EFFECT OF BROWN LEAF SPOT DISEASE ON THE GROWTH AND YIELD OF SWEET POTATO

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ABSTRACT

Polybagged sweet potato plants were inoculated with conidia of *Cercospora batatae* scraped from sweet potato leaves infected with brown leaf spot. The completely randomized design was followed in laying out the experiment. Leaves inoculated at different ages showed varying responses to infection with significant differences in the number and size of lesions and percentage of defoliation. Leaves inoculated at 15-21 days old were found most susceptible to the disease. Initial symptom of the disease was first observed as light green lesions approximately 0.5 mm in diameter 2 weeks after inoculation. The lesions increased gradually until they reached 3 to 4.2 mm diameter 32 days after inoculation. Coalition of lesions was observed at this stage followed by subsequent defoliation. Inoculated plants showed decrease in yield resulting from the adverse effects on yield components. The two trials yielded 9.57%, 5.05% and 26.23% reduction in weight of tubers, roots and tops, respectively. The number of tubers also decreased in inoculated plants. Analysis of variance of weight of tops showed significant difference from the uninoculated ones while the other parameters were not significantly different.

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KEY WORDS: Sweet potato. Brown leaf spot. *Cercospora batatae*. Symptomatology. Lesions. Defoliation. Effect of pathogen. Yield and yield components.

INTRODUCTION

Brown leaf spot, caused by *Cercospora batatae* Zimm., is a common disease of sweet potato. Despite its prevalence in sweet potato fields, limited pathogenicity studies have been done on the disease.

Knowledge of the effect of a disease on the crop helps to determine whether application of control measures is warranted or not. Usually, under field conditions,

leaves of varying ages are present in any growth stage of sweet potato. However, susceptibility of sweet potato leaves at varying ages to brown leaf spot disease is still unknown. Leaves of varying ages may have different reactions or manifestations to disease infection.

This study presents the effect of *C. batatae* on the growth and yield of sweet potato, the symptoms of brown leaf spot disease on leaves of different ages and the leaf age which is most susceptible to the fungus.

MATERIALS AND METHODS

Preparation and Care of Test Plants. — Planting materials of BNAS-51 sweet potato variety were obtained from the Philippine Root Crop Research and Training Center at ViSCA, Baybay, Leyte, Philippines. Cuttings of about 30 cm long were planted vertically at 15 cm deep in black polyethylene bags (47.72 x 45.72 x 0.15 cm) filled with sterilized soil. A basal application of complete fertilizer (14-14-14) at the rate of 60-60-60 kg of N, P_2O_5, and K_2O per hectare at planting time was applied to each plant. Control plants were sprayed at weekly intervals with benlate at the rate of 0.01 g/l of water to prevent fungal infection.

Preparation of Inoculum and Inoculation. — Since no artificial medium suitable for sporulation of *C. batatae* had been developed, inoculum using diseased leaves collected from the field were used. In the laboratory, the diseased leaves were placed inside plastic bags with moist tissue paper and tied with rubber band in the open end to provide sufficient moisture needed for sporulation of the fungus. Spore suspension was made by scraping both surfaces of the infected leaves using sterilized brush and placing the spores into distilled water in a beaker until the spore concentration reached approximately 4000 spores/ml.

The prepared spore suspension was sprayed uniformly to the test plants using a hand plastic atomizer. Spraying was directed to both surfaces of the test leaves of each plant excluding the control plants. The inoculated plants were carefully coiled around the pole supports so that the entire plant can be covered with plastic bags for 48 hr to provide sufficient moisture needed for the establishment of the spores on the leaves.

Statistical Design. — The completely randomized design (CRD) with 5 replications consisting of 6 plants per replication and 2 treatments was followed in setting up the experiment in the field. The two treatments were the inoculated and uninoculated plants to determine the effect of the disease on crop yield. From the inoculated plants, susceptibility and symptomatology studies of the different leaf ages to the disease were determined. Two trials were conducted.

