Selection of D. alata Cultivars of Low Susceptibility to Anthracnose (Colletotrichum gloeosporioides)

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ABSTRACT

A wide range of introductions of D. alata have been evaluated over several years for their low susceptibility to anthracnose (Colletotrichum gloeosporioides). Data are given on their morphological characteristics, cultural behavior, yield performance and culinary grade. The existence of these cultivars underlines the need for a system of description and interchange of germplasm of edible yams.

Introduction

Although anthracnose has been known on yams, for a long time, it was generally believed to be a disease of relatively low economical importance (Coursey, 1967). Now, in Puerto Rico, for instance yields of Dioscorea alata are reduced from 20% to 100% under anthracnose syndrome over 48 farms (Mignucci and Cordero, 1981); in Guadeloupe between 50% and 100% of D. alata cv. Pacala fields have been thus destroyed in 1978. The disease has been well described by many authors including Baudin (1956) in Ivory Coast; Fournet and al. (1974); Messiaen (1975); Toribio and Jacqua (1978); Lourd and al. (1979); Geiger and al. (1980); Nwankiti and Okpala (1981); Toribio and al. (1981). The following presentation summarizes their findings.

The disease usually begins on old leaves, in normal plantations, with round or irregular necrotic spots, brown at first, then black, with a brown halo, primarily joint to ribs of the ab-axial lamina face. Spots can coalesce. Severe attacks on mature and young leaves and also on vines can lead to a mechanical stunting and branching habit from the repeated dying of each regrowth at the few-leaf stage.

Anthracnose is a disease of D. alata, but it can also be detrimental to D. cayenensis-rotundata (see Benoue athracnose or "Appollo disease", Nwankiti, 1978) and is known on D. bulbifera and even on D. trifida, but rarely.

A problem is the true nature of the fungus complex. Colletotrichum gloeosporioides of which the perfect form is Glomerella cingulata, is always involved in the antharacnose syndrome. But, on one hand, it has so narrow relations with other involved in the Colletotrichum (Gloeosporium musarum of banana tree, C. gloeosporioides of Carica papaya, of Entendophragma, for instance) that its range of hosts may be wide and changing under unknown circumstances. On the other hand, a number of fungi seem to be also involved in anthracnose syndrome, depending from level of intensity and nature of inoculum. Botryodiplodia

theobromae, mainly, Fusarium, often, and Rhizoctonia solani sometimes are associated with it as secondary pathogens, at least. Moreover it seems that the whole "species" C. gloesporioides may be genetically unstable and evolving. All these traits account for the versatility of the epidemies with location, year and cultivars.

Nevertheless the process of contamination is now rather well known. Based on the anthracnose cycle, integrated control of the disease must act at the soil level. If chemicals or cultural protection must be used, the varietal resistance or tolerance remains the more economical and in most cases the more sure of anthracnose control.

Methods and Techniques

A survey of available local yam cultivars in Guadeloupe and Martinique in 1966-1967 combined with the first phytopathological approach (Bullit, Lefort, unpublished). Lack of adequate resistance level associated with high commercial value leads to wide introduction (1969, from New-Caledonia, 1975 from the world collection of Mayaquez, Puerto Rico, see Martin, 1976) and screening of chemical treatments. From field notation of 120 accessions, a number of cultivars was selected and compared under stastical design in humid and sub-humid locations to local cultivars. Experimental then commercial multiplication was developed with the extension service, professional and governmental aid to promote new cultivar cultivation in both islands and French Guyana.

Variability in the Collection

More than 100 cultivars have been observed within 11 years (1970-1981) among which 76 remains at the end of this period[1]. Some have died after 1 to 3 years, or are recent introductions. More than 50 have been present for 10 years.

Table 1 sums up the behaviour of consistent samples of the collection including more or less the same cultivars over the 11 years. Changing of the dominant class of disease level shows the variation of its intensity over the years.

Table 1. Percentage levels of anthracnose over several years among a D. alata collection in Guadeloupe.

Level of Anthracnose*	1970	1971	1972	1977	1979	1981
0 - 1	24	48	34	14	28	27
1,5 - 3,0	18	24	40	38	31	52
3,5 - 5,0	58**	28	26	48	41	21
N	33	58	62	50	54	52

*0 = no disease; 5 = max. disease.

**Underlined: dominant class.

[1]They include 35 West Indian, 18 Neo-Caledonian, 8 West African cultivars. Others are from widely diverse origins.

The behaviour of the remaining 76 cultivars over the years 1979 and 1981 is interesting. They consist of the same cultivars as the samples considered in Table 1, plus others introduced or collected to counterbalance the erosion of the "Pacala" choice group (Degras and al., 1972) after the epidemy of 1978. But the distribution within the three classes of disease level remains the same as in Table 1. What is interesting is the shifting of the cultivars from a class to another. Though on a mean basis the intensity of the disease lowers from 1979 to 1981, cultivars from the class 1.5 - 3 and even from the class 0 - 1 have shifted to the class 3.5 - 5. About half of the cultivars remain in their original class. This shows the importance of the ecology or the fungus population interactions with the host susceptibility.

