UNIVERSITI PUTRA MALAYSIA

ANTHRACNOSE FRUIT ROT OF CHILLI (CAPSICUM ANNUM L.): SOME ASPECTS OF ITS ETIOLOGY, EPIDEMIOLOGY AND CONTROL IN PENINSULAR MALAYSIA

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by

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LIST OF ABBREVIATIONS

g	gram
hr	hour
ml	millilitre
mg	milligram
mm	millimetre
pH	hydrogen ion exponent
µ	micrometre
MT	metric ton
CWT	hundredweight
%	percent
kcal	kilo calories
kg	kilogram
ha	hectare
ppm	parts per million
PDA	potato dextrose agar
CA	chilli agar
^{o}C	degree (s) Celsius
viz.	namely
ft	foot; feet
in	inch(es)
m	metre
Mo	Molybdenum
Mn	Manganese
Zn	Zinc
Fe	Ferrum, iron

An abstract of the thesis presented to the Senate of Universiti Pertanian Malaysia as partial fulfilment of the requirements for the degree of Master of Agricultural Science

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Faculty : Agriculture

Anthracnose fruit rot is a serious limiting factor in the production and yield of fresh chillies (*Capsicum annuum* L.) in Peninsular Malaysia. Isolates obtained from diseased chilli fruits collected in various localities in the country yielded the fungus, *Colletotrichum capsici* (Syd.) Butler & Bisby.

Pathogenicity studies on mature chilli fruits confirmed that *C. capsici* could produce typical elliptical or oblong straw-coloured lesions on the fruit surface with subsequent development of black acervuli in concentric rings. Comparison of isolates on potato dextrose agar showed that all the isolates were relatively similar in cultural and morphological

characteristics. Germination of conidia occurred 3 - 4 hours after plating on chilli agar medium. Branching of germtubes occurred between 16-24 hours after germination. The fungus grew over a wide range of hydrogen-ion concentrations (between pH 3.0 and pH 10.0) with optimum between pH 7.0 and pH 9.5. Acervuli formation and development was more evident on alkaline medium than on acidic medium. Optimum temperature for mycelial growth was between 25 ^{o}C and 32 ^{o}C. The minimum and maximum temperatures for visible growth were 10 ^{o}C and 45 ^{o}C, respectively.

Studies on several inoculation methods under laboratory conditions showed that dipping non-blemished chilli fruits into a spore suspension of 1 X 10^{6} spores/ml, followed by incubation in a moist chamber gave good lesion development. This method was therefore adopted as a rapid in-vitro inoculation technique for mass screening tests. Screening of local and introduced varieties of chilli at various growth stages indicated differential resistance of chilli varieties to C. capsici, although growth stage had little influence on the incidence of anthracnose ripe rot disease.

Studies also showed that chilli seeds infected with C. capsici had a higher percentage of germination than non-infected seeds though subsequent seedling growth was retarded. The spread of the disease in the field was greatly influenced

by the direction of prevailing winds, indicating the importance of wind-borne spores to disease spread. Rainfall influenced disease depending on the amount, duration, intensity and pattern of rainfall during a crop cycle.

In-vitro screening of fungicides indicated that Brestan 10 (maneb + fentin acetate) was highly inhibitory to the growth of the fungus. However, field evaluation of 14 test fungicides indicated that none of the chemicals tested was very effective in controlling anthracnose ripe rot disease of chilli due to various limitations.

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PENYAKIT ANTHRAKNOS BUAH CILI (CAPSICUM ANNUUM L.): BEBERAPA ASPEK ETIOLOGI, EPIDEMIOLOGI SERTA PENGAWALAN DI SEMENANJUNG MALAYSIA

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Penyakit bintik berpusar adalah satu faktor pembatasan yang serius dalam produksi dan penghasilan cili-cili segar (Capsicum annuum L.) di Semenanjung Malaysia. Buah-buah cili berpenyakit yang diambil dari beberapa tempat dalam negara, dan telah diasingkan, mengandungi kulat, Colletotrichum capsici (Syd.) Butler & Bisby.

Kajian-kajian patogenisiti ke atas buah-buah cili yang masak mengesahkan bahawa C. capsici boleh menyebabkan lesion-lesion berbentuk bulat - panjang atau bujur yang biasa, berwarna jerami, di permukaan buah, diikuti oleh tumbuhan acervulus hitam berbentuk bulat. Perbandingan terhadap

dektros kentang (PDA) yang telah diasingkan menunjukkan semuanya adalah seakan-akan bersifat terpelihara dan morfologi. Percambahan conidia berlaku 3-4 jam selepas saduran ke atas agar cili. "Germtubes" atau tiub germa merebak di antara 16-24 jam selepas percambahan. Kulat-kulat tumbuh dalam lingkungan kepekatan hydrogen ion yang luas (di antara pH 3 dan pH 10) dengan optima di antara pH 7 dan pH 9.5. Pembentukan dan perkembangan acervulus lebih nyata pada penimbal alkali dibandingkan dengan penimbal asid. Suhu optima untuk pertumbuhan kulat adalah di antara 25 ^{o}C dan 32 ^{o}C. Suhu minima pertumbuhan nyata ialah 10 ^{o}C dan maksimanya 45 ^{o}C.