The leaf ages were determined by making weekly placement of tags to the youngest unopened leaves starting from planting. Therefore,

when the plants were 6 weeks old, the vine was divided into 5 sections representing varying stages of leaf maturity and the leaves were identified from the base to the shoot corresponding to:

29-35 day-old leaves
22-28 day-old leaves
15-21 day-old leaves
8-14 day-old leaves
1-7 day-old leaves

The 29 to 35 day-old leaves corresponded to the first tagged leaves while the 1 to 7 day-old leaves corresponded to the last tagged leaves. Each replication consisted of 6 plants and 10 random leaf samples represented test leaves. Threads used as leaf tags were loosely tied so that when the petioles grew, the thread did not hurt nor cut the tagged leaf. Another thread was used to mark the divisions of the ages on the vine so that, in case the tagged leaf prematurely fell off due to abnormalities, a visible mark was still attached to the vine. The thread colors used were red (29-35 day-old leaves), blue (22-28 day-old leaves), white (15-21 day-old leaves), green (8-14 day-old leaves) and yellow (1-7 day-old leaves).

RESULTS AND DISCUSSION

Disease Development.

Two weeks after inoculation, light green lesions which were approximately 0.5 mm in diameter, appeared both on the lower and upper surfaces of the leaves. These lesions gradually increased in size and turned brown with yellow green border advancing at the periphery of the lesion. At 18 days after inoculation, the diameter of the lesions ranged from 1 to 1.75 mm. Four to 7 days later, the lesions reached 2 to 2.46 m (Fig. 1A). Twenty-five to 32 days after inoculation, the lesions further increased to 3 to 4.22 in diameter (Fig. 1B). At this stage, coalition of lesions became prevalent. Lesions close to each other combined and coalesced (Fig. 1C) forming dried blighted areas on the leaf (Fig. 1D). Severely infected leaves turned yellow then subsequent defoliation occurred as shown in Fig. 1E.

Effect of Pathogen on Leaves of Different Ages Gauged in Terms of:

Size of Lesions. Table 1 shows the average size of lesions per leaf of the different leaf ages obtained at weekly intervals. At 18 days after inoculation, the significantly biggest lesion (2.21 mm in diameter) was observed in 15-21 day-old leaves. Sizes of lesions among the other leaf ages were not significantly different from each other. At 25 days after inoculation, a corresponding increase in size was not significantly different. At 32 days after inoculation, the biggest lesion diameter was again observed in 15-21 day-old leaves (4.89 mm). In general, the size of lesions within a given leaf age increased with time from 18-32 days but the differences between treatments were more or less maintained throughout. How-