Varietal Response to Fungicide Treatment

Sixteen cultivars have been submitted to an artificially uniform contamination of Colletotrichum gloeosporioides in a field experimental design. Each plot was split into a treated (Propineb 210 g/hl weekly, plus Benomyl 50 g/hl every fortnight over 6 months) and untreated part. Details of this work have not been published (Fournet and al., 1974). No correlation has been found between anthracnose susceptibility and yield, which means that high yielders may be susceptible or resistant. Goana, for instance which benefits from the treatment, is potentially high yielding and very susceptible. Telemaque while being rather resistant is a low yielder. At least, anthracnose is not involved in its low productivity. On the reverse, a phyto-toxicity effect from the fungicides on some cultivars like Bete-bete seems possible.

An interesting point is the heterogeneity in the response of the so-called Pacala group of cultivars. This gives some encouraging prospects for a clonal selection against anthracnosis susceptibility.

Selected Cultivars of Low Susceptibility

Among the material introduced from New Caledonia two cultivars appeared promising, Belep and Lupias. The next important introduction brings Florido, (Puerto Rico, Pyramid (India), Taniela vulaleka, Binugas, Kinabayo and Kabusah, and Oriental from Barbados.

A series of trials was conducted without a significative level of anthracnose, showing the high productivity of Pacala when at its best.

The behaviour of some of the promising cultivars has also been tested over a range of plantation densities (Arnolin and al., 1973). They seemed to benefit from higher level of density than Pacala, while admitting smaller seed-set.

The cultivars from Puerto Rico have been described by Martin (1975) and Martin and Delpin (1978). Here are brief characteristics of the two neocaledonian cultivars.

Lupias is a male flowering, rather little-leafed D. alata; its tuber is spheroid to ovo-spheroid, weighing about 1.5 to 2.5 kg in good culture at about 15,000 plant/ha; though the flesh is rather creamy to white except towards the head where it turns brown to reddish, it is often oxidizing under any physical or insect damage; more over at cooking it turns greyish, a factor turning many tasters against it. It is an excellent type for mechanichal planting and harvesting. Care must be taken for a good organic and mineral balance in the soil.

Table 2. Yield of selected cultivars of D. alata without anthracnose attack in Pacala traditional area of cultivation.

Cultivars	Yield +/ha	Rank
Pacala	56.8	a
Sea 190	37.8	b
Sea 189	36.7	b
Sea 191	34.4	b
Belep	27.6	bc
Florido	27.3	bc
Sea 144	19.5	c
Coconut Lisbon	13.3	c

Table 3. Comparative yield of selected cultivars of D. alata in different ecological areas of Guadeloupe.

		Yieldt/ha			Yield %
Cultivars	Origin	Basse Terre	Grande Terre	Moyenne	Pacala mean
Temoins					
Tahiti*	Guadeloupe	48.9	40.2	44.5	281
Pacata St.	Guadeloupe	21.5	10.2	15.8	100
Oriental	Barbade	13.5	12.3	12.9	82
Selections					
Lupias	N.Caledonia	44.0	10.4	27.2	172
Belep	N.Caledonia	32.3	10.5	21.4	135
Florido	Puerto Rico	34.6	8.1	21.3	135
Sea 144 Taniela-vulaleka	Fiji	30.0	5.5	17.7	112
191 Binugas	Philippines	36.7	6.9	21.8	138
189 Kinabayo	Philippines	34.3	10.2	22.2	141
190 Kabusah	Philippines	26.6	17.7	22.1	140

*About 25% to 50% Tahiti harvested tuber, the head part, is unpalatable and served as seed material. The edible flesh is rather coarse and less appreciated by many people.

Belep has rather wide leaves, its aerial parts being when young somewhat pinkish (stems wings); its tuber is pear shapped to fan-shapped but bearing over light brown skin many fine roots; the flesh is white. When densily planted (25,000 plants/ha or more) its 1 to 2 tubers weighing 0.8 to 1.5 kg are easily mechanically harvested.

Belep and Kinabayo are now the principal cultivars involved in a seed producing scheme incorporating INRA, extension service and a farmer cooperative in Guadeloupe.

Table 4. Result of a cooking and tasting trial with selected cultivars of D. alata.

Color	Sea 189*	Sea 190	Sea 191	Pacala
- Whiteness/10	4	9	8	8
- Other /10	3	2.5	1.5	0.8
Fibrousness/5	1.4	2.0	2.8	1.6
Compactness/5	3.6	2.0	1.2	2.6
Friability /5	1.3	3.3	3.7	2.7
Gum /5	2.4	1.2	1.1	1.5
Sweetness /5	1.3	1.2	0.6	0.4
Bitterness /5	0.2	0.6	0.9	0.5

*In other trials this cultivar gives better results.

Discussion - Conclusion

Anthracnose at least for D. alata, is the most threatening disease over the world, its ability of sudden epidemics causing death of plants in wide areas. Its name of "lighting" in some Pacific islands referred perhaps to its main damaging weather, but may be significant also of its behaviour.

As true breeding of D. alata through flowering is only a recent promise, varietal improvement within the species will be delayed during the search of cultivars of naturally tolerant clones. A knowledge of morphological and/or physiological traits associated with anthracnose resistance-susceptibility would be useful. Roughly it can be said that resistance to the disease seems rather linked with primitive characters; the bulbiferous type (Degras, 1976) is rather tolerant or resistant; four out of the six cultivars of the "choice" group III of Martin and Rhodes (1972), Rhodes and Martin (1973) existing in our collection.

In many countries (Pacific islands, Nigeria, Ivory Coast) efforts are made to select low susceptible anthracnose cultivars. In this direction it seems that the material from the Pacific area and insular South Asia play a great part.

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