Kajian-kajian ke atas beberapa kaedah suntikan di makmal menunjukkan bahawa mencelup buah-buah cili yang tidak cedera ke dalam ampaian spora dengan kepekatan air 1 x 10^{6} spora/ml, diikuti dengan kaedah pengeraman dalam tempat lembab menghasilkan calar-calar yang baik. Cara ini telah dipilih sebagai kaedah suntikan *in vitro* yang sesuai untuk ujian-ujian penyiasatan berkumpul. Siasatan terhadap cili-cili tempatan dan jenis-jenis yang dicadangkan pada peringkat-peringkat pertumbuhan tertentu, menunjukkan beberapa penahanan yang berlainan pada *C. capsici*, walaupun di peringkat pertumbuhan, kecil pengaruhnya terhadap berlakunya penyakit anthracnose.

Kajian-kajian menunjukkan juga bahawa biji-biji cili yang dijangkiti *C. capsici* mempunyai peratus percambahan yang lebih

tinggi daripada biji-biji yang tidak dijangkiti, walaupun pertumbuhan anak-anak pokok yang seterusnya tergencat. Arah tiupan angin telah mempengaruhi penyebaran penyakit ini di ladang menunjukkan pentingnya spora yang dibawa angin dalam merebakkan penyakit. Hujan boleh mempengaruhi penyakit, bergantung kepada kekerapan, lama, lebat dan pola-pola hujan semasa sesuatu giliran tanaman.

Siasatan *in vitro* terhadap racun kulat menunjukkan bahawa Brestan 10 (maneb + fentin acetate) adalah peka besar ke atas pertumbuhan kulat itu. Walau bagaimanapun penyaringan di ladang terhadap 14 racun kulat yang diuji, menunjukkan bahawa tiada bahan kimia yang didapati paling berkesan untuk mengawal penyakit anthraknos cili, disebabkan terdapatnya beberapa pembatasan.

CHAPTER 1

INTRODUCTION

1.1 The chilli plant

Capsicum annuum L., commonly known as capsicum, chilli or chilli pepper, includes a large number of horticultural varieties and is by far the most economically important of all the cultivated species of *Capsicum*. It belongs to the family Solanaceae and is a native of Central and South America (Purseglove, 1968; Ware and McCollum, 1975; Thompson and Kelly, 1978; Anon., 1983). Under cultivation, the chilli plant is an annual although several cultivars may be perennials in warmer climates. Flowers are small, white, 5-partite and borne singly on the axils of leaves. Different cultivars have berries or pods or seed-vessels that vary in shape and size. When ripe, the colour of the berries ranges from blood-red to yellow, orange, dark violet to even green or black. Seeds are white or straw-coloured, flat and kidney-shaped and are attached to a fleshy placenta. Pungency is due to to a non-volatile compound called capsaicin, the vanillyl amide of isodecylanic acid (Burkhill, 1935; Purseglove, 1968; Anon., 1983). The amount of capsaicin is controlled by a single dominant gene and varies enormously in various cultivars. Matthew *et al*. (1971) reported that generally the amount of capsaicin in chilli

ranges from 0.1 percent to 1 percent, while the Indian variety has capsaicin content in the range of 0.2 percent to 0.5 percent.

Domestic and wild species of Capsicum were found in the New World as early as prehistoric times. Columbus carried the seed to Spain in 1493 (Thompson and Kelly, 1978) and from there, it was introduced to Europe and Asia. Purseglove (1968) and Heiser (1976) reported that by 1542 there were already three races of Capsicum being cultivated in India. In 1931 Ochse, Bakhuizen and van den Brink reported that C. annuum was "cultivated everywhere in the Dutch East Indies for its pungent fruits". C. annuum can be grown from sea-level to 6,000 feet or more. At present in Java, chilli is planted between rice-crops and in Malaysia it is cultivated as a garden crop or on small farms. In India, chilli is widely grown in areas around Madras and in the plains of upper India. During the period from 1969 - 1971, the world production of fresh capsicum was given as 5,027,000 metric tons(MT) per year and production increased to 7,055,000 MT per year during the period from 1979 - 1981 (FAO, 1982). India is now the biggest producer and exporter of chillies with annual exports exceeding 200,000 cwt. (9,072 MT) per year in some years, followed by Thailand with about 100,000 cwt (4,536 MT) per year (Purseglove, 1968). Purseglove (1968) also reported that Sri Lanka imports the largest quantities of chillies, followed by the United States and Malaysia.