium head rot was one of the most common disease of several crops. It could be devastating on greenhouse crops. Generally, the fungus was saprophytic in nature. However, when the environments were favorable, it could infect the host plant, especially at the heads and seeds of sunflower. Although this fungus has a wide distribution on other hosts, it has not been reported from areas in which sunflowers are grown commercially as an oil - seed crop. Thus this is the first report of its occurrence on head of sunflower in Thailand.

Symptom. The fungus developed on the surface of sunflower head and the corresponding areas became covered with a greyish mass of conidia and conidiophores which later turned dark brown to black. Many conidia were produced in a warm and moist atmosphere and they readily gave rise to secondary infections. The infected young seeds were not filled up while the infected mature ones became shrunken, distorted and ungerminated (Figure 16). The pathogen infected the head surface or seeds only but never penetrated to destroy the receptacle of sunflowers (Figure 15).

Distribution. The National Corn and Sorghum Research Center, Pakchong, Nakhon Ratchasima.

Causal organism. *Cladosporium* sp. The fungus was characterized by dark color conidia with 1 - 2 cells. The conidia were variable in shape and size ranging from ovoid to cylindrical and irregular with mostly typical lemon - shaped. Conidiophores were also dark with branches forming in cluster or single.

Dissemination. The fungus was airborne and could over winter between crops in small bits of leaf debris and on bricks and woodwork.

Figure 17. Root knot disease characterizing by typical root knot galls.

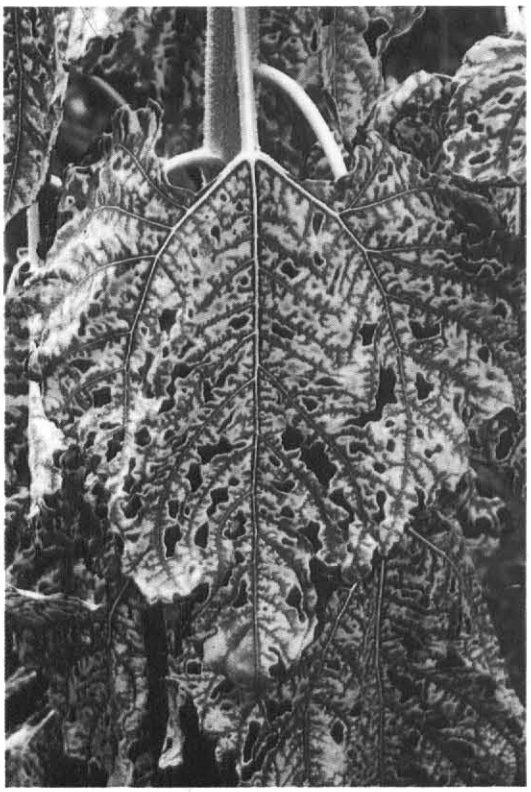

Figure 18. Mineral deficiency? Showing intensive necrosis of leaves.

Factors influencing infection. The spores were very resistant to dry weather and low temperature. Temperature and humidity largely determine disease severity. The optimum conditions for disease development were low temperature (22 - 25°C) and a relative humidity over 95%. Humid conditions at night appeared particulary important possibly because light retards germ - tube growth of the spores. Sunflower head which stands itself in such position that it could collect drops of water was favorable to the infection by the pathogen.

7. Miscellaneous diseases

During the investigation some disease symptoms were noticed arround the study sites but have not been confirmed by isolation and subsequent inoculation in the laboratory yet. Such diseases were characterized with the symptoms similar to:-

7.1 Root knot disease caused by nematode. The causal organism produced typical root - knot galls that were two to three times as large in diameter as healthy roots. Above ground

Figure 19. Virus or mycoplasma disease ? Showing chlorosis, mosaic and distortion of leaves.

symptoms included a general reduced growth similar to that caused by other root diseases (Figure 17).

7.2 Mineral deficiency. The disease caused chlorosis, necrosis, cupping and crumoling of leaves. Sometimes it caused the heads to break off without other severe symptoms observed. It was similar to boron or molybdenum deficiency (Figure 18).

7.3 Yellow and mosaic. The disease was characterized by chlorosis, mosaic, distortion and tattered margins of leaves. The chlorotic areas of the leaves assumed a yellowish color, were small, and symptoms did not disappear as leaves matured. These symptoms were similar to the ones caused by virus or mycoplasma (Figure 19).

7.4 Leaf blight. The disease typically produced necrosis of the interveinal areas of leaves and enlarged to the margin. The leaf turnd blight resulting in premature defoliation. The symptom was similar to that caused by *Phomopsis* sp. (Figure 20).

