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Effect of Red Rot Fungus and Root Knot Nematode Infection on the Growth and Yield of Sugarcane

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ABSTRACT

A field survey of sugarcane germplasm for red rot disease (*Colletotrichum falcatum* Went) and a root-knot nematode (*Meloidogyne incognita* Chitwood) in Nigeria was carried out. Out of 49 sugarcane cultivars examined, thirty-six viz. B6604, B57175, B5992, B4681, B69620, B61208, BJ6547, Co691, D47/15, DB20/58, DB95/57, BJ6552, DB5155, Co997, Co440, LS1-029, CP29/116, LS1-83, LS1-047, LST-026, Co957, BR6223, Co443, Co453, LS1-057, IAC48/65, Co404, LS1-019, LS1-098, Co396, Co976, LS1-058, LS1-028, LS1-085, LS1-086, and Q70 were infested. Significant reduction in growth of sugarcane cultivar B5992 was evident as a result of additive effects of both the red rot and root knot disease complex, whereas the reduction in top growths of eight other cultivars tested was not evident. The roots of the cultivars Co396, B6604, D47/15, B5992, B57175, Q70, Co696, and Co443, were moderately to heavily galled by *Meloidogyne incognita* infection. The symptoms of infection include yellowing of leaves and severe drying of upper foliage of all the sugarcane cultivars tested.

INTRODUCTION

The sugarcane *(Saccharum officinarum* L.) red rot disease caused by *Colletotrichum falcatum* Went, was first reported in Java in 1893, and the since been reported in areas where sugarcane is grown. According to Stackman and Marrar (1957) the disease is more severe, particularly in Africa and Australia where a 50 percent yield loss had been reported.

The root-knot nematodes, *Meloidogyne* spp. are serious nematode pest of sugarcane (Goodey *et al.*, 1965). Along with other parasitic nematodes, an estimated annual yield loss of 15.3 percent, which is equivalent to annual monetary loss of US$ 16,464, 854,000 (FAO, 1984) have been recorded.

The role of parasitic nematodes as agents aggravating microbial and fungal problems of sugarcane was first speculated by Cobb (1906). Apt and Koike (1962a) reported reduction in growth of sugarcane infected by *Meloidogyne incognita acrita* and *Pythium graminicola* singly and in combination. They reported also a reduction in the growth of the same crop infected by *Helicotylenchus nannus* and *P. graminicola* singly and in combibation (Apt and Koike, 1962b). Information on the interrelationships among various pests and pathogens on sugarcane is still scanty.

In Nigeria, sugarcane cultivars are imported from various countries including Australia, Barbedos, Hawaii, India and Guyana for propagation in the Nigerian Sugar Estates. Several of these cultivars are known to be susceptible to various pests and pathogens (Caveness, 1967; Jerath, 1968; Parson, 1970; Awoderu, 1973; Ajogbasile and Mabadeje, 1979). Salawu (1985, 1986) reported seventeen sugarcane cultivars including Co1001

and Co957, which are popular commercial varieties in the Nigerian Sugar Estates is susceptible to *M. incognita*.

The present investigation reports on a survey of sugarcane varieties for red rot disease and root-knot nematode the growth of selected sugarcane varieties.

MATERIALS AND METHODS

A survey on red rot disease of sugarcane varieties was carried out at the University of Ilorin Sugar Research Institute farm. Randomly forty-nine sugarcane samples of each variety were collected and studied. Each sample consist of eight stalks from four stools were cut into pieces and examined for the symptom of the red rot in the vascular bundle. Later, eight varieties viz. Co396, B6604, D47/15, B5992, B57175, Q70, Co 696 and Co 443 were found infested by red rot fungus were used in subsequent studies.

Single budded settlings were raised using red rot infested stalks in perforated 5-litre plastic pots containing steam-sterilized top soils mixed with pure sand in ratio 2 :1. Two weeks after emergence, the settlings were inoculated with approximately 5000 second stage juveniles of *M. incognita* established on *Celosia argentia*. The cultivars infested by red rot fungus but not inoculated with the nematode served as the control. Each cultivar was replicated three times, and randomly arranged on screenhouse bench. Plants were inrrigated with tap water daily. At four-week intervals after inoculation, 8g NPK fertilizer was added to each plant.

After 140 days of inoculation with nematode, the plants were carefully removed from the pots and roots were gently washed in tap water to remove the adhering soil particles. The fresh root, shoot and millable cane weights, the stalk length (from ground level to the topmost dewlap, TVD) were recorded. The total soluble solids (TSS) was determined by a hand refractometer. Later on sugarcane stalks were splited and examined for red rot infestation recorded.

The root-knot index using the rating suggested by Taylor and Sasser (1978) was done in determining the severity of attack by *M. incognita* per root system (0=no gall, immune; 1= 1-2 galls, resistant; 2= 3-10 galls, moderately resistant; 3= 11-30 galls, susceptible; 4 =31 galls and above, highly susceptible).