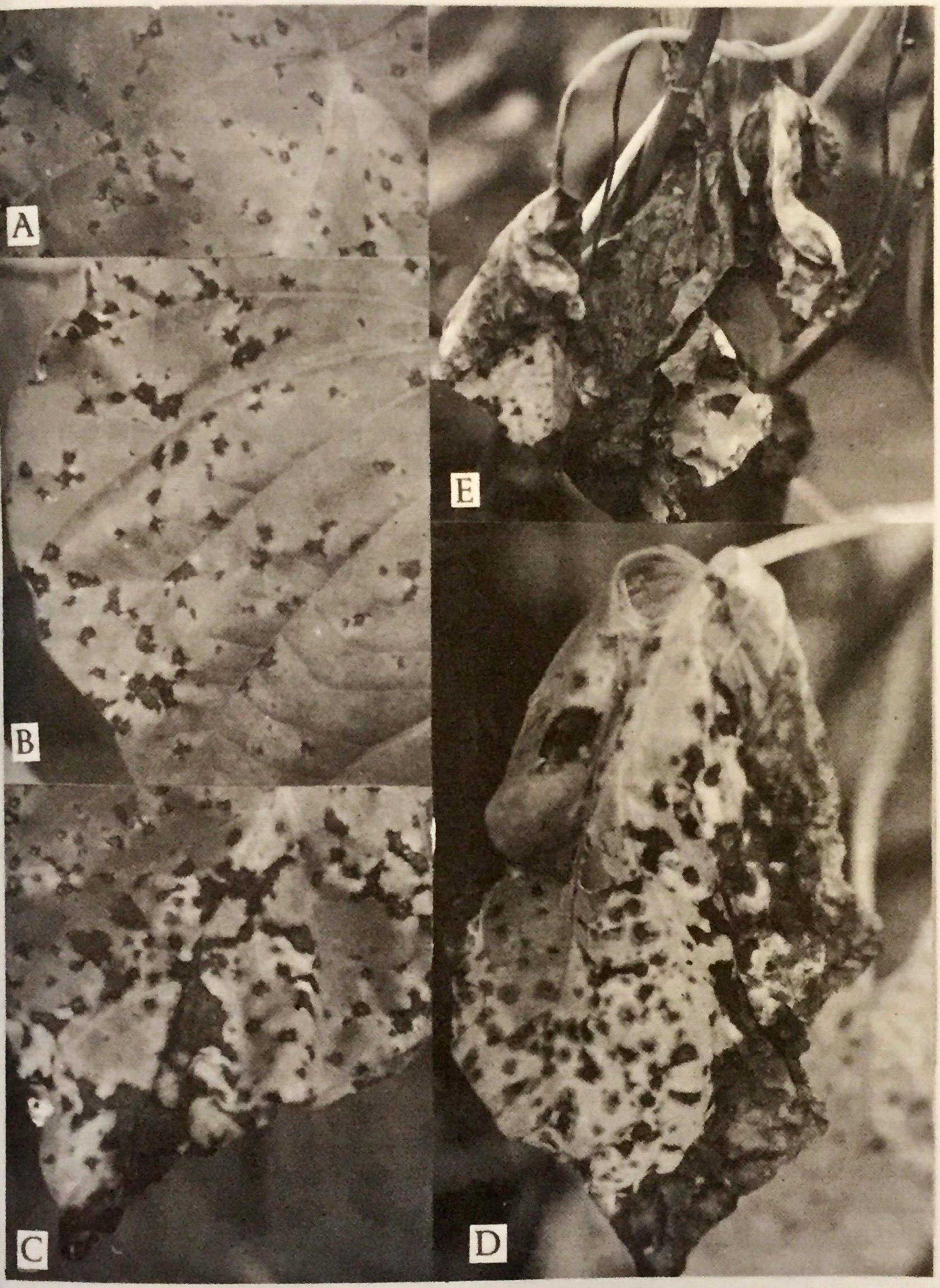

Fig. 1. (A.) Sweet potato leaf (BNAS-51 variety) showing distinct lesions of brown leaf spot disease 18-25 days after inoculation. (B.) Brown leaf spot lesions on sweet potato leaf reaching their maximum size 25-32 days after inoculation. (C.) Sweet potato leaf showing coalition of lesions 32 days after inoculation with *Cercospora batatae*. (D.) Severe coalition of lesions and blighting symptoms in sweet potato leaf as a result of brown leaf spot disease infection. (E.) Sweet potato plant showing severe blighting leading to defoliation as a result of *C. batatae* infection.

ever, lesion sizes of the leaves younger or older than 15-21 day-old were not significantly different from each other.

Miller (1953) noted a close correlation between resistance of the varieties to *Cercospora arachidicola* wherein the lower the riboflavin content, the greater the susceptibility to peanut leaf spot. In another study, Martinez (1979) postulated that the younger leaves contain more inhibitory substances that prevent the rapid development of the disease. He also explained that younger plants recovered faster from infection because of rapid cell division. Wingard (1953), meanwhile, pointed out that young beet leaves were practically immune to attacks by *C. beticola* because their stomata were so small to provide an opening wide enough to allow the entrance of germ tube of the fungal spores which can only enter the host through the well-developed and mature stomata.

Number of Lesions Per Leaf. Weekly counts of the number of lesions per leaf of the different leaf ages tested showed a progression on the number of lesions from the first and second week of counting. However, lesion count on the third week decreased on all the leaf ages except for 1-7 and 8-14 day-old leaves (Table 1). At third week of lesion count (32 days after inoculation), coalesced lesions were observed particularly on the last 3 older leaf ages (15-21, 22-28 and 29-35 day-old leaves). The decline in the number of lesions on these group of leaf ages on the third week could be

Table 1. Number of lesions per leaf, size of lesions, percentage coalition of lesions, and percentage defoliation in sweet potato (BNAS-51 variety) inoculated at different leaf ages with *Cercospora batatae*.

Leaf Age (days)	Size of Lesions			Number of Lesions[1]			% Coalition[2]	% Defoliation[3]
	18[4]	25	32	18	25	32		
1-7	1.53b	2.03c	3.82b	22.43 bc*	27.5c	29.21c	12.66	19.88d
8-14	1.65b	2.38bc	4.26b	36.43a	36.1bc	37.35bc	13.66	21.28c
15-21	2.21a	2.85a	4.89a	42.57a	55.83a	54.9a	15.89	23.54a
22-28	1.72b	2.54ab	4.18b	33.88ab	42.13b	40.47b	15.44	22.82ab
29-35	1.63b	2.49ab	3.93b	24.49bc	39.99b	35.86bc	14.09	22.25bc
Total	8.74	12.29	21.08	159.8	201.25	197.79	71.74	109.77
Mean	1.75	2.46	4.22	31.96	40.25	39.56	14.35	21.95

[1] Size and number of lesions were obtained at weekly intervals starting from 18 days after inoculation until the third week (32 days after inoculation).

[2] Taken at 32 days after inoculation.

[3] Daily count of the different leaf ages that fell due to the disease for 30 days starting at the onset of defoliation until 30 days.

[4] Number of days after inoculation.

* Treatment means in the same column followed by a common letter are not significantly different at 1% level, DMRT

due to the fact that when lesions coalesced, the exact original number of lesions that composed a coalesced lesion. was difficult to obtain (Fig. 1C).

Differences in lesion number of various leaf ages were highly significant in all the lesion counts done. At 25 and 32 days after inoculation, lesion number in some cases was slightly lower than in the previous readings owing perhaps to coalition of lesion with further disease development. Hence, to determine lesion number it may be best to rely on readings taken at 25 days after inoculation. Leaves younger and older than 15-21 days old had significantly fewer lesions per leaf in both 25 and 32 days after inoculation but it was statistically similar to 8-14 day-old leaves at 18 days after inoculation.

Percentage Coalition of Lesions. Sweet potato leaves of varying ages did not show significant differences in percentage coalition of lesions (Table 1). This suggests, therefore, that factors other than leaf age affect the coalition behavior. These factors are very likely the degree of infection related to size and number of lesions.

Percentage Defoliation. Plants with leaves ranging from 1-7 day-old had significantly lesser defoliation. The other leaf ages did not differ significantly in percentage defoliation (Table 1). It was observed that plants with the oldest leaf ages tested (29-35 day-old) were the first to show defoliation followed by the preceding leaf ages. It is probable that slight infection of the disease on oldest leaves was enough to induce early leaf fall since they were already near their senescence stage.

Effect of the Disease on Crop Yield.

Number and Weight of Tubers. Table 2 shows the weight of tubers of the inoculated and uninoculated plants. Tuber yield of the uninoculated plants was higher (9.72 kg) as compared to inoculated plants (8.79 kg). Although the average of 2 trials resulted in an average reduction of 9.57% in tuber yield due to brown leaf spot disease infection, there were no significant differences between the number and weight of marketable and non-marketable tubers between the uninoculated and inoculated plants. On the contrary, Teri, Thurston and Lozano (1978) pointed out that when the weather is warm and moist, *Cercospora* spp. infecting cassava can cause considerable damage to foliage, thereby resulting in stunted growth and yield decline. Similarly, Cock (1977) in a separate study, revealed a 14% yield increase of the susceptible cassava variety Llanera because of control of the brown leaf spot and blight leaf spot of cassava. Based on the result, the degree of infection in this study appears to be not adequate to cause significant reduction in yield of BNAS-51 sweet potato variety under existing conditions.

Weight of Roots. Infection by *C. batatae* on sweet potato decreased weight of non-tuberous roots by 5.05% (Table 2). However, the difference was not significant be-

Table 2. Weight of tubers, roots and tops (kg) and number of marketable and non-marketable tubers of sweet potato (BNAS-51 variety) inoculated or uninoculated with *Cercospora batatae*.[1]

Treatment	Weight (kg)	Number	
		Marketable	Non-Marketable
Inoculated Plants			
Tubers	1.758	7.9	10.7
Roots	0.490		
Tops	5.040		
Uninoculated Plants			
Tubers	1.945	9	15.4
Roots	0.516		
Tops		6.832	

[1] Average of two trials.

tween the inoculated and the uninoculated plants.

Weight of Tops. Results show that the disease significantly reduced the weight of tops by 26.23% (Table 2). Such decrease in top weight could be attributed to severe defoliation and poorer growth of the inoculated plants. When the plants were harvested, the inoculated plants were observed to have exposed vines without leaves in contrast to the uninoculated plants which had many leaves still attached to their vines. Correspondingly, inoculated plants had lesser top weight than the uninoculated plants. However, such decline in top weight did not significantly affect the yield of sweet potato.

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