Figure 20. Phomopsis blight? Showing the interveinal necrosis of leaf that enlarged to the margin.

DISCUSSION

Surveys of sunflower diseases were conducted during May 1987 to April 1988 to investigate the occurrence of the diseases on sunflower (*Helianthus annuus* L.) in Nakhon Ratchasima, Khon Kaen, Nakhon Pathom and Chon Buri. Diseases were identified in the field on the basis of symptoms and later were confirmed in the laboratory by isolation of the pathogen and subsequent inoculations. It was found that Alternaria leaf and stem spot *(A. helianthi* and *A. zinniae)* and Septoria leaf spot (*Septoria* sp.) were the two major diseases around the study sites. Other major diseases included base and root rot disease (*Sclerotium* sp.), mineral deficiency (boron or molybdenum) and Cladosporium head rot (*Cladosporium* sp.). Downy mildew (*Plasmopara* sp.), rust (*Uredo* sp.), root knot disease, virus or mycoplasma diseases and leaf blight (*Phomopsis* sp.) occurred sporadically. This is the first report of diseases on sunflower in Thailand that includes the first incidence of Cladosporium head rot. The parasite is not prevalent and has not been known or reported to cause serious damage in any other countries.

In the northern area of Thailand, no kind of diseases were detected and the collection of sunflower diseases during the previous time has been made from northeastern and central only, since no report of disease on sunflower near northern cultivated area was confirmed perhaps, the investigation has to be reconducted to confirm the solid result.

Some disease symptoms in the study such as root - knot, leaf blight, or yellow and mosaic have not been identified and confirmed for the causal agent in the laboratory because the specimens have been detected in small amount from the infected tissues, or the infections have just occurred and disease symptoms have not yet become evident during the investigation. Very few specimens of some specific diseases are difficult to be isolated or identified with simple procedures in the laboratory. Failure to detect some causal agents is indicated by a minus sign; the absence of disease syndrome and some specific symptoms indicate the occurrence of the disease on the study sites.

Some diseases such as downy mildew and rust are primarily found at the National Corn and Sorghum Research Center only and its absence from other areas may be attributed to a lack of requirement for a high atmospheric humidity while the low incidence of the mentioned diseases was probably due to the widely scattered distribution of their alternate hosts. The parasite's preference for vectors or predispositions factors which decreases in number is developed for agriculture and recreation. The absence of the mentioned diseases in other sites could mean that the conditions in the drier areas do not favor infection and the diseases may not develop well under such conditions.

The incidence of the attack of the root - knot disease at Kasetsart University, Kampaengsaen Campus in Nakhon Pathom was generally very light and difficult to detect. Wherever an obvious attack occurs, it was usually restricted to one or two individual plants. It was only one site that the root - knot disease was found. The virtual absence of severity would indicate the recent establishment of the disease in the area.

Alternaria helianthi, A. zinniae and *Septoria* sp. are three among several fungi causing foliar lesions on sunflower. They are widely distributed whereever sunflowers are grown. (Ayadin, 1983 ; Saharan and Singh, 1976). *A. zinniae* was considered the principal fungus for an outbreak of leaf and stem spotting of sunflower in Manitoba in 1960 (McDonald and Martens, 1963). Several *Alternaria* species have been reported to cause leaf and stem spotting including *A. zinniae, A. helianthi* (Carson, 1987) and *Septoria* sp. has caused damaging levels of leaf spot in many countries. (Henry and Gilbert,

1924). However, the incidence on a site basis of these major diseases which were the most common, were found most serious and widely distributed on the sites surveyed in all areas. It caused 100% damage to almost 2 acres of sunflower plants at The National Corn and Sorghum Research Center.

Alternaria spp. was consistently isolated from both leaf spots which were roughly circular in shape, uniformly dark - colored and brown flecks or streaks on the stem. *A. zinniae* usually caused a target - like appearance. These spots were identical to those on zinnia illustrated by Neergaard (1945). It was difficult to defermine the extent of the damage attributable to infection by *A. zinniae* or *A. helianthi* as nummerous other types of leaf nerosis occurred on the leaves caused by other factors.

The importance of these diseases on sunflowers is difficult to estimate as the crop is susceptible to many diseases affecting stems and leaves which obscure the effects of any one disease. Further studies on the prevalence and importance of these diseases as the contributor to this complex should be made to assess their relative importance and to determine whether they warrant extensive control measures. A more detailed study or comprehensive survey would be required, if possible, effects of site and climatic factors including a preliminary control measure by chemicals as to solve the urgently encountered problem at the moment. A similar servey is also needed in the northern region of the country to find out if a similar disease problem also exist.

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