RESULTS AND DISCUSSION

The results of the investigation are presented in Tables 1 and 2. Out of forty-nine sugarcane cultivars surveyed for red rot disease, thirty-six were infested viz. B6604, B57175, B5992, B4681, B69620, B61208, BJ6552, BJ6547, Co957m, LS1-019, Co691, D47/15, DB20/58, DB95/57, DB5155, Co997, Co976, Co440, LS1-029, CP29/116, LS1-083, LS1-17047, LS1-026, BR6223, Co443, Co453, LS1-057, IAC48/65, Co404, LS1-098, Co396, LS1-058, LS10928, LS1-085, LS1-086 and Q70 (Table 1). This result agrees with the earlier report (Anon, 1954) where a severe infestation of red rot disease was recorded in commercial sugarcane varieties in Zaria, Kano, Katsina, Sokoto and Ilorin areas in Nigeria. It may be mentioned that cultivar Co997, Co957 and B61208 are popular commercial varieties in the Nigerian Sugar Estates. Therefore,

it appears certain that an outbreak of red rot disease on these sugarcane varieties will affect the production of the crop adversely. This study thus suggests for development of effective control measure to combat the disease. All the nine sugarcane cultivars infected with *Meloidogyne incognita* were found susceptible. Roots of cultivars D47/15, BR6223, Co396, B5992, B57175, Co696, B6604 were heavily galled, while, Co453 and Q70 were moderately galled (Table 2).

Table 1. Red rot infestation in sugarcane varieties in Nigeria.

Red rot disease infestation	Sugarcane varieties
Infected by red rot disease	B6604, B57175, B5992, B4681, B69620, B61208, BJ6552, BJ6547, Co957, Co691, D47/15, DB20/58, DB95/57, DB5155, Co997, Co976, Co440, LS1-029, CP29/116, LS1-083, LS1-047, LS1-026, BR6223, Co443, Co453, LS1-057, IAC48/65, Co404, LS10-98, Co396, LS1-058, LS1-028, LS1-085, LS1-086, Q70, LS1-019
Uninfected by red rot disease	LS1-087, LS1-054, Dacca, Co1001, LS1-029, Co449 Co449, LS1-050, CP36/111, Mex52/29, LS1-084, LS1-031, LS1-033.

Table 2. Fresh shoot root and millable cane weights, stalk length and total soluble solids (TSS) in sugarcane red rot and root-knot disease complex (means of three replication).

Sugarcane cultivar	Parameters / Treatments	140 days after inoculation with nematode		
		Fresh weights		
		Shoot (g)	Root (g)	Millable cane (g)
Co396	Inoculated	392.8±25.7	165.0± 12.5	222.9±8.6
	Uninoculated	395.7±4.1	180.2±9.7	236.2±3.4
B6604	Inoculated	301.6±4.6	119.6±1.3	65.1±9.9
	Uninoculated	367.5±19.5	255.6±7.0	157.1±17.7
D47/15	Inoculated	272.7±15.3	213.7±14.6	154.9±4.7
	Uninoculated	190.6±13.0	226.1±2.6	61.8±4.3
B5992	Inoculated	184.3±1.8	279.0±26.0	62.5±0.5
	Uninoculated	214.7±22.4	232.9±9.6	104.7±5.9
B57175	Inoculated	230.4±15.1	131.6±9.6	157.8±17.2
	Uninoculated	293.7±7.5	182.0±8.3	171.5±5.7
Q70	Inoculated	213.8±19.6	231.2±8.7	108.7±8.7
	Uninoculated	213.5±25.8	226.0±3.0	116.2±9.8
Co443	inoculated	308.7±19.0	155.2±11.0	162.3±10.2
	Uninoculated	277.0±11.6	157.0±12.6	142.2±7.6
Co.696	Inoculated	215.5±12.6	245.7±5.5	156.5±16.0
	Uninoculated	247.6±5.4	157.1±22.8	142.2±9.8

Sugarcane cultivar	Parameters / Treatments	140 days after inoculation with nematode			
		*Stalk length (cm)	TSS	Mean Root Galls per root	RKI**
Co396	Inoculated	105.9±2.7	17.7±1.2	93.7±19.0	4
	Uninoculated	105.7±5.2	19.7±0.3	—	—
B6604	Inoculated	52.0±4.2	17.7±1.9	120.0±21.5	4
	Uninoculated	48.0±2.6	16.3±2.2	—	—
D47/15	Inoculated	68.9±4.3	21.3±0.7	133.0±22.6	4
	Uninoculated	53.5±3.2	20.3±0.3	—	—
B5992	Inoculated	40.5±0.3	19.7±0.3	197.3±27.5	4
	Uninoculated	43.8±3.4	20.0±0.6	—	—
B57175	Inoculated	73.8±3.2	21.3±0.7	180.0±26.3	4
	Uninoculated	80.9±0.7	21.3±0.3	—	—
Q70	Inoculated	60.3±0.2	17.7±0.7	23.3±9.5	3
	Uninoculated	53.9±3.4	18.0±1.0	—	—
Co443	inoculated	101.2±1.9	16.5±0.6	110.0±20.6	4
	Uninoculated	87.1±3.3	18.3±0.7	—	—
Co.696	Inoculated	63.7±3.2	20.7±0.3	231.7±29.8	4
	Uninoculated	87.1±2.9	18.3±0.6	—	—

Out of the eight sugarcane cultivars tested and evaluated for root-knot and red rot disease complex, sugarcane cultivar B5992 consistently showed significant decrease in number of fresh millable canes shoot weights, and stalk length, whereas decrease in growth and yield of other cultivars, was not evident (Table 2). Significant reduction in growth of this cultivars was due to additive effect of the nematode and the fungus. Apt and Koike (1962a) reported a similar reduction in growth of sugarcane as result of severe damage caused by *Meloidagyne incognita acrita* and *Pythium graminicola*. Yellowing of the leaves during the plant growth was evident in all cultivars, was possibly due to lack of adequate nutrient uptake by plants through destruction of root tips caused by nematode.

Colletotrichum falcatum is a cumicolous fungus whereas *Meloidogyne incognita* attacks the root. These organisms constitute one of the major factors in sugarcane production; their association with sugarcane plantation is not desirable. Thus, effective control measures are desirable to reduce damage caused to the crop by both organisms for increased yield